



**INVESTIGATING THE LEARNER-CENTRED TEACHING
CLASSROOM PRACTICES OF SCIENCE AND TECHNOLOGY LECTURERS:
A CASE OF TEACHER TRAINING COLLEGES (TTCs) IN MALAWI.**

**PhD (CURRICULUM AND TEACHING STUDIES- SCIENCE EDUCATION)
THESIS**

By

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DECLARATION

I, the undersigned, hereby do declare that this thesis is my own original work which has not been submitted to any other institution for similar purposes and where other people's work has been used acknowledgements have duly been made.

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CERTIFICATE OF APPROVAL

The undersigned certify that this thesis represents the student's own work and effort and has been submitted with our approval.

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DEDICATION

This thesis is dedicated to my children for their support over the long period of study.

Also to my beloved parents, Mr. and Mrs. D. Kwerengwe (senior), who emphasised the value of education and had a great influence on my life.

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ABSTRACT

This study investigated the classroom practices of initial primary teacher training colleges (TTC) lecturers in Malawi. The purpose was to examine if the TTC lecturers' classroom practices satisfied the curriculum demands that learner-centred teaching (LCT) be fully implemented during teaching and learning activities. To generate data, classroom observations and post-lesson interviews were conducted on 8 Science and Technology lecturers at Ophunzira Teacher Training College. In total 29 lessons were observed. The researcher adopted Timulak and Elliott (2003) interpretive research design. Data pertaining to classroom practices were analysed using Bybee's, et al. (2006) BSCS 5Es learning model.

Findings of the study reveal that regarding the classroom practices, the lecturers show consistencies in their implementation of learner-centred teaching (LCT) methods. Based on the observational data, TTC Science and Technology lecturers' classroom practices depict LCT at surface level. However, the classroom observation as well as the post lesson interviews data reveal that the lecturers demonstrated understanding of LCT. The findings suggested that TTC Science and Technology lecturers' knowledge and skills regarding LCT pedagogical paradigm was limited. The findings of this study have strengthened the existing literature by indicating that one hundred percent LCT has not been achieved in the TTC classrooms in Malawi.

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LIST OF ABBREVIATIONS AND ACRONYMS

LCT: learner-centred teaching

TTC: teacher training college

IPTE:..... initial primary teacher education

BSCS: Biological Sciences Curriculum Study

MOEST: Ministry of Education, Science and Technology

NESP: National Education Sector Plan

DEFINITION OF TERMS

Learner: Is an individual admitted to, or enrolled in, a program for the initial preparation as a teacher: teacher trainee in initial primary teacher education (Oduro, 2020).

Teacher education: Refers to a programme of training designed to equip prospective and practicing teachers with the knowledge, skills, and dispositions they will require to effectively teach at a certain educational level (Cambridge Advanced Learner's Dictionary, 2016)

Teacher training college (TTC): It is an educational institution that trains and prepares initial teachers for primary school teaching(Cambridge Advanced Learner's Dictionary, 2016).

Lecturer: It is a TTC teacher/tutor that teaches student teachers in the classroom(Cambridge Advanced Learner's Dictionary, 2016). In this thesis, the term lecturers may be used instead of Science and Technology teacher educators or tutors.

Classroom practices: Are a process that involves multiple agents and their interactions within the classroom as a system. This includes activities of learning and teaching processes located within the classroom as a system (van de Grift, 2004).

Teaching approach: This is a way of going about teaching which suggests ways that encourage good performance. It is a way of looking at teaching and learning. An approach gives rise to methods, the way of teaching something, which use classroom activities or techniques to help learners learn (Merriam Webster's Intermediate Dictionary, 2016).

Teaching methods: These are procedures, techniques or ways of teaching especially in accordance with a defined plan. The term teaching method refers to the general principles, or pedagogy used for classroom instruction (Merriam Webster's Intermediate Dictionary, 2016).

Teaching strategy: It is a careful plan of teaching activities to be undertaken which ensures effective teaching and learning. It is a plan of action designed to achieve a specific goal or series of goals (Issac, 2010).

Teaching techniques: Refer to the unique ways of carrying out a particular task, in the teaching and learning process. Thus, it's the individual teachers' unique way of applying a strategy (Merriam Webster's Intermediate Dictionary, 2016).

Critical Thinking: Refers to a collection of mental activities that include the ability to intuit, clarify, reflect, connect, infer, and judge. It brings these activities together and enables the learner to question what knowledge exists (Beyer, 1995).

Collaborative learning: These are instructional approaches in which learners work together in small groups to accomplish a common learning task (Leonard & Leonard, 2001).

Surface learning: It involves recalling and reproducing content and skills. Surface learning is very much about the idea, the content, the knowledge and the information (Hattie, 2012; Webb, 2005).

Deep learning: It involves things like extending ideas, detecting patterns, applying knowledge and skills in new contexts or in creative ways, and being critical of arguments and evidence. The deep learning is when one relates or extends or transfers that knowledge (Hattie, 2012; Webb, 2005).

Traditional teaching: It is when a teacher directs learners to learn through memorisation and recitation techniques thereby not developing their critical thinking problem solving and decision making skills (Reece & Walker, 2007)

Teacher centred: In teacher-centred teaching, learners put all of their focus on the teacher. The teacher talks, and the learners exclusively listen. During activities, learners work alone, and collaboration is discouraged (Webb, 2005).

Learner-centred: When a classroom operates with learner-centred instruction, the learners and the instructors share the focus. Instead of listening to the teacher exclusively, learners and teachers interact equally. Group work is encouraged, and learners learn to collaborate and communicate with one another (Tummons, 2007).

CHAPTER 1

INTRODUCTION TO THE STUDY

1.1 Structure of the thesis

This thesis has five chapters. Chapter 1 introduces the study. The researcher discusses the context of the study, history of primary teacher education in Malawi, the learner-centred teaching (LCT) philosophy, LCT practices in Science and Technology, Teaching of Science and Technology in teacher training colleges, the problem statement, purpose of the study, research questions, as well as the significance of the study, the rationale for the study, and aims of the study.

Chapter 2 presents the literature review. It examines in some details constructivism from which learner-centred teaching (LCT) relies upon, their relationships and how these impact on teachers' classroom practices and learners' learning. The researcher reviewed the constructivist theory of learning and analysed the concept of LCT as identified by various authors and researchers followed by an overview of the implementation of LCT both in the developing as well as the developed world. A comprehensive description of Bybee's, et al. (2006) 5Es learning model as a lens for analysing classroom practices has also been given. The chapter ends with lessons learnt from the implementation of LCT in both developed and developing countries.

Chapter 3 presents the research design and methodology. The researcher has chosen for the study, an interpretivist approach, and outlines the research design. With roots in philosophy, psychology and education, an interpretivism approach attempts to extract the most pure, untainted data. The researcher describes the various phases of the study, how respondents (persons who experienced LCT) were selected, interviews were conducted and observed Science and Technology lecturers in their classrooms. Ethical issues and the importance of reflexivity end the chapter.

Chapter 4 tells the research story. This chapter presents the findings from the data generated in the research process from interviews and classroom observations. It looks into the lecturers' understanding and interpretation of LCT mainly through their classroom practices and narrations. It presents the different emerging themes and the interpretations that the researcher makes of the research findings within an interpretivism paradigm. A synthesis and discussion of the research findings in relation to the research questions has also been given. The researcher discusses how TTC Science and Technology lecturers create their LCT according to their knowledge, understanding and classroom contexts. This chapter equally identifies the skills lecturers consider to be important for successful LCT.

Chapter 5, the final chapter summarises the research journey, draws conclusions and points some limitations and implications of the study for policy and practice and ends with some suggestions for further research.

1.2 Context of the study

The Ministry of Education, Science and Technology (MOEST) is responsible for the provision of most of the primary school teacher training (Ministry of Education & Malawi National Commission for UNESCO, 2004). It owns most of the teacher training colleges (TTCs) in the country and provides the primary teacher education curriculum. For its TTCs it recruits the lecturers, monitors teaching and learning processes to ensure quality, provides funds for the purchase of teaching and learning resources, puts policies in place concerning delivery of educational services and organises teachers' inservice trainings (insets) for capacity building purposes. The main goal of the TTCs in Malawi is to train teachers at primary school level in order to meet the schools' demand (MoEST & Malawi National Commission for UNESCO, 2004).

In its 1985-1995 Education Sector Development plan, the Government of Malawi focused on resources, equity, and system efficiency (Malawi Government, 2013). Developed in the wake of the World Declaration on Education for All (Inter Agency Commission, 1990), however, Malawi's 1995-2005 policy investment framework (PIF) shifted the focus towards an emphasis on providing access to basic education through the provision of free primary education and promoting learner-centred teaching (LCT) classroom practices.

However, the 2001 PIF contains no direct references to LCT classroom practices, nor does it explicitly address the need for pedagogical reforms. Nevertheless, LCT methods are highlighted in the primary school and primary teacher education curricula, which were announced in 2006 and are currently being implemented. Primary education in Malawi underwent major changes through the primary curriculum and assessment reform (PCAR)

process. The TTC curriculum was reformed as well. The new curricula have been designed to be implemented by teachers using learner-centred teaching (LCT) classroom practices, and continuous learner assessment (TTC Science & Technology curriculum, 2017).

According to interviews with TTC lecturers and a thorough inspection of government reform documents (Malawi MOE, 2005), the government of Malawi is striving to promote teachers' use of LCT methods as opposed to teacher-centred ones. Thus, Malawi has spelt out its commitment to learner-centred teaching (LCT). For example, in December 2003 the Malawi Government through the Ministry of Education, Science and Technology (MoEST) signed a memorandum of understanding with InWent Capacity Building International, German to train TTC lecturers and other stakeholders in education in order to build institutional capacity to implement and fully utilise LCT approaches in TTCs as well as at higher education levels (InWent, 2008, p.3). Capacity building workshops and in-service training activities about the implementation of the learner-centred teaching (LCT) methods were organised and conducted both locally and internationally. In its National Education Sector Plan (NESP 2007-2017, p.49; Malawi Government, 2013), the Ministry of Education, Science and Technology states that it implemented a curriculum reform which emphasises on learner-centred participatory teaching strategies and continuous assessment in order to improve quality and relevance of education. Similarly, in unit 4 of the TTC orientation manual for open and distance learning (ODL), learners are introduced to LCT methods for both learning and teaching purposes in the primary schools (MoEST, 2010, p.49). On page ix of the TTC Science and Technology syllabus, there is an emphasis that LCT methods are intergrated in the curriculum for implementation in the classrooms (MoEST, 2017).

A close study of the TTC curriculum reveals a shift from teacher-centred towards learner-centred teaching (Malawi MOE, 2005; Ministry of Education, Science & Technology, 2006). The National Strategy for Teacher Education and Development (NSTED) addresses the need to educate and continually develop the professionalism of teachers so that they are able to use a variety of learner-based delivery techniques at primary school level (Malawi MOE, 2003). Both the initial primary teacher education (IPTE) and primary school curriculum and assessment reform (PCAR) frameworks are in agreement with the NSTED and advocate for the use of LCT methods in teacher training colleges and schools. The two frameworks redefine the roles of the teacher to create a context for learners to explore, investigate, and share experiences. They describe the teacher's role as that of an effective helper or facilitator not by showing the right way but by drawing attention to a neglected or counter-productive factor in the learners' processes (Malawi MOE, 2004).

As a science teacher educator, the researcher was interested in investigating the TTC lecturers' classroom practices to learn about their understanding of the LCT concept. The need for investigating the TTC lecturers' classroom practices as they implement LCT seems to be justified especially in a context where it has been introduced and emphasised in the curriculum. The current expectation is that the TTC curriculum reform will foster greater learner achievement via LCT within the classrooms (MIE, 2017). The researcher did a systematic literature search of multiple databases such as google scholar to find relevant information about LCT classroom practices in Malawi TTCs but could rarely find any. He also checked websites of influential journals such as <https://journals.sagepub.com>,

<http://www.unima.mw>, plus many more. This made the researcher conclude that information about teaching practices of TTC lecturers in Malawi is scanty.

1.3 History of Primary Teacher Education in Malawi

At Independence in 1964, Malawi was training its primary school teachers through a two-year college residential course. By the 1980s, this model no longer met the demands of the evolving education system in which greater and greater numbers of children were enrolling in primary schools, and there was need for an increased number of teachers to teach them. So in 1989, the Malawi Special Distance Teacher Education Program (MASTEP) was established to train teachers on-the-job through a combination of short residential courses, local seminars, and distance learning methods. MASTEP was discontinued after 3 years, and replaced by a program of one year's field training followed by one year's residential course in a college (Hauya, 1997; Kunje & Lewin 2000). According to Kunje and Lewin (2000), all these training programmes followed the traditional didactic methods to prepare the teacher trainees. Learners were treated as recipients of knowledge who could only play a passive role in achieving learning objectives.

Then, in 1994, Malawi announced a Free Primary Education (FPE) for all – an initiative that resulted in nearly a 50 percent increase in primary school enrollment numbers, from about 1.9 million to 2.8 million, within a two-year period (Kunje & Lewin, 2000). This change created an unprecedented demand for new teachers to which the government responded with an emergency training program. At the same time, a number of factors were converging, causing Malawi's Ministry of Education to rethink its methods of preparing and providing teachers. Some of the factors included the requirements of Malawi's Policy

and Investment Framework (PIF) which specified a class size of 60 pupils per class and upgrading of TTC staff to a minimum of degree level to improve the quality of learning and teaching in TTCs (Kunje, et al., 2002).

As a direct response to Malawi's PIF and continuing enrollment pressures, the Malawi Integrated In-Service Teacher Education Program (MIITEP) was created in 1996, effectively replacing its pre-service teacher training system. MIITEP, which was structured in such a way that student teachers spent twenty months in schools and three months in college respectively, remained the sole model of training of primary school teachers in Malawi (Mazloun, 1999; Kunje, et al., 2002). The structure of the MIITEP program consisted of three parts: an orientation course, in-service teaching, and a final review. MIITEP was a mixed mode program, i.e. one that combined college-based work with different types of distance learning (Lewin, 2003, p. xxix).

The MIITEP program attempted to shift teacher training practices toward a more participatory and learner-centred approach. In the in-service training portion of the MIITEP program, learners were assigned to schools and were advised and assessed by qualified teachers, primary education advisors, headteachers, and college tutors. The final component of the program was a one month review course in which learners returned to the TTCs for a final review and examinations (MacNeil, 2004). Thus the MIITEP programme was introduced in order to rapidly provide a large number of primary school teachers in response to the dramatic increases in pupil enrollment ushered in by FPE and to introduce a more progressive, interactive and learner-centred teaching (LCT) methods in both colleges and schools (Kunje, et al., 2002).

In 1995/96 academic year, the pupil/ teacher ratio in primary schools stood at 134:1 (MOE, 1996). The massive recruitment of teachers succeeded in reducing the pupil/teacher ratio to 63:1; however, it did not solve the problem of ensuring that children were taught by competent and qualified teachers (Kunje & Lewin, 2000).

Although the MIITEP programme was successful in achieving its goal to train over 23,000 teachers in a relatively short period of time, it faced many obstacles as well. The rigorous nature of the program proved problematic for both learners and supervisors. The time constraints of the program meant that college tutors were unable to visit the learners while also conducting orientation training for another cohort. The rationale behind MIITEP programme was to shift the place of learning for new teachers from colleges to classrooms. This relied heavily on support from existing teachers in schools, but because many of these teachers were unqualified themselves (and even if they were qualified, they had not been exposed to the new LCT practices being promoted by the program), the learners did not get high quality instruction and advice during the in-service portion of the program (MacNeil, 2004).

Moreover, college tutors tended to teach their classes using the traditional methods—didactic and lecture format. This method directly contradicted with the learner-centred and participatory methods advocated for through MIITEP (MacNeil, 2004). According to Kunje, et al. (2002), the primary teacher education curriculum seemed to be contradictory in that the philosophy behind the MIITEP program promoted and encouraged the use of LCT and participatory methods, but the teaching styles during the short three-month orientation course reverted to the traditional rote learning classroom practices.

The MIITEP curriculum was based on a set of student teacher handbooks (modules) both in the college and during the school-based training. These handbooks emphasised learner-centred teaching (LCT) and learning strategies in order to help learners develop higher cognitive levels as well as improving basic skills in literacy and numeracy. However it was observed that the regime devised was impossible to execute. TTCs kept no continuous assessment records of learner performance, the curriculum in use in the colleges appeared to be inefficiently delivered. Observational studies indicated that there was limited application of LCT principles (Kunje and Chiremba 2000; Kunje, et al., 2002).

Though one of the two principle aims of MIITEP was to promote use of LCT methods to instruction Kunje and Chiremba (2000) and Kunje and Stuart (2002) found out that learners in TTCs were given few opportunities to gain a deeper understanding of the teaching and learning contexts, the role of the curriculum, or strategies for adapting it to their learners' needs and interests. Few examples were observed of training in learner-centred instructional principles or reflective practice, incorporation of new learning into trainees' experience of primary schooling, or their perspectives on effective teachers and the teaching profession. Much of the material in the handbooks, as well as the training by tutors, was approached as facts to be learned, and the assessment regime reinforced this recall-based orientation of the curriculum in practice.

Given the problems cited above the Ministry of Education introduced the Initial Primary Teacher Education (IPTE) program in 2005 in part to respond to the obstacles of the MIITEP program. The IPTE program replaced the MIITEP program due to quality

concerns. The IPTE program is also directly linked to the PCAR framework that aimed at putting in place an outcomes-based curriculum.

IPTE is a two year programme with two components: residential and school based training. Initially, learners stayed in college for one year in the first year of their training. The first year was divided into three terms. At the end of these three terms the learners wrote an end of year examination set by the Malawi National Examinations Board (MANEB). The school-based training was carried out in the second year in form of teaching practice, which was supervised and assessed by the head teachers, the local Primary Education Advisor (PEA) and the teacher educators. However, in 2017 the IPTE (TTC) curriculum was revised. One of the changes made was to reduce the school based teaching practice period from three terms to two and increased the college based phase from three terms to four. Table 1 shows the summary of the structure of the IPTE programme.

Table 1: Summary of the structure of the IPTE programme

Year	Activities
First year terms 1 and 2	Learners stay in college. Activities done include: projects and assignments, assessed by lecturers.

First year term 3 and second year term 1 Teaching practice in various primary schools

Learners stay in college. Activities done are similar to those in first year terms 1 and 2, plus reflecting on field teaching practice, lesson observations, tests assessed by lecturers – and end of term or module examinations by subject lecturers. In term 3 there are final examinations administered by MANEB

The IPTE Science and Technology curriculum consists of both the subject content and the methodology (MIE, 2017). The curriculum is organised in such a way that the lecturer first teaches a particular topic and then the teaching method for the topic. Table 2 illustrates the activities in Science and Technology classrooms during the college based part of training.

Table 2: Summary of activities done in Science and Technology during the residential period of the programme

Subject	Activities
	1. Introducing a particular topic within the syllabus 2. Discussing or doing experiments about the topic or responding to lecturers' questions

Science and Technology

3. Exploring and developing activities used when teaching a particular topic
4. Practising how to teach a particular topic (Micro teaching)
5. Discussing possible errors that pupils make in the topic under discussion.
6. Discussing teaching and learning methods for that particular topic

The structure of the Science and Technology curriculum is that each unit or chapter has an introduction, success criteria, background information, activities for the learners, tips for each activity, summary of key concepts, reflection and assessment, glossary and further references/reading materials (MIE, 2017).

1.4 The learner-centred teaching (LCT) philosophy

According to Nunan (1990, p.179) a teaching philosophy is a statement of beliefs and thoughts about what is important in teaching and learning. A teaching philosophy statement is a narrative that includes: one's conception of teaching and learning, a description of how one teaches and justification for why he/she teaches that way. A general LCT philosophy emerged as an offspring of communicative language learning (Nunan, 1990, p.179). The shift from the structural to the communicative approach implied in some way a shift from teacher centred to learner-centred teaching. Kaplan and Maxwell (1994, p.3) wrote: *“various teaching approaches have fostered the notion of learner-centred classroom”*.

Obviously, Kaplan and Maxwell were precisely referring to the notion of how learning takes place and try to facilitate learners' learning process. In Kaplan and Maxwell's scenario the aim was the learners' communicative competence and the focus was always on the learner rather than on the teacher.

Another undeniable root of the LCT philosophy seems to be the humanistic approach to teaching, which, based mainly on the works of Maslow (1943) and Rogers (1953), emphasises the importance of the learners' affective factors—like motivation and enjoyment in the foreign language learning process. Rogers' (1959, p.487) humanistic psychology seems to have had a direct influence on the learner-centred teaching (LCT) approach. According to Underhill (1989, p. 251), Rogers proposed a shift of focus in education from teaching to learning, and from teacher to facilitator. He saw teachers as facilitators of learning not just from the neck up, but of learning that involves the whole person. Therefore, the teacher's task is not to teach the learners how to learn, but to offer learning methods, and the learners learn by themselves. The teacher should not live as teacher but a facilitator. It is good for the learners to apply their potentials. In teaching, the teacher is not a director or a controller but only a consultant, which is learner-centred (Underhill, 1989, p. 251).

There are many different learner-centred philosophies that have developed over the years. In this study the researcher adopted the constructivist philosophy. Constructivism is a learner-centred philosophy that emphasises hands on learning and learners actively participating in lessons (Doolittle, 1999). Constructivists believe that learners should be

able to discover knowledge on their own through hands on activities because it is the most effective way of learning and is considered true learning.

Many authors and researchers of LCT practices consistently cite several key elements that are critical and serve as the basis or philosophy for the definition of LCT that is utilised for the purposes of this study. According to Doyle (2008), Fink (2003) and Weimer (2002), these elements include the following: classrooms should be safe and comfortable environments in which to learn; teaching should be done in ways that optimise learners' learning; the focus should be less on the teacher and more on the learning process; learners to share control and take greater responsibility for their own learning, thereby empowering and motivating them to learn and learners' past experiences and knowledge is recognised, valued and allowed to expand.

Thus, the LCT philosophy places an emphasis on creating an environment of caring, and recognising that both teachers and learners are learners who work together to improve the learners' capacity for learning (Candela, et al., 2006; Doyle, 2008; Fink, 2003; Weimer, 2002). There is also a shift from a focus on content to what the learner needs to learn (Diekelmann, 2002), and an increased emphasis on establishing positive relationships between teachers and learners (Bankert & Kozel, 2005, p. 277; Candela, et al., 2006); Clark, 2008; Palmer, 2001; Weimer, 2002). The learner-centred teaching (LCT) approach of using prior knowledge and experiences to understand new information and generate questions, hypotheses, and possible models to explain typical situations is supported by constructivist theories of learning (Fosnot, 1996; Rogers, 1969,1994; Weimer, 2002). Critical thinking is promoted and more meaningful deep learning occurs when learners'

previous knowledge and experiences are allowed to contribute to the learning activity. In conclusion, LCT is based on the philosophy that the learner is at the heart of the learning process (Machemer & Crawford, 2007).

1.5 Teacher training colleges (TTCs) learning environment

TTCs seem to have adequate and appropriately qualified academic staff . According to Schott and Jere (2018) the overall proportion of M.Ed to B.Ed lecturers is 24%; 75 lecturers have M.Eds against 312 with B.Eds (Schott & Jere, 2018). Currently, the minimum qualification for a TTC lecturer is a first degree (NESP, 2017; NCHE, 2015). Lecturers specialise in their teaching subject. Each TTC enrolls learners according to its bed space and not necessarily classroom size. Each TTC learner must have a Malawi School Certificate of Education with a science subject as one of the admission conditions (MOEST IPTE 16 Advertisement, October 2020). Upon admission into a TTC, learners are supposed to take all subjects in class. The standard is that each class must have a maximum of 18 learners i.e. in TTCs, lecturer to learner ratio is at 1:18 (NCHE, 2015). However, at the time of this study each class had a maximum of 30 learners. The classrooms have fixed seating arrangements where learners usually sit in rows facing the chalk board where the lecturer's chair is positioned.

LCT is emphasised in the initial primary teacher education (TTC) curriculum (MIE, 2017). The TTC curriculum assumes all LCT methods are possible and applicable to the Malawian context. This is evident in the TTC teaching syllabus as well as the learners' modules (MIE, 2017) where much of LCT methods are suggested. Vavrus, et al. (2011)

observe that once well implemented, learner-centred teaching (LCT) methods promote participatory and deep learning that is beneficial to learners.

The adoption of LCT classroom practices in TTCs is challenging because the continuous assessments as well as the external examinations continue to assess primarily learners' knowledge of discrete, factual information, often referred to as declarative knowledge, rather than their critical, analytical skills (Vavrus, et al., 2011). Besides, the Science and Technology curriculum is externally determined, controlled and the teacher training colleges (TTCs) lecturers simply follow it. In addition, the curriculum is overloaded (Khomani, 2003) with limited time to go through all the content. Many activities/tasks were put in the curriculum (MIE, 2017) such that most lecturers hardly cover all of them within the four terms period learners are in college. This poses obstacles when trying to integrate LCT methods into classroom practices, because often these methods are seen as being ineffective in preparing learners to pass the exams, which is the priority focus for most teachers, learners and parents. Marzano (2007) observes that learners must be actively engaged in the processing of information and that the teaching and learning processes must involve an interaction among the teacher, the learners, and the content.

Science and Technology, being a practical subject, demands the availability and use of adequate teaching and learning resources. The TTC curriculum recommends use of a variety of teaching, learning and assessment resources (both commercial and non-commercial) such as ICT equipment, internet, local environment, primary school learners' books, primary school teachers' guides plus many more. However, in TTCs, teaching and learning resources are not enough for all learners to interact with. In some cases, certain

teaching and learning resources, for example laboratory supplies and reference text books are not available at all (Milner, et al., 2011). Thus, the learning environment in TTCs is generally inadequate to support quality teacher education. This situation forces lecturers to ask their learners just to discuss the concepts and /or ideas in some topics (MOEST, 2000). Despite the constraints TTC lecturers are required to employ all LCT methods in the classrooms.

1.6 LCT classroom practices in Science and Technology

Most of the research in science teaching evidences that LCT model is one of the successful strategies for providing meaningful learning experiences to learners in science classrooms (Brooks & Brooks, 1993; Johnson & Johnson, 2009). Various experimental research works carried out by a number of investigators found out that inquiry-based science activities have positive effects on learners' achievements, attitudes, skills and understanding towards science in comparison to those learners taught using traditional methods (Ball & Bass, 2000; Lawson, 2010). Substantial research has also connected learners' satisfaction to effective teaching methods (Long, et al., 2014). LCT has, therefore, become an indispensable need for the modern teaching-learning process of Science and Technology .

In recent years, the Malawi Government has advocated for the use of LCT methods into the academic curricula and now teachers incorporate LCT in the practice settings (MIE, 2017; Malawi Government, 2000). The Ministry of Education, Science and Technology revised the primary teacher education curriculum, textbooks and conducted orientations for TTC lecturers for using LCT based practices in classrooms (MIE, 2006). Although educational institutions have embraced LCT to prepare learners for the practice demands,

to date there has been limited attention to the contextual influences that could impede a lasting adoption of this model (Mtika & Gates, 2010).

The primary aim of this study was to examine classroom practices from the perspectives of TTC Science and Technology lecturers as they implement LCT. A reformation may not last if attention is not paid to contextual influences that make it vulnerable to erosion over time (Wiltsey, et al., 2012). Failure to understand the experiences of those implementing new changes has been identified as a significant shortcoming of most educational reforms (Fullan & Miles, 1992). LCT is a promising pedagogy for today's generation of teachers. Therefore, any factor that could affect its sustainability calls for attention. Examining the TTC lecturers' classroom practices and experiences of LCT will provide an insight into how these perspectives may influence the implementation and the sustainability of LCT in the practice settings. The primary research question for this study was, how do TTC Science and Technology lecturers practice learner-centred teaching (LCT) in the classrooms?

The TTC Science and Technology curriculum follows a Socrates teaching and learning approach. Socrates recommends examining one's thoughts and identifying gaps in one's arguments (Lodge, 2006). For instance, Socrates suggests that teaching is not didacticism, but a process of joint inquiry (Lodge, 2006, p. 314). Often, Socrates begins this process of joint inquiry with questioning, followed by an evaluation to assess the validity of arguments. In addition, throughout this process Socrates integrates summaries and examples, which he then uses as launching points for further inquiry (Lodge, 2006). In this

way, Socrates interacts through dialogue, checking for understanding in order to stir up ideas and memories.

The TTC Science and Technology curriculum (MIE, 2017) promotes self observation and self-evaluation during the teaching and learning process. It provides social learning environments such as those inherent in peer group works and small group activities to allow learners to see other points of view. It also provides some explanations to guide learners' thought processes during explorations. Learners' reflection is promoted in the curriculum (MIE, 2017) through questions that seek reasons and evidence.

Bruner (1966) and Flavell (1987) consider reflection as the mind observing its own procedures. Metacognition is concerned with how learners think about their own thinking and account for their own mental processes. The TTC Science and Technology curriculum in Malawi has adopted the reflective practitioner model of teacher education which connects theory and practice and integrates content and pedagogy in teaching and learning (MIE, 2017). In short, the curriculum design is based on reflective and practice principles. The curriculum has the following features; a broad range of instructional practices, inclusion of LCT methods to promote depth of understanding in learners, integrates metacognition activities, and utilising formative assessment. It encourages learners to reflect on their learning and learn from experience, solicit feedback from both the lecturer and fellow learners. It also assumes learners' responsibility for own learning. Therefore, it is worth investigating the lecturers' classroom practices to understand how the curriculum is being implemented using the learner-centred teaching (LCT) approaches.

The TTC Science and Technology curriculum (MIE, 2017) allows learners to assess their own thoughts and actions for the purposes of personal learning and development. For example, think-ink-pair- share activities give chance to learners to think of a solution to a problem, write the answer down and then share with colleagues in pairs or whole class. This process helps others to develop.

1.7 Orientation of the TTC Science and Technology curriculum

The TTC Science and Technology curriculum (MIE, 2017) emphasises on the process of learning by learners themselves through using different suggested LCT methods (Kaambankadzanja, 2012; Mizrachi, et al., 2010), use of learners' prior knowledge and inclusion of learners' tasks and activities and assessment practices (MIE, 2017). There are success criteria which stipulate the expected standards of achievement and are formulated in such a way that learning is an active process.

The TTC Science and Technology curriculum (MIE, 2017) is non-authoritative and participation-focused. In its structure, learners have opportunities to bring teaching/learning resources and to reconstruct or restructure their own knowledge based on pair or group discussions, field trips and experiments. It is an activity-centred curriculum. The curriculum does not encourage learners to just memorise information but are led to work with and use the information they are given, both individually and with other members of the class. The structure lends itself heavily to activities that require learners to engage in investigations, freedom of expression, open discussions, field trips, projects, presentations, and written reflections on learning (MIE, 2017).

Open discussions, also known as dialogue in this study, promote mental activity. These features make the curriculum learner-centred and, therefore, process oriented. Learning takes place through and from experiences (experiments, field work, class discussions) towards gaining new insights of self and practice. In short the curriculum stresses on learners' active and purposeful learning through appropriate and practical tasks (MIE, 2017). The activities/tasks in the curriculum allow for learners' active participation, exploration, experimentation, and involvement of all the learners through whole class discussions. Some activities provide room for exchange of ideas between and among learners and between the learners and their teacher (MIE, 2017).

Activities such as modeling and creating of teaching and learning resources, responding to questions (exercises), unit assessments help learners to reflect on their learning, an element of learner-centred teaching (LCT). Other activities which are included in the curriculum to ensure use of LCT methods are; analysis of the primary school curriculum to determine if it matches with the TTC curriculum, learners involvement in preparing schemes and records of work and lesson plans and designing and conducting scientific investigations, and exploring teaching strategies. The syllabus demands learners to observe lessons in primary schools and allows them to prepare and micro-teach mini lessons and assess peers on the same.

Self-reflection and self-evaluation tasks are featured at the end of each topic and are mostly done through question and answer. For example on page 7 of the curriculum (MIE, 2017) there is a reflection and assessment activity of which self-reflection, self-evaluation and

feedback are embedded. However, most of the tasks are supposed to be done through group work. Where group work is used effectively, interaction between and among learners, learner-teacher and with the materials, is maximised. An analysis of the curriculum shows that content is presented to learners in different forms such as use of text to present information, illustrations through diagrams, tables, photographs, and a variety of activities which demand use of a variety of learner-centred teaching methods. At the end of each topic the lecturer is required to assess (summative) the learners on their understanding of the topic (MIE, 2017). It allows learners to do class exercises to reflect on what they have learned, develop assessment tools, analyse ways for assessing large classes.

1.8 The teaching and learning context of Science and Technology in TTCs

Science and Technology is one of the compulsory subjects in primary schools as well as teacher training colleges (TTCs) in Malawi. It was introduced as an integrated learning area in primary and secondary schools (Fabiano, 2002; Ministry of Education and Vocational Training, 2001), as well as in TTCs (MIE, 2017). The introduction of Science and Technology in teacher training colleges (TTCs) is, therefore, not surprising considering that TTCs train teachers to teach in primary schools. In this regard the TTC Science and Technology curricula closely resemble the primary school Science and Technology curricula.

In Malawi, learner-centred teaching (LCT) methods have been implemented for over fifteen years now (MIE, 2006). Teacher training colleges (TTCs) have modules and critical thinking manuals which highlight LCT methods (for example; Ministry of Education, 2005. Initial Primary Teacher Education Teaching Syllabus- Science and Technology ;

Malawi Institute of Education, 2018. Initial Primary Teacher Education - Science and Technology Module 2, 2018). There are manuals about LCT classroom practices and the lecturers have been trained using the manuals to successfully implement it in the classrooms (Inwent, 2008, Learner-Centred Education; Malawi Institute of Education, 2015, Critical Thinking Training Manual for Malawi). Thus, after the revision of the Science and Technology curriculum (in 2006) emphasising the use of LCT methods, lecturers were trained, basic manuals on LCT were produced and distributed to all TTCs (Inwent, 2008).

However, teacher training colleges (TTCs) lecturers are still struggling to use LCT methods in their respective classrooms (Chiphiko & Shawa, 2014). Even though well-planned and supported by the government, LCT implementation has not always been as successful as hoped, and evidence suggests that a wide gap exists between the expected goals of the curriculum reforms and actual progress achieved in classrooms (Chiphiko & Shawa, 2014; World Bank, 2010).

In teacher training colleges (TTCs) both the lecturers and the learners heavily depend on modules for teaching and learning processes (MIE, 2017). The modules have pre-determined learning outcomes. A module is a self-contained and comprehensive instructional package, meaning that basically everything that the learner needs is in the module. It is a form of individualised instruction whereby learners use a self-contained package of learning activities that guide them to know or to be able to do something. There is also a syllabus to guide the lecturers in planning and implementing activities.

Science and Technology , being a practical subject, requires substantial investment in terms of infrastructure. It requires a laboratory for experiments and practical sessions including during examinations. The TTCs have purposely built laboratories which make them offer the subject without major hitches in terms of infrastructures. Learners' assessments include an end of module/term test, at least two assignments/short tests each term. This is done in terms one and two of year one. Then in term three of year one and term one of year two, all learners go into schools for teaching practice. Teaching practice is where the teacher trainees practise teaching and are expected to apply the knowledge and skills learnt while at college. While in teaching practice schools, the teacher trainees are assessed by their lecturers through supervision and structured observation of their (teacher trainees') lessons.

Finally in terms two and three of year two, learners go back to college to reflect on the teaching practice, finish their course and sit for national examinations. The learners are also required to take some continuous assessment activities during the same period just like in terms one and two of year one. The national examinations count for 60% and the college tests/continuous assessments grades count for 40% towards the final grade of a learner.

As is the case with the primary school curriculum, the TTC curriculum also shows an inclusion of learning outcomes. Learning outcomes can be defined as the knowledge, skills and understanding a learner would be expected to acquire as a result of the learning experience (European Communities, 2009). With the use of learning outcomes, the focus shifts from what the lecturer is able to teach to what the achievements and level of understanding of the learners are expected to be. The curriculum stipulates levels of learners' achievements as follows; from 0% to 39% is a failure, 40% to 49% is a weak

pass, 50% to 69% is a strong pass, 70% to 84% is a credit and 85% to 100% is a distinction (MIE, 2017). Taking a strictly LCT approach, learning outcomes refer to the achievements of the learner and thus do not relate to the perspective of the teacher or of the teaching process as such.

1.9 The statement of the problem

There is much talk about LCT in education circles in Malawi as it is seen to promote deep and lasting learning in learners (Fahraeus, 2013). While much has been written on its value in promoting deeper and more lasting learning; creating active, engaged learners and developing critical thinkers and problem solvers (Doyle, 2008; Fink, 2003; Weimer, 2002), some scholars say little has changed in the way teachers teach in the classrooms (Schaefer & Zygmunt, 2003, p. 238).

In Malawi, LCT classroom practices have to be implemented with inadequate teaching and learning resources accompanied by external administration of national examinations (Mtika & Gates, 2010). This raises a question about what form of LCT takes place in such an environment. Mtika and Gates (2010) researching on LCT in Malawi concluded that appropriation and application of the concept is problematic. Furthermore, Science and Technology is a practical subject that is amenable to the use of LCT methods to teaching where learners are expected to take very active roles in the teaching and learning processes. Information is scanty on other researchers investigating LCT in relation to teaching Science and Technology in TTCs. It would be helpful if LCT associated problems are understood with respect to the subject specifics.

Considering all the initiatives by the Malawi Government on promoting use of LCT methods in the classroom and its importance, a question that arises is that if TTC Science and Technology lecturers are to teach through learner-centred teaching (LCT) methods, what is their understanding of the concept and what are their classroom practices?

Due to classroom context factors, an effort to transform classroom practices from a traditional teaching format to learner-centred teaching (LCT) may be complicated and equally challenging. Therefore, it is important to study how TTC lecturers experience and put into practice this change process in order to facilitate understanding and potentially improve classroom processes. There is need to understand the classroom practices and experiences of TTC Science and Technology lecturers who are implementing learner-centred teaching (LCT) methods over a period of time. It is also important to understand how they interpret LCT, and how these interpretations are manifested in the classrooms.

1.10 Purpose of the study

The purpose of this study was to investigate the classroom practices of teacher training colleges (TTCs) Science and Technology lecturers in the light of the LCT philosophy.

1.11 Research questions

1.11.1 Main research question

The main research question was: How do TTC Science and Technology lecturers practice learner-centred teaching (LCT) methods in the classrooms?

1.11.2 Specific research questions

To guide the investigation the following specific research questions were posed:

1. What are the classroom practices of TTC Science and Technology lecturers?
2. Why do they choose those classroom practices?
3. How do such classroom practices show the learner-centredness of the lessons?

The research questions assisted the researcher to determine how TTC Science and Technology lecturers facilitated classroom instruction using LCT methods. The researcher's interest was to assess how TTC lecturers' classroom instructional practices respond to LCT philosophy of promoting learners' learning and autonomy. Proper and full understanding of LCT philosophy by TTC lecturers will lead to effective implementation of LCT methods. It was important to investigate how TTC Science and Technology lecturers practiced LCT methods and under what contexts. Bearing this in mind, the three sub-questions primarily ask about what is going on in the classrooms, how the lecturers are teaching where LCT methods are identified as successful and what reasons are put forward for why they are successful in their contexts.

The questions sought to investigate Science and Technology lecturers' classroom practices of LCT methods. It is important to understand how the lecturers use classroom instruction to engage learners, how they adapt their teaching and interaction strategies, how confident they are in clarifying their expectations to learners, whether or not they apply classroom discussion as a learning tool, and how effective their formative assessment and feedback strategies are in benefitting the learning environment.

1.12 Significance of the study

The outcomes of this interpretivist study may broaden the mind, improve the ways of

thinking to see learner-centred teaching (LCT), and it will enable the reader to see ahead and define the researcher's posture through intentional study of LCT classroom practices. The main contribution of this study is the acknowledgment of the TTC Science and Technology lecturers' classroom practices and their potential in transforming the classrooms with authentic and effective forms of LCT methods amid institutional constraints. This study was necessary because it can increase understanding on the real situation of teaching approaches that can be used in Malawian TTCs. The study has significantly enriched different studies that had been undertaken on learner-centred teaching (LCT). The study has come up with recommendations on how to effectively implement LCT classroom practices in TTCs despite the prevailing institutional constraints. This study has also given the insights to better understand the complexity of adopting LCT practices in the context of teaching and learning in Malawian TTCs.

Findings of this study might also inform teacher educators in TTCs and curriculum developers regarding the implementation of LCT in Malawian context. They could also be helpful in informing the TTC management about the everyday practices of LCT methods of teaching in the Science and Technology classrooms. The information would hopefully help inform their decisions about putting in place strategies and support programmes that might help TTC lecturers to effectively translate the policy of LCT into practice. The information could also be used by other lecturers to improve the use of learner-centred methods of teaching in their classrooms which might in turn improve the teaching/ learning process for learners.

1.13 Motivation for the study

Inspired by the growing interest and emphasis in implementing LCT in TTCs, the researcher decided to do a research to examine Science and Technology lecturers' classroom practices and analyse how LCT is practiced in the classrooms despite the institutional constraints. The researcher was interested to do a research on classroom practices to understand the Science and Technology lecturers' perceptions and classroom experiences as the government is advocating for quality learning through implementation of LCT. The reason for choosing Science and Technology is that it is perceived to be one of the most resource reliant subjects. When Abrahams and Millar (2008, p. 1945) posit that in many countries, one of the features of science education that sets it apart from most other subjects is that it involves practical work - activities in which the learners manipulate and observe real objects and materials, it becomes apparent that teaching and learning rely on those resources which learners should manipulate and observe. This means that Science and Technology is best taught through self discovery. Learners should conduct experiments themselves to better understand the scientific processes. Hence, Jenkins (1989) articulated that laboratory teaching, as a method of Science teaching, reflects the importance of practical work that should be conducted by learners themselves.

CHAPTER 2

LITERATURE REVIEW

2.1 Chapter overview

In this chapter, the researcher discusses the learner-centred teaching (LCT) concept, learner-centred teaching worldwide, key lessons from literature review, historical perspective of learner-centred teaching, constructivism, conceptual framework, the BSCS 5Es Instructional Model, as well as the chapter summary.

2.2 Introduction

According to Fahraeus (2013, p.1-6) learner-centred instructional approaches promote deep and lasting learning. Institutional constraints may make successful implementation of proven strategies difficult even when teachers acknowledge the advantages of LCT classroom practices. Duffy and Cunningham (1996) observe that constructivism serves as an umbrella term for LCT classroom practices.

2.3 Learner-centred teaching (LCT)

2.3.1 Definition of learner-centred teaching (LCT)

The term learner-centred teaching (LCT) is widely used in the teaching and learning literature. It is substantially based on constructivist approaches by giving importance to

activity, exploration and independent learning (Carlile & Jordan, 2005). Many terms have been linked with LCT, such as flexible learning (Taylor, 2000), experiential learning (Burnard, 1999), self-directed learning and, therefore, the slightly overused term LCT can mean different things to different people. In addition, in practice it is also described by a range of terms and this has led to confusion surrounding its implementation (O'Neill & McMahon, 2005). This, according to the researcher, creates confusion in terms of identifying what approaches are genuinely learner-centred and those which are not. This confusion is exemplified by the range of terms and other strategies that involve learners and mention learning being tagged as learner-centred. Although LCT and efforts to involve learners have a kind of bread and butter relationship, they are not the same thing.

Learner-centred teaching (LCT) does not have one universally-agreed definition, despite it being a term often used by many scholars and educationists (O'Neill & McMahon, 2005). The lack of such a definition poses a challenge to education institutions, teachers as well as learners. This must be taken into account when analysing and discussing LCT in all its possible forms and in all its relevant contexts. However, in spite of the lack of a universal definition, there is a principle which has been agreed upon by all proponents and researchers of the LCT practices. This is that LCT is based on the philosophy that the learner is at the heart of the learning process (Machemer & Crawford, 2007). This is a notion which underlies all attempts at applying the LCT methods. Whilst this means that the learner is the focal point of the process, the teacher's role of providing guidance and encouragement to learners and ensuring availability of adequate teaching and learning resources during the teaching and learning processes remains paramount, particularly when one considers that learners are not all the same.

In its original usage, learner-centred teaching (LCT) aims to develop learner autonomy and independence (Jones, 2007) by putting responsibility for the learning path in the hands of the learners (Rogers, 1983; Pedersen & Liu, 2003). LCT instruction focuses on skills and practices that enable lifelong learning and independent problem-solving (Young & Paterson, 2007). LCT theory and practice are based on the constructivist learning theory that emphasizes the learner's critical role in constructing meaning from new information and prior experience.

Nanney (2004) defines LCT as a broad teaching approach that encompasses replacing lectures with active learning, integrating self paced learning programmes and/or cooperative group situations, ultimately holding the learner responsible for his/her own advances in learning. The researcher's understanding of Nanney's definition is that LCT is a teaching method that replaces the traditional didactic lecture method to an approach that keeps the learners at the centre of the learning process and gives autonomy to them. This actually explains why the Government of Malawi opted for LCT classroom practices in order to support and sustain the provision of quality education. As Nanney (2004) points out, in the LCT approaches learners are responsible for their own learning and the teachers become facilitators playing a little role. As facilitators, they help learners access information and as instructors, they directly teach content.

Harden and Crosby (2000, p. 335) describe learner-centred teaching (LCT) as focusing on the learners' learning and what learners do to achieve this, rather than what the teacher does. This definition emphasises the concept of the learner doing. Lea, et al. (2003, p. 322)

summarise some of the literature on LCT to include the followings tenets; the reliance on active rather than passive learning, an emphasis on deep learning and understanding, increased responsibility and accountability on the part of the learner, an increased sense of autonomy in the learner, an interdependence between the teacher and the learner, and a reflexive approach to the teaching and learning process on the part of both teacher and learner.

Concordia University (2016) agrees with Lea et al's (2003) definition of LCT by stating that in learner-centred instruction, learners and instructors share the focus. Instead of listening to the teacher exclusively, learners and teachers interact equally. Group work is encouraged, and learners learn to collaborate and communicate with one another. This approach includes active learning, in which learners solve problems, answer questions, formulate questions of their own, discuss, explain, debate, or brainstorm during class; cooperative learning, and inductive teaching and learning (Concordia University, 2016) .

In agreement with Harden and Crosby (2000, p. 335), Cranton, et. al. (2006) hints that LCT is an approach to teaching that focuses on the learners and their development rather than on the transmission of knowledge; it addresses the balance of power in teaching and learning, moves towards learners actively constructing their own knowledge, and puts the responsibility for learning on the learners. According to Weimer (2013) and Vavrus, et al. (2011) numerous research evidence associates LCT with the attainment of quality education as compared to teacher-centred teaching practices, where teaching is often focused on what the teacher knows and on unilateral transmission of knowledge followed by recitation and evaluation, rather than on the facilitation of learning.

The LCT philosophy is that all methods of teaching should shift the focus of instruction from the teacher to the learner (Machemer & Crawford, 2007). Therefore, LCT is all-inclusive as it aims to empower all learners irrespective of their differences. The researcher maintains that one basic benefit of LCT is that it caters for the personal needs, abilities, and learning styles of individual learners. Therefore, learners cannot just listen and take notes as in a teacher-centred learning environment; instead they should participate in a variety of class activities, and interact with one another. This ensures that learners are involved in higher-order thinking skills like analysing, synthesising, and evaluating. As Weimer (2002) observes this means subjecting every teaching activity to the test of a single question; given the context of my learners, course and classroom, will this teaching action optimise my learners' opportunity to learn? The learners are responsible for their own learning; that is, they actively participate in discovering and understanding ideas in the teaching and learning process. This type of learning enables learners to reflect on their learning and their learning processes.

However, given the implied indistinctness, ambiguity and possible confusion linked to the definition of LCT (O'Neill & McMahon, 2005), this study is accommodative of various labels that are related to the expectations linked to the reforms sought by the paradigm shift in Malawian education. Carlile and Jordan (2000) in Al-Mekhlafi and Nagaratnam (2012) maintain that there seems to be no single theoretical basis for LCT in the literature. It appears to relate primarily to the constructivist view of learning in the importance it places on activity, discovery and independent learning. Emes and Cleveland-Innes (2003, p.11)

conclude that definitions are based on practices and ways of teaching in the classroom and focus on the conditions under which learner-centredness occurs.

LCT is a concept and a practice in which learners and teachers learn from one another (McCombs and Whistler, 1997); a learning oriented rather than content oriented (O'Neill & McMahon, 2014); a means that places learners at the heart of the learning process and meeting their needs (Edwards, 2001). According to literature, the LCT concept is understood as active learning (Bonwell & Eison, 1991) which occurs when learners solve problems, answer questions, formulate questions on their own, discuss, explain, debate, role play or brainstorm in a class; cooperative or team based learning (Johnson, et al., 1991; Michaelson, et al., 2004), which takes place when learners work in teams on problems and projects under conditions that assure both positive interdependence and individual accountability.

Based on the explanations from different authors in the previous paragraphs of this section, the researcher, therefore, considers learner-centred teaching (LCT) as an instructional approach which seeks teachers' active involvement of learners in classroom processes with emphasis on learners' learning. They are pedagogical practices that move the focus from the teacher and instruction to the learner and learning. The researcher has chosen this definition for LCT considering the objectives of this study and the context under which teaching and learning takes place in Malawi. Collins and O'Brien (2003) observe that properly implemented LCT methods can lead to increased motivation to learn, greater retention of knowledge, deeper understanding, and more positive attitudes towards the subject being taught.

For Malawi, LCT as described in the TTC knowledge-based Science and Technology curriculum is characterised by a number of features including discovery approach, active participation of learners, and engagement in experimentation, brainstorming, walk around talk around, one stays three astray and ball bearing and other science processes among others (MIE, 2017; Inwent, 2008). LCT is compatible with the national goals of providing quality education and democratic classrooms (participation) as advocated for in the Malawi National Education Sector Plan (NESP, 2008 p.18). It is an approach where teachers put the needs of the learners at the centre of what they do in the classroom, rather than the learner being made to fit in whatever needs the teacher has decided upon (Machemer & Crawford, 2007). By needs of the learners the researcher means observable gaps between a learner's present knowledge or competence and the expected standard/benchmark identified as necessary in the learning process. This means that activities which put the learner at the centre of teaching and learning must begin by using or finding out the learners' existing or prior knowledge, skills and understanding of the topic. At the centre of LCT is the pedagogical orientation that needs to empower learners through enhanced critical and reflective thoughts resulting from the integration of life experiences they bring to school. Promoting learners' creative, critical thinking, and problem-solving skills, the focus of LCT is to provide opportunities for learners to construct knowledge and apply it beyond the classroom.

McCombs and colleagues (Baker, 1973; Lambert & McCombs, 1998; McCombs & Whisler, 1997) identify two important features of learner-centred instruction: a focus on individual learners (their heredity, experiences, perspectives, backgrounds, talents, interests, capacities, and needs) and a focus on learning (the best available knowledge about

learning, how it occurs, and what teaching practices are most effective in promoting the highest levels of motivation, learning, and achievement for all learners). This two-fold focus on learners and learning informs and drives educational decision-making processes. In learner-centred instruction, learners are included in these educational decision-making processes, the diverse perspectives of individuals are respected, and learners are treated as co-creators of knowledge in the learning process (McCombs and Whisler, 1997; Meece, 2003).

2.3.2 Characteristics of a learner-centred environment

An LCT environment allows learners to shape their own learning paths and places upon them the responsibility to actively participate in making their educational process a meaningful one (Isoski, T. et.al, 2015). Learners must be viewed as co-producers of knowledge. In a learner-centred teaching (LCT) environment, the teacher should design ways to uncover the knowledge, skills, interests, attitudes, and beliefs of every learner. An LCT environment firmly places the responsibility for learning and decision-making on the learner (Weimer, 2013, p. 81).

Learners must be challenged in their perception as customers to be provided customer service that threatens the shift towards learner-centred teaching (LCT). From the definitions given in section 2.3.1, learner-centred learning experience is not a passive one, as it is based on the premise that learner passivity does not support or enhance learning and that it is precisely active learning which helps learners to learn independently (Machemer & Crawford, 2007).

Learner-centred teaching (LCT) methods are informed by both constructivism and sociocultural theories of learning (Li, 2012). Meece (2003) and Cornelius-White (2009) observe that a learner-centred teaching (LCT) environment takes into consideration the learner's active involvement in the classroom practices and teachers play a facilitative role to ensure every learner takes responsibility for his/her own learning. This suggests that, in an LCT environment, teachers change their role from authoritative-teacher directed to facilitative-learner -directed, helping them (learners) to learn. Meece, et al. (2011) suggests that active learning in LCT results from an active interaction between teachers and learners.

Learner-centred teachers know that learners are not blank slates (Weimer, 2013, p. 81). This implies that a conceptual understanding, or misunderstanding, of a subject is based on what learners bring with them, including their social and cultural traditions and experiences. Moreover, because learners' thoughts and beliefs are often tacitly held, it is important to create many opportunities to draw those beliefs to the surface and make them visible to the learner, the instructor, and the classroom community, as appropriate. The more visible a learner's thinking becomes, the more opportunity an instructor has to understand the learner's misconceptions and correct them. In this way, the instructor can build upon what the learner already knows and is able to do. Thus, a learner-centred environment seeks to avoid the dilemma of undiscovered thinking by presenting learners with subject-related problems or challenges, soliciting their thoughts and ideas about how to solve the problem, and asking them to explain the reasons behind their thinking.

Tsui (2002, p.740-763) outlines the learner-centred teacher's role in a learner-centred environment in the following extract; *If teaching is conceived as constructing a bridge*

between the subject matter and the learner, learner-centred teachers keep a constant eye on both ends of the bridge. The teachers' attempt to get a sense of what each learner knows, cares about, is able to do, and wants to do can serve as a foundation on which to build bridges to new understandings.

According to Tsui (2002, p.740-763), LCT is based on the idea of teach learners how to think. Some of the ways to help learners how to think are: learners must know that a teacher doesn't have all the answers; a teacher must question everything and encourage learners to do the same; a teacher must force learners to make their own choices, push them to try new things, etc.

2.3.3 Assessing learners in a learner-centred teaching (LCT) classroom

Learner-centred teachers teach learners how to think, solve problems, evaluate evidence, analyse arguments, generate hypotheses—all those learning skills essential to mastering material in the discipline (Weimer, 2013, p.132). They do not assume that learners pick up these skills on their own automatically. Furthermore, within LCT there is an intrinsic motivation for learning, with the emphasis being on cooperation rather than competition between and among learners. In Malawi, learners in TTCs compete for positions in class as a result of grades awarded by their lecturers. In some cases the learners are extrinsically motivated to learn in order to receive parental praises or lecturer approval.

In LCT, the issue of assigning grades to learners is discouraged. As part of the learner-centred teaching (LCT) approach, learners must be given the opportunity to compare their ideas with their peers and their teachers, whilst contributing to developing their curricula

in a meaningful manner. Van Eekelen, et al, (2005) hints that the role of the teacher changes from being entrusted with the transmission of knowledge role to supporting and guiding self-regulated learner learning. Weimer (2002) observed that instructional action should focus on learners' learning.

The concept of self-assessment is an essential activity to help learners take responsibility for their own learning, an important aspect of LCT (Weimer, 2013). Based on these arguments an examination is a technique of power, where a learner is controlled. The use of written examinations is still a strong practice in Malawian TTCs and is primarily a summative assessment, i.e. an assessment for judgment or accreditation. The addition of more formative assessment, which emphasises feedback to learners on their learning, would 'enhance their (learners') learning and encourages a more learner-centred teaching approach.

2.3.4 LCT as collaborative learning

Learner-centred teaching (LCT) encourages collaboration and learners can learn from and with each other (Weimer, M. 2013). This means classrooms must be seen as communities of learners. However, this approach has many implications for the design and flexibility of the curriculum, course content, and interactivity of the learning process. With LCT, learners are responsible for planning the curriculum or at least participate in the choosing, a case which is not possible in Malawian context. In Malawi the curriculum is already pre-determined by the government and TTC lecturers just follow it.

Learner-centred teaching (LCT) practices focus on the role of the learner as an active participant in the process of teaching and learning (Brandes & Ginnis, 1996). Accordingly,

Ayele, et al., (2007) contend that learner-centred practices require the active participation of both teachers and learners. Therefore, there is a need for the learners' participation in the learning process, secondly, a need for the stimulation of learners' interest and curiosity to learn and thirdly, a need for the promotion of critical thinking and problem solving in learning (Dewey, 1985).

In summary, LCT classroom practices focus on the role of the learner as an active participant while the teacher plays a facilitative role in the teaching and learning process (Schuh, 2004). Therefore, the following characteristics should govern the instructional processes:

- (i) Learners' active involvement and participation in the teaching and learning process (Nanney, 2004; Harden & Crosby, 2000, p. 335; Lea, et.al., 2003); active learners engagement occurs when teachers and learners co-construct meaning of scientific concepts and topics in a freely and cooperative environment, the practice which empowers learners with classroom autonomy.
- (ii) Teaching and learning should focus on deep learning as opposed to surface learning (Lea et al. 2003, p. 322; Weimer, 2013, p.31-33);
- (iii) Learners must take responsibility and be accountable for their own learning and the teacher must play a facilitative role in the teaching-learning process (Bybee, et al., 2006; Brandes & Ginnis, 1996; Lea, et.al. 2003);
- (iv) The teacher and the learner should learn from each other (Weimer, 2013, p.81);
- (v) An emphasis on teacher's and learners' reflective practice during teaching and learning process (Dewey, J. 1993; Vakalisa & Gawe, 2011, p.60; Schon, 1983).
- (vii) An increased sense of autonomy in the learner (Lea, et.al. 2003)

2.3.5 Implications of LCT for teaching and learning

The implications for learner-centred teaching and learning is that teachers must make the learner more active in acquiring knowledge and skills. Weimer (2013) considers that successful teaching and learning is not teaching that endlessly tells learners what they should do and what they should know. The teacher should not demonstrate pedagogical showmanship but facilitate learning. Spence (2010) adds to Weimer's conception of a teacher's facilitative roles by arguing that classes should be spaces like playgrounds where learners can try, fail and be coached. This implies that the insights of teachers as facilitators focus on what learners do rather than what teachers do. Throughout the process of learning teachers are attentive to how learners react to content and activities.

Nanney (2004) states that teachers should facilitate a lesson such that learners should discover the world around them as opposed to having it presented to them through a textbook or a teacher as knowledge depositories. Weimer (2013) observes that the giving of marks and grades to learners should be under emphasised, while the giving of advice and the learning function must be over emphasised. Learners shouldn't be compared with one another. Comparison of learners highlights competition rather than personal improvement.

In learner-centred teaching (LCT) classrooms where the focus is on how learners will own the content, will see how it makes sense and realise its usefulness in the world teachers have to implement activities where the learner will understand and think about the content rather than cover the content (Weimer, 2013; Wiggins & McTighe, 2005). The role of the learner-centred teaching (LCT) teacher is being compared to that of a guide (Weimer,

2013; Wiggins & McTighe, 2005). Guides show the way; likewise teachers inform, advise, warn of danger, support but those who follow the guide have to walk on their own. As already hinted in this section, in an LCT classroom the learner's task is to do the learning. In this case the teacher must guide and assist learners in learning for themselves-picking ideas apart, forming their own thoughts about them, and owning material through self-exploration and dialogue. A facilitator assists learners to plan how to achieve learning objectives. Teachers must challenge the learners' thinking, allow them to ask questions, make hypotheses and test their validity (Fosnot, 2005).

The teaching of new knowledge has to be done in meaningful ways so that it promotes lasting learning. First it has to be assimilated to the learners' prior knowledge so that the learner can use it effectively in new tasks and transfer it to new situations. For learners to assimilate the content, they must have the opportunities to practice the new skills to deepen their understanding of the new information. Weimer (2013) observes that it is important to start with identifying those teaching practices that tend to make learners dependent and those practices that develop autonomous learners. By enabling learners to make the transition from merely receiving information to actively exploring ideas, from just answering questions to generating them, teachers can encourage learners to take responsibility for their learning leading to self-directed learning.

All in all the positive effects of the pure learner-centred teaching (LCT) have been proved in a number of case-studies and are well-documented in the literature (O'Neill & McMahon, 2014; Armstrong, 2012; Rogers, 1983; Hannafin & Hannafin, 2010; Šumskaitė, 2014; Tamelis, 2014; Sajienė & Tamulienė, 2012; Ruškus, et al., 2007;

Tūtlys, 2010; and Pukelis, 2011). All these authors hint that learner centred teaching (LCT) promote learning in learners.

2.4 Learner-centred teaching (LCT) worldwide

2.4.1 Learner-centred teaching outside Africa

Metto and Makewa (2014) observed that in developed countries such as the United States of America (USA) and most European countries, learner-centred teaching (LCT) approaches are practiced to a large extent as compared to several developing countries. Sablonnière, et al. (2009) posit that in Western societies, teachers and learners have experienced both teacher-centred and learner-centred approaches from public debates and real life classroom experiences. They observed that the United States, Canada and the European Union spend considerable amounts of resources to promote LCT approaches at all levels of their education systems. A variety of different approaches have been developed under the umbrella of the learner-centred approach. These include cooperative learning, learner-centred instruction and hands-on learning.

Research into LCT and curriculum reform has reported mixed results. Some schools in the United States have reported some successes in restructuring curricula in order to engage learners' ideas and interests and to develop their knowledge in key areas (Westheimer, 1998; Darling-Hammond, 1997; Muncey & McQuillan, 1996; Meier, 1995).

Lancaster (2017) carried out a study for a PhD thesis at Arkansas State University- USA, with 25 first and second year learners and 2 teachers of the classes as respondents. The purpose was to compare learner achievement and views of alternative learning environment (ALE) programs for learners in rural Arkansas Delta schools utilising both teacher centred

and learner-centred environments. Additionally, the study addressed how each environment (learner-centred and teacher centred classrooms) nurtured independence skills, leadership, and social growth as assessed by weekly reflections, classroom observations, learner focus groups, and surveys.

In his study Lancaster (2017) used a mixed methods research design and generated both quantitative and qualitative data through bi-weekly lesson observations, semi structured interviews and learner focus groups. Data from the LCT compiled from the bi-weekly lesson observations had shown a clear change in the learners' ability to work independently and collaboratively, along with providing leadership opportunities that might not have been attained in traditional classes. The results of this study suggest alternative learning environment classes can integrate learner-centred learning techniques without compromising learner learning outcomes both academically and socially. Lancaster's (2017) study further indicate that when offered the opportunity such as that provided in the learner-centred environment, respondents will achieve higher academic learning outcomes.

Similarly, Garner (2015) conducted mixed methods experimental study for an MA thesis at Wittenberg University- USA, to examine the impact of a learner-centred learning environment on middle school learners as evident by their ability to solve problems and communicate thinking on various summative assessments in Mathematics using both qualitative and quantitative data. Respondents were 46 grade 7 high-achieving learners (11 females, 10 males from one class and 19 females, 6 males from another class) in two mathematics classes. Both in-class and out of class tasks were used in the analysis of this

study. However, Garner (2015) did not make comparisons between learner-centred teaching and teacher centred teaching as Lancaster (2017) did.

Garner (2015) found that the learner-centred learning methods led to an increase in learner understanding as evident through various assessment measures. Also, it was made clear that learners enjoyed problem-based tasks and appreciated the collaboration made available through this method of learning. Garner (2015) affirmed that a learner-centred environment is beneficial to learner learning in mathematics and leads to an increase in learners' ability to problem solve and communicate their thinking.

Overall, Garner (2015) determined that these learner-centred methods led to improved understanding of the mathematical concepts and an increase in learners' abilities to communicate their understanding on summative assessments. Learners showed a positive view of these learner-centred instructional methods. Lancaster (2017) and Garner (2015) agree in their findings because both found out that learner-centred teaching practices improve learners' learning.

A lot of literature shows that despite the benefits of learner-centred approaches, teaching in many parts of the world is still characterised by teacher-centred approaches (InWent, 2008). For example, study findings in primary schools in Ireland reveal that teachers eagerly embraced constructivism at the outset but realities in their classrooms such as large number of learners, the breadth of the curriculum and the wide range of learners' abilities impact the successful transition to learner-centred approaches (O'Shea & Leavy, 2013). The realities in the Irish primary schools are apparent in several other countries, especially

in developing countries and they hinder the effective use of learner-centred approaches at all levels of education (de la Sablonnière, et al. 2009).

Barbara (2000) has also published extensively on the topic of learner-centred teaching (LCT). Her work emphasises the role of positive feedback between the learner and the teacher and the importance of an encouraging climate of learning both in and outside the classroom. Her work also found significant value in our better understanding the individual learner's perspective on the learning experience and having diverse approaches that allow all learners to be better invested in their learning experience. The lesson from Barbara (2000) has the idea that there must be a positive feedback between learners and their teachers. This is possible when a teacher uses LCT methods and when there are enough instructional resources. This is not the case in the study areas and Malawi in particular. This situation plus other institutional constraints have triggered this research in order to reveal what is happening with LCT in such challenges.

Ebert-May and Derting (2011) conducted a research on learner-centred teaching (LCT) in Vietnamese Transnational University. A workshop designed to help faculty shift from teacher centred teaching to LCT in Science courses was initiated. The survey indicated that 89% of the respondents stated that they applied learner-centred methods. In contrast, observational data showed the majority of faculty, 75%, used lecture method, which is teacher centred pedagogy, showing a clear disconnect between faculty's understanding of their teaching and their actual practices. The study revealed that there are situations that teachers may think that they are using learner-centred teaching methods but in reality, they are still using teacher centred pedagogies.

The study carried by Yeung (2009) in Hong Kong on learner-centred approaches to teaching since 1980 found that learners in the country tend to be traditional learners who rarely experience real learner-centred learning. Teachers continue to focus on teacher centred pedagogies to their learners. Constructivist learning models such as inquiry learning remain little used by learners in most Hong Kong classrooms.

Manal, et al. (2008) carried out a research that assessed teachers' perceptions on LCT. He found that 56% of teachers acknowledged that LCT improves ability of learners to learn materials. Moreover, 51% agreed that learners have to be prepared differently for the class. The researchers finalised that teachers are willing to apply LCT in teaching their learners. They argue that teachers should be given continuing training for the benefits of LCT and learners must be guided through orientation programmes that can be held at the beginning of their courses.

A research by Kalughula (2004) in Bangladesh found out that LCT classroom practices are possible even with overcrowded classes if the teachers are prepared to cope and manage the situation efficiently and effectively. Since this is possible in Bangladesh, therefore, it is also possible in any country Malawi inclusive. However, it is clear that little has been done in Malawi by initial primary teacher trainers, curriculum developers, school inspectors and researchers to collaborate with classroom teachers to work out pedagogical solutions for the overcrowded classes (Mtika, 2010). Kalughula (2004) found out that classroom teachers in Bangladesh were left alone to find a way on how to face the challenges. Malawi is also facing the same scenario. It is, therefore, time to involve

teachers in finding the most appropriate pedagogical practices that take into account the realities in Malawian schools. The problem of overcrowded classes has been presented as the hindrance to LCT approaches by many researchers (Mtika, 2010).

In another study, Mohammed and Harlech-Jones (2008) reported that professionally-trained teachers in Pakistan were not able to apply LCT methods they learned because of the reality of the schools. Teachers claimed they got no support from school managers who did not encourage thinking of intellectual quality, who demanded that teachers follow directives, cover the syllabus, use tasks in textbooks and produce results. The researchers believe that reforms in developing countries fail because reformers do not understand the realities of the lives and professional environments of the implementers.

In their study in Malaysia, Yusoff, et al. (2003) investigated the extent to which teachers practice learner-centred teaching (LCT). They used a framework for the LCT which comprised of seven components: learners' empowerment, learners' engagement, collaboration, teachers' role, higher order thinking skills, assessment and approaches/methodology/strategy. The results of the study revealed that teachers practiced different forms of LCT varying from collaborative/cooperative learning, problem based learning, to debate and action research in a decreasing frequency (Janor et al., 2013).

In a study in Vietnam, Thanh-Pham (2010) identified several practical difficulties in implementing LCT in Vietnamese education sector. He writes: *Vietnamese educators are*

dedicated to importing various Western teaching and learning approaches especially a learner-centred approach and see these approaches as standards for education reforms. This happened because they believe that a learner-centred learning approach promises to provide learners with new skills like creativeness, independence, activeness, cooperativeness, etc. in many ways such advanced approaches can be considered a fashion (Thanh-Pham, 2010). Even though Thanh-Pham accepts the idea of LCT, he warns that local constraints should be taken into consideration when implementing such a huge educational change- LCT

In a Sri Lankan study for a Masters' Thesis, Dahanayake (n.d.) investigated the secondary level classes for practicing LCT. His findings reveal that even though teachers and learners have positive attitude towards LCT, the approach is yet to be practiced at a greater scale. While policy makers and teacher educators in Malawi and other countries in the world often blame the teachers for failing to implement LCT, they rarely are aware of the underlying issues which affect the appropriation and application of LCT in real classrooms.

2.4. 2 Learner-centred teaching in Africa

In the Sub-Saharan Africa and other developing countries LCT trainings and /or orientations have been largely sponsored by international aid agencies (Hardman, et al., 2008; O'Sullivan, 2004; Tabulawa, 2003) as a drive to improve the quality of teaching and learning in line with international discourse outlined in the Millennium Development Goals (MDGs) and Education for All (EFA) (Westbrook, et al., 2013; UNESCO, 2004).

Vavrus, et al. (2011) observed that research in LCT in sub-Saharan countries is limited. In the wake of the Education For All as a global movement advocating active learning

techniques in its list of conditions for quality education (UNESCO, 2012), a number of countries embraced LCT. For example, Botswana implemented LCT with the help of USAID (Tabulawa, 2003). Namibia tried LCT within its teacher education reform (Dahlstrom, 1999); Ghana put emphasis on teacher training in LCT (Akyeampong & Stephens, 2002); Tanzania strongly recommended LCT to improve educational quality (Vavrus, 2009); South Africa's Outcomes Based Education reform promoted LCT approaches (Chisholm & Leyendecker, 2008) and Mozambique's new curriculum for basic education endorsed LCT (Guro & Weber, 2010).

Though a number of institutions have successfully implemented LCT in Science classrooms in Africa (Akinbobola, 2006), they are too few compared to the magnitude of the failures of the approach in developing countries. According to literature (e.g. Akinbobola, 2006), in a number of countries attempts at transforming traditional classrooms into learner-centred classrooms have failed. Schweisfurth (2011) agrees with Akinbobola's (2006) observations after he synthesised the findings from every available article on LCT published in the *International Journal of Educational Development*, which is the main academic journal on education in developing countries contexts. He reviewed 72 articles on this theme over three decades. He observed that almost every single one carried the same strong message that LCT isn't working. Whether it was a case of full-scale policy changes, or small scale interventions by individual programmes or agencies, even when teachers were apparently enthusiastic about the ideas, there were no expected changes to practice or learning. Schweisfurth (2011) observed that the evidence for this lack of change was, frankly, overwhelming.

Schweisfurth (2011, p.244) explains that it is not only in the Global South that questions have been asked both about how widespread learner-centred practice is, and whether it fulfils all its foundational promises. Even when it was inscribed in policy in England, practice differed between teachers and many remained quite teacher centred in their practice. He emphasises that this trend remains the case in many countries in the Global North, where, ironically, many countries look for pedagogical inspiration from Asian countries such as Singapore with successful results on international tests. Schweisfurth (2011) observes that on a more foundational level, children from less educated families are likely to be disadvantaged by LCT.

While learner-centred approaches are seriously encouraged by their proponents, Schweisfurth (2011) warns that implementing the approaches has mostly failed. Schweisfurth (2011, p. 245) explains that as a globally travelling policy and practice, prescriptions and innovations regarding LCT are often found in contexts where it is culturally new and where the realities of educational governance and resources for schools have not historically accommodated it. In a recent analysis of the research on LCT implementation reported in the international journal on education and development, it was evident that the history of the implementation of LCT in different contexts is riddled with stories of failures grand and small (Schweisfurth, 2011, p. 245). Harley, et al. (2000); Nakabugo and Siebörger (2001) and Tabulawa (2003) agree with Schweisfurth (2011) as they observe that across a wide range of developing countries contexts, the reports of failure to implement LCT as teachers and learners struggle to make the paradigm shift far outnumbered the stories of successful transitions from the pedagogies in place towards

LCT. According to Nakabugo and Sieborger, (2001) the challenge of implementing LCT has been labeled a paradigm shift.

Reporting on a study conducted among in-service teachers in South Africa, Brodie, et al. (2002) posit that the challenge with the implementation of learner-centred approaches is that teachers tend to understand reform and implementation differently. South Africa is said to be one of the rare African countries where LCT is officially promoted and supported. Nonetheless even in this context LCT has been unable to dislodge teacher-centred practices (Chisholm & Leyendecker, 2000).

In a qualitative study involving 18 respondents from 9 schools over a three-year period (1996–1998) in South Africa, Brodie, et al. (2002) conducted class observations with teachers implementing learner-centred activities. The teachers were part of the students who enrolled in Further Diploma in Education at the University of the Witwatersrand on a 2-year in-service teacher education programme in Mathematics, Science and English Language teaching using learner-centred teaching practices. Brodie, et al. (2002) explored whether teachers adopted the form rather than the substance of learner-centred practices and to do this they developed the concepts of forms that were categories like groupings, tasks, and activities. Substance included ways teachers elicited, constructed and developed understanding; ways learners asked questions and how teachers responded to help them develop their thinking. For instance they observed activities like group work, but save for the physical classroom arrangement.

The research focused on teachers' pedagogies, and the extent to which these might be called learner-centred. The sample consisted of 18 teachers: 9 of mathematics; 5 of English;

and 4 of science. They started with a sample of 25 teachers, but over the 3 years of the research 7 teachers dropped out. The 18 teachers taught at 9 different schools in 2 of the 9 provinces in South Africa. Among these schools, Brodie, et al. (2002) found out that there were considerable disparities in resources, with the rural schools far less resourced than the urban schools. They generated data through classroom observations and interviews (about 8 lessons per teacher over the 3 years). They also held interviews with principals.

In their findings, Brodie, et al. (2002) concluded that teaching remained very directive and focused on content. Teachers did not allow opportunities for the facilitation of their learners' construction of knowledge. They did not take into account learners' interests, prior knowledge, experiences and aptitude. In this case the conclusion drawn was that teachers predominantly embraced the form rather than the philosophy of the learner-centred teaching approach.

In a related study, Manqele (2017) carried out a research in South Africa to determine the level to which LCT has been adopted by rural and underdeveloped secondary schools. He used qualitative research methods to discern data from Physical Science teachers, learners and Physical Science Heads of Departments from the selected schools. In addition, the researcher conducted classroom teaching observations, analysed relevant documents and interviewed some respondents to determine their views and experiences on using learner-centred teaching methods.

Purposive sampling technique was used to select the respondents from 6 high schools. The respondents were 18 Physical Science teachers- three from each school, 18 Grade 10 to 12

learners- three from each school, and 6 Physical Science heads of departments, 1 from each school. The findings of the study revealed many challenges to rural schools in adopting and implementing learner-centred approach. The overall conclusion of the study is that, after two decades since the introduction of learner-centred approaches in South Africa, rural schools have not yet managed to adopt and implement learner-centred pedagogy as an important part of the post 1994 educational innovations.

A similar study in Namibia was carried out by Kapenda (2008) who investigated how senior secondary school mathematics teachers implemented learner-centred teaching in mathematics classrooms. He carried out a qualitative phenomenological research that involved 8 weeks of fieldwork investigations of secondary school mathematics teachers' classroom practices. Specifically, this study utilised multiple case studies. Three Grade 11 mathematics teachers (two females and one male) were selected from three different government schools. Data was generated through classroom observations, semi-structured interviews and video recordings in order to understand the nature of the teachers' classroom practices. Each mathematics teacher was observed for a period of two to three consecutive weeks.

The results of his research revealed different types of classroom interactions that were common in the three classrooms. These included among others, question and answer dialogue between the teacher and the learners. Using his research findings, Kapenda (2008) concluded that mathematics teachers at senior secondary schools used the expository method more often in their teaching than other teaching methods such as lecturing and discussions. He observed that the teachers also used the chalkboard very often, especially

when assigning class activities. The textbooks were mostly used as referrals. Kapenda (2008) therefore, concluded that most teachers in Namibia are still struggling with the implementation of learner-centred teaching (LCT) approaches. According to him the results of his research presented an attempt to use LCT approaches.

Similarly, a study on the implementation of learner-centred approaches in Namibia showed non-implementation of the strategies citing challenges of teacher professional capacity, limited resources, cultural factors and learner background (O'Sullivan, 2004). Kamupingene (1998) agree with O'Sullivan's (2004) observation by reporting that Namibia is still experiencing problems with the implementation of LCT approaches despite all the attempts made to implement this approach smoothly. That is, several teachers in Namibia are experiencing problems with the implementation of learner-centred teaching (LCT). Likewise LCT was unsuccessful in Lesotho. Moloi, et al. (2008) suggest that the student teachers' professional training may not have prepared them to deal with problems likely to emerge when teachers use LCT in contexts moulded by teacher-centred culture. The researchers evoke the possibility that teachers may not have put in enough effort or else have underestimated the value of group work altogether- a consequence of being under-prepared for LCT.

2.4.3 Learner centred teaching (LCT) in Malawi

In line with international policy imperatives, initial primary teacher education (IPTE) in Malawi advocates for learner-centred teaching (LCT) for all its trainee teachers as reflected in the government's educational policy which stipulates that prospective teachers need to undergo well organised teacher education which advocates LCT (Malawi Government,

2000). For example, an orientation course for unqualified primary school teachers in Malawi stressed active involvement of the learners, guided discovery learning and building on the learner's interests (Croft, 2002).

Kayange (2017) conducted a research on the use of learner-centred methods in the teaching of Mathematics in TTCs in Malawi. He used a mixed method approach which combines quantitative and qualitative data collection methods. The quantitative methods involved the use of an interview guide to gather data from 160 learners while the qualitative methods involved the use of interviews and lesson observations to obtain data from 7 mathematics teacher educators. Kayange (2017) established that LCT methods were used to a large extent in the teaching of mathematics despite some difficulties that learners as well as teacher educators experienced during the process of teaching and learning.

Kasakula (2017) carried out a study on Investigating the Learner Centredness of Strategies Used in the Teaching of Science and Technology in Primary Schools in Malawi. The study took place in Maravi Education Zones, Nguludi in Chiradzulu district. Data for the study were generated through lesson observations and post lesson interviews. He carried out the study in 10 different primary schools in the district. He used a purposive sampling method to select the 10 schools as well as the respondents. The respondents in the study were 10 standard 8 teachers. He used a mixed methods research design. The results of Kasakula's (2017) study indicated that the teaching strategies used by the observed teachers were not learner centred as emphasised in the Curriculum Blueprint (MIE, 2006). Teachers dominated in class activities with little learner participation, except in question and answer discourse and during demonstration of the experiments.

Chiphiko and Shawa (2014) conducted a study about Implementing Learner-Centred Approaches to Instruction in Primary Schools in Malawi. This study was conducted to find out how primary school teachers implement learner-centred approaches in Kasungu District. The study employed the progressivism learning theory propounded by John Dewey as the theoretical framework. Using qualitative methods, data were generated by interviewing 12 teachers (6 male and 6 female), classroom observations and document analysis. The study revealed that due to classroom challenges, primary school teachers fail to plan for learner-centred approaches at lesson planning level, fail to stimulate learners' interest during classroom instruction and fail to engage in critical thinking and problem solving activities with their learners in class. However, the study findings by Chiphiko and Shawa (2014) indicated that there exists some LCT practices in the classrooms in Malawi. This agrees with a study about Implementing Integrated Literacy Approaches in an English Classroom in Malawi carried out by Mmela, E. (2006) who found out that the learner-centred integrated literacy approaches of the constructivism based philosophy, which are also included in the Malawi curriculum are possible but implementation is still a challenge in the primary classes. Data were collected from pre- and post-study interviews, a series of audio taped lesson planning and lesson reflections, lesson observation summaries, and a researcher's journal. The study established that the lecturers' understanding of LCT is limited to a change of instructional methods from teacher-centred to learner-centred methods. They showed little evidence of understanding how learners' mental cognition functions and the kind of instructional competence learners needed to acquire during the teaching processes. The same was reflected during

their classroom practices where the lecturers dominated most of their instructional practices. Effective guidance and facilitation of the learners' group activities was notably absent when the lecturers assigned the learners into group activities. Many times the lecturers initiated questions to the learners contrary to the constructivist learning beliefs. The learners were also given limited time to reflect on the scientific and technological aspects under discussions.

The Malawi Government through the Ministry of Education, Science and Technology , is advocating for learner-centred teaching in schools and initial primary teacher education colleges (MIE, 2017). Nyirenda (2015) carried out a study about Exploring Challenges in the Implementation of Learner-Centered Approaches in Urban Primary Schools: The Case of Selected Schools in Blantyre, Malawi. The aim of the study was to explore challenges teachers in urban primary schools face in the implementation of learner-centred approaches. The study was conducted in two schools (A and B) in Blantyre city-Malawi. She used convenient sampling to identify the study schools. Her sample was 8 standard 7 teachers, 2 head teachers and 1 primary education advisor (11 officers in total), plus two classes of standard seven learners (school A had 105 learners and school B had 110 learners in standard 7). Nyirenda's (2015) study revealed that teachers in urban primary schools do not follow LCT principles which stipulate that learning must be an active process, a constructive process, a cooperative process and a reflective process.

Therefore, in Malawi research shows LCT has not fully taken root (Nyirenda, 2015). For example, Mtika and Gates (2010) researching on learner-centred teaching (LCT) in Malawi

conclude that appropriation and application of LCT approaches is problematic. They carried out a qualitative study involving four trainee teachers in their second year of teacher training practice, and their supervisor. The researchers conducted interviews, class observations and studied the novices' critical incident logs related to LCT. They equally found out that LCT was not implemented in the classrooms. In their interviews, lecturers ascribed their varying degrees of application of LCT to the teacher education system, the learners' personal stance, the school culture, and the national curriculum. Trainee teachers declared that they were taught to use LCT approaches but their own lecturers used the transmissive approach and they lacked practice in learner-centred activities. This therefore, implies that though teachers are trained to use learner-centred methods in classrooms in order to align with international policy imperatives (Malawi Government, 2000), there is evidence that learner-centred teaching has not been implemented in classrooms (Moloi, et al., 2008; O'Sullivan, 2004; Vavrus, 2009). This agrees with other researches in classroom instruction which show persistence of teacher-centred practices (Hardman, et al., 2008).

Furthermore the school culture where they were placed was teacher oriented and trainees had to fit in and adopt the dominant practices for peer acceptance. The curriculum was congested and examination-oriented and both novices and trained teachers had to face the challenge of implementing learner-centred approach in an educational system based largely on rote learning. Those teachers equally encountered resistance from learners not used to learner-centred teaching (LCT) methods.

2.5 Some historical perspective of learner-centred teaching (LCT)

The term LCT is a very old concept in the education setting and traces back to the works

of some well-known philosophers and educators such as Socrates and Jean-Jacques Rousseau (Henson, 2003). Socrates (469-399 B.C.) believed that the disciplined practice of thoughtful questioning enables a learner to examine ideas and be able to determine the validity of those ideas and guide the learner to discovery (Brun, 1984, p. 151). Jean-Jacques Rousseau (1712 -1778) in his book, *Emile* (1975), held the child-centred philosophy (as opposed to curriculum- centred theory) as the most appropriate in the task of progressive education because it makes room for learning by discovery and care- taking as well as educating. The concept of LCT has been credited as early as 1905 to Hayward and in 1956 to Dewey's work (O'Sullivan 2003). Carl Rogers, the father of client-centred counseling, is associated with expanding this approach into a general theory of learning (Burnard, 1999; Rogoff, 1999).

The term LCT was also associated with the work of Piaget and more recently with Malcolm Knowles (Burnard, 1999). Rogers (1983, p.25), in his book *Freedom to Learn for the 80s*, describes the shift in power from the expert teacher to the learner, driven by a need for a change in the traditional environment where in this *so-called educational atmosphere, learners become passive, apathetic and bored*. In the school system, the concept of child-centred education has been derived, in particular, from the work of Froebel and the idea that the teacher should not *interfere with this process of maturation, but act as a guide* (Simon, 1999). Simon (1999) highlighted that this was linked with the process of development or readiness, i.e. the child will learn when he/she is ready. The paradigm shift away from teaching to an emphasis on learning has facilitated power shift from the teacher to the learner (Barr & Tagg, 1995).

According to Mizrachi, et al. (2010), LCT has generated world-wide interest especially after the Dakar conference on Education For All (EFA) in the year 2000. Following discourses about universal primary education, LCT has become popular in sub Saharan Africa and has received a lot of support from the donor community (Schweisfurth, 2011; Sriprakash, 2010).

According to Piaget (1952, 1971), Vygotsky (1978) and Dewey (1997), the concept learner-centred teaching (LCT) is at first understood pedagogically as a constructivist approach that has emerged from the constructivist learning theory. The pioneers of the theory distinguished cognitive from social constructivism where cognitive construction stipulates that the new information is added to the prior knowledge and social constructivism adds how learners' interaction with the environment around them leads to developing deeper understanding through collaborations and questioning by comparing their thinking processes to that of their peers and in being engaged in questioning for revising their understanding on a concept or a theory. The authors have largely emphasised that teacher centred teaching has to be replaced by hands-on activities and group work, in which learners determine on their own what they want to do in class (Piaget, 1952, 1971; Vygotsky, 1978; Dewey, 1997).

Carlile and Jordan (2005) hint that the theoretical standing of LCT is often surprisingly absent in the literature but observe that it appears to relate primarily to the constructivist view of learning in the importance it places on activity, discovery and independent learning. McCombs and Whistler (1997) agree with Carlile and Jordan (2005) by stating that LCT relies more on the theory of social constructivism, because social constructivism

takes into account the social nature of the learning environment as a collaborative atmosphere between the teachers and learners. Therefore, learner-centred teaching (LCT) has some connections with the social constructivist view, which emphasises activity and the importance of communities of practice/others in the learning process. The constructivist view of activity is related more to performing physical activities, for example, projects, practicals. Performing of physical activities is also promoted in Science and Technology since it is a practical subject. The constructivist conception uses LCT strategies because this type of learning will help learners develop critical thinking and collaboration skills and learning takes place in environments where learners are able to participate actively (Chan & Elliot, 2004; Cheng, et al., 2009).

2.6 Constructivism

2.6.1 Historical perspectives

According to literature early educational theorists who contributed to constructivist thoughts are Jean Piaget, John Dewey, Lev Vygotsky, and Jerome Bruner (Glaserfeld, 1995; Roblyer & Edwards, 2000). However, Glaserfeld (1989) credits Giambattista Vico as the first philosopher to put forth the constructivist theory of knowledge in his Latin treatise *De antiquissima Italorum sapientia* (1710). According to Glaserfeld (1989), Vico's quote *verum esse ipsum factum* which means that true itself is fact or the true itself is made, is a proposition that has been read as an early instance of constructivist epistemology. Lo (1996) concurs with Glaserfeld (1989) that Giambattista Vico published a treatise on the construction of knowledge in 1710 and that it was through Vico's writings that the term constructivism was taken. According to Lo (1996) the treatise illuminated

the idea that knowledge is something that is constructed by the knower. Vico's concepts deal mostly with the relationship between truth, knowledge and the origins of language and the desire of the human mind to create knowledge (Lo, 1996).

Von Glasersfeld credits Giambattista Vico with first defining a way of knowing and learning as constructivist (Gruender, 1996). Vico believed that the human reason can only know what the human mind has made (Glasersfeld, 1989, p.3). Because of this philosophy, Vico is credited with being the original constructivist. Believing that there is nothing that is true or real other than what the experiencer creates within the mind. According to literature, Glasersfeld's own thinking had been profoundly influenced by the theories of Piaget (Oxford, 1997). While Vico is credited with coining the term constructivism, Piaget is seen as the original constructivist. His theory of knowledge, published in 1954, portrayed the child as a lone scientist creating his or her own sense of the world (Oxford, 1997).

Bliss (1993) states that Piaget was one of the first to put forward the notion that children construct their own knowledge; this knowledge seen as being of a different kind from that of an adult, evolving and changing over the years. von Glasersfeld (1995) concurs with Bliss (1993) that another proponent of the constructivist ideology, like Vico, prior to the establishment of a constructivist philosophy, was Jean Piaget. Piaget's constructivism is often referred to as cognitive constructivism. Piaget takes credit as being called the founder of constructivism (von Glasersfeld, 1995). Piaget's theory of cognitive development is based on the presence of a central processing system that develops and becomes more

complex with maturation. Maturation is considered to depend on both genetic and experiential factors.

von Glasersfeld (1995) observes that Piaget (1896–1980) was unquestionably the pioneer of the constructivist approach to cognition. Because of his work with children, in studying the development of their knowledge, much of Piaget's work has been categorised, mistakenly, according to von Glasersfeld (1995), as child psychology rather than philosophy. Piaget's early work, *La construction du réel chez l'enfant (1937)* was an attempt to show that human infants can construct for themselves the reality they experience (von Glasersfeld, 1995). He sought the foundations of knowledge with an explicitly biological foundation (Lewin, 2003). Piaget viewed himself as a constructivist. In discussing three tendencies of psychological research he writes; *the third tendency, which is decidedly my own, is of a constructivist nature.*

Huitt, W. (2009) adds that constructivism has its roots in the cognitive theories of Piaget and Vygotsky and embraces several aspects of both of their theories. Gul (2016) concurs with von Glasersfeld (1995) and Huitt (2009) by stating that the psychological roots of constructivism began with the developmental works of Jean Piaget (1896–1980), who developed the theory of genetic epistemology that analogised the development of the mind to evolutionary biological development and highlighted the adaptive function of cognition. Thus, for Gul (2016) Piaget (1896-1980) can be considered the father of the theory of constructivism.

The vast majority of Piaget's (1980) theories developed through working with children where he would challenge the idea that children are inferior thinkers compared to adults

(Gul, 2016). Piaget proves that children develop differently by establishing a theory involving cognitive stages. The goal of the theory is to explain the mechanisms and processes by which infants, and then the child, develops into an individual who can reason and think using hypotheses. To Piaget, cognitive development was a progressive re-organisation of mental processes as a result of biological maturation and environmental experience. In Piaget's work there is active learning, schemes, assimilation and accommodation, etc. Piaget (1971) proposes that children progress through a sequence of four stages of cognitive development; sensorimotor, pre-operational, concrete operational and formal operational: assumed to reflect qualitative differences in children's cognitive abilities. During these stages children's abilities and thinking evolve from, among other things, concrete to abstract. The development takes place through a gradual process of interacting with the environment. Piaget (1971) went on to propose that when children confront the environment and encounter a reality that does not fit with their view, they undergo disequilibrium – a phase in which the children resolve the new reality or knowledge with their existing view or reality as they know it. This process of disequilibrium and subsequent assimilation with existing knowledge or in other words, constructing new knowledge on existing or prior knowledge is the foundation of constructivism. Gul (2016) notes that Piaget's hypothesis that learning is a transformative rather than a cumulative process is central.

According to Huitt (2009), Piaget's theories indicate that humans create knowledge through the interaction between their experiences and ideas. Hence, Glasersfeld (1995), Huitt (2009) and Gul (2016) all agree that Jean Piaget is one of the first theorists in constructivism. Huitt (2009) observes that Piaget's view of constructivism is the

inspiration for radical constructivism due to his (Piaget's) idea that the individual is at the centre of the knowledge creation and acquisition process. He (Huitt) observes that Piaget rejected the idea that learning was the passive assimilation of given knowledge. Instead, he (Piaget) proposes that learning is a dynamic process comprising successive stages of adaption to reality during which learners actively construct knowledge by creating and testing their own theories of the world. The application of Piaget's work to educational practice has focused on the activities of the learner.

John Dewey's (1859–1952) ideas support the constructivist models of teaching. He is often classified as a constructivist (Oxford, 1997). His beliefs about education and ways of knowing included the premise that knowing is not done by an outside spectator but is instead constructed by a participant, with society providing a reference point or theory for making sense of the experience (Oxford, 1997). Dewey expanded on the notion that all knowledge is constructed by the knower by including the idea that there is a relationship between the individual, the community, and the world mediated by socially constructed ideas (Oxford, 1997). He emphasised teaching that was learner centric, which is today interpreted as being situated in a context that is relevant to the learner. He categorically claimed that learning that did not centre around the problems of the learner was worse than useless (Roblyer & Edwards, 2000). Dewey also pointed out the need for learning to be collaborative. He attributed participatory and collaborative learning owing to human beings being inherently social in nature. Like Vygotsky, Dewey upheld the role of the learners' social environment. He is often quoted in most literature as a social constructivist (Oxford, 1997; Roblyer & Edwards, 2000).

For Dewey (1859–1952), education depends on action—knowledge and ideas emerge only from a situation in which learners have to draw out experiences that have meaning and importance to them. Dewey argues that human thought is practical problem solving, which proceeds by testing rival hypotheses. These problem-solving experiences occur in a social context, such as a classroom, where learners join together in manipulating materials and observing outcomes (Dewey 1997, p. 89). Dewey invented the method of progressive education in North America. He rejected the notion that schools should focus on repetitive, rote memorisation and proposed a method of directed living – learners would engage in real-world, practical workshops in which they would demonstrate their knowledge through creativity and collaboration (Dewey, 1997, p. 89). He observes that learners should be provided with opportunities to think for themselves and articulate their thoughts. Dewey called for education to be grounded in real experiences. Dewey (1965, p. 315) in Reece (2013, p.320) wrote, *‘if you have doubts about how learning happens, engage in sustained inquiry: study, ponder, consider alternative possibilities and arrive at your belief grounded in evidence’*.

Like Piaget, Bruner (1915-2016) identified specific stages of a child’s development; Enactive, Iconic and Symbolic stages. Bruner in McLeod (2018, Feb 05) emphasises that learning must be a process of discovery where learners build their own knowledge, with the active dialogue of teachers, building on their existing knowledge. According to Bruner learning is an active, social process in which learners construct new ideas or concepts based on their current knowledge. Bruner observes that learners are more likely to retain

knowledge attained by engaging the real world and contextualised problem-solving than by traditional transmission methods.

For Bruner (1961), the purpose of education is not to impart knowledge, but instead to facilitate a child's thinking and problem-solving skills which can then be transferred to a range of situations. Specifically, education should also develop symbolic thinking in learners. Bruner (1961) emphasises learning as a discovery; an approach to learning where learners interact with the environment, raise questions, conduct experiments and manipulate objects. Bruner (1961) believed that when learners discover concepts by exploring them on their own, they are more likely to remember and understand them. This idea puts Bruner amongst radical constructivists because discovery of knowledge is indexed in the learner's experience. According to McLeod (2018, Feb 05) in Bruner's text (1960), *The Process of Education was published*. The main premise of Bruner's text was that learners are active learners who construct their own knowledge.

Bruner (1961, p.21-32) proposes that learners' construct their own knowledge and do this by organising and categorising information using a coding system. Bruner believed that the most effective way to develop a coding system is to discover it rather than being told about it by the teacher. The concept of discovery learning implies that learners construct their own knowledge for themselves. This is a constructivist approach. The role of the teacher should not be to teach information by rote learning, but instead to facilitate the learning process.

Bruner emphasises on the role of the teacher, language and instruction. He thought that

different processes are used by learners in problem solving, that these vary from person to person and that social interaction lay at the root of good learning. According to Bruner (1966), learners construct new ideas based upon their current and past knowledge. Biggs and Tang (2007) concur with Bruner (1961, 1966) by emphasising that learners construct knowledge with their own activities, building on what they already know. Both Bruner and Piaget agreed that children are naturally ready to learn language when born. Bruner places a much larger focus on adult participation in the learning process, although both theories consider children as active participants in the process.

Lev Vygotsky's (1896–1934) relevance to constructivism derives from his theories about language, thought, and their mediation by society (Manus, 1996). Vygotsky perceived that thought evolved from both the experiences and maturation process of an individual (Manus, 1996). Significantly, he also believed that constructs have social origins and that they are learned through interaction with others (Oxford, 1997). Vygotsky (1978) put much of his efforts into studying the relationship of speech and communication with learning in a social context. In *Mind and Society*, Vygotsky writes, “*children solve practical tasks with the help of their speech, as well as their eyes and hands*” (Vygotsky, 1978). Although social speech is internalised in adulthood, Vygotsky (1987) contends that it still preserves its intrinsic collaborative character. Von Glasersfeld (1995) calls Vygotsky the founding father of Social Constructivism.

In his experiments, Vygotsky (1987) studied the difference between a child's reasoning when working independently versus reasoning when working with a more competent person. He devised the notion of the zone of proximal development to reflect on the

potential of this difference. Vygotsky's findings suggest that learning environments should involve guided interactions that permit learners to reflect on inconsistency and to change their conceptions through communication.

Vygotsky (1987, p.39) emphasises on the role of language and culture in cognitive development and in how people perceive the world, and claim that they provide frameworks through which they experience, communicate, and understand reality. He suggests that people learn with meaning and personal significance in mind, not just through attention to the facts. Vygotsky (1978, p. 39) states: *A special feature of human perception ... is the perception of real objects ... I do not see the world simply in colour and shape but also as a world with sense and meaning. I do not merely see something round and black with two hands; I see a clock....*

Vygotsky's (1987) work contains a central scope focused on the social aspects of acquiring knowledge. Knowledge is not simply constructed, it is co-constructed. He suggests that one learns best through interacting with others. Through the process of working with others, learners create an environment of shared meanings with peers. By being immersed in the new environment, the learner is able to adapt subjective interpretations to become socially accepted.

Vygotsky developed social constructivism (Glaserfeld, 1995). He rejected the assumption made by Piaget that it was possible to separate learning from its social context. Vygotsky (1978, p.57) posits that every function in the child's cultural development appears twice: first, on the social level and, later on, on the individual level; first, between people (inter-

psychological) and then inside the child (intra-psychological). Like Piaget, Vygotsky believed that there are some problems out of a child's range of understanding. However, in contrast, Vygotsky believed that given proper help and assistance, children could perform a problem that Piaget would consider to be out of the child's mental capabilities (Woolfolk, 2015). From Vygotsky's (1978) work one gets social constructivism, group work, apprenticeship, etc.

Vygotsky focused more on social development theory which is based on social ideas that believe learners can learn more while they are learning in a social environment. Both Dewey (1965) and Vygotsky (1987) emphasise the importance of a social environment and culture for the learners. Vygotsky contributed the idea that learning and development are integrally tied to communicative interactions with others; and Dewey contributed the idea that schools have to bring real world problems into the school curriculum. Piaget focuses on the role played by logical and mathematical reasoning. On the other hand, Dewey emphasises on the nurture of independent reasoning.

Dewey (1965) puts more emphasis on the physical action part because it gives more value to the education and connects the learners' experiences and teaches them what they can do by using their bodies actively. According to Dewey (1965), to learn by experience one must be aware of the step leading up to what we do and the step that comes after what we do. Vygotsky's perspective towards experience and culture is not that far from Dewey's perspective. Vygotsky recognised two levels of culture which are close to Dewey's concept. Dewey sees two levels of experience: the culture that appears through everyday concepts, and the culture that appears through scientific ideas. Vygotsky profoundly explained the

activity as both the actions that humans take and the subtext of those actions which happen by desired consequences (Vygotsky, 1987).

By comparing Bruner's and Vygotsky's works, it is apparent that both emphasise on a child's social environment. Both agree that adults should play an active role in assisting the child's learning. This observation is similar to Wood, et al., (1976) who posit that both Bruner and Vygotsky emphasise on the social nature of learning, citing that other people should help a child develop skills. Bruner built on Vygotsky's work (Wood, et al., 1976). Similarly, Piaget emphasised on individual cognitive constructivism while Vygotsky on social constructivism. Piaget (1971, 1980) tells us that cognitive development is a product of the mind achieved through observation and experimentation, whereas Vygotsky (1978) views cognitive development as a social process, achieved through interactions with other knowledgeable members of the culture. Vygotsky's theory is very similar to Piaget's assumptions about how knowledge is created as well as how people learn, but Vygotsky places more importance on the social context of learning. In Piaget's theory, the teacher plays a limited role, whereas in Vygotsky's theory, the teacher plays an important role in learning.

Piaget proposed many applicable educational strategies, such as discovery learning (with little teacher intervention) with an emphasis on activity and play. Vygotsky incorporated the importance of social interactions and a co-constructed knowledge base to the theory of cognitive development. Vygotsky promoted guided discovery learning in the classroom (Woolfolk, 2015). Guided discovery involves the teacher offering intriguing questions to learners and having them discover the answers through testing hypotheses.

Piaget (1971) and Bruner (1990) are considered the chief theorists among the cognitive constructivists, while Vygotsky (1978) is the major theorist among the social constructivists (Wood, et al., 1976; Von Glasersfeld, 1989; Gul, 2016). Although Dewey, Piaget and Vygotsky worked within different cultural milieus, each scholar questioned how children might be taught to think in new ways and so move beyond lockstep re-enactment of the known. Each felt that the necessary quality of intellectual engagement could only be nurtured by giving children developmentally-appropriate opportunities to make sense of their worlds in conversation with others. Thus, most fundamentally all the three theorists looked to the increased vitality and capacity of human intelligence as the only potential source of the social progress they all desired.

Driver and Oldham (1988) list practical implications to include: Learners are viewed as active learners. Children bring their ideas with them to the classroom. These ideas interact and sometimes interfere with learning. Knowledge is not ‘out there’ but personally and socially constructed; Teachers bring their prior conceptions about knowledge and learning to the classroom and this is reflected in their practice. This means teaching does not involve the transmission of knowledge but the organisation of situations in the classroom.

Li (2012) agrees with Driver and Oldham (1988) by hinting that learners bring prior knowledge into a learning situation in which they must critique and re-evaluate their understanding of it. In Science and Technology, this means engaging the learner both physically and mentally with the learning experiences. Glasersfeld (1995) observes that constructivism is a theory of knowledge with roots in philosophy, psychology, and cybernetics. It asserts two main principles:

1. Knowledge is not passively received but actively built up by the learner;
2. The function of cognition is adaptive and serves to organize the world that is experienced by the learner, and not necessarily the discovery of ontological reality.

Learning activities in constructivist settings are characterised by active engagement, experiential learning, inquiry-based, problem – based learning, and collaboration with others. As a dispenser of knowledge, the teacher's role is to guide, facilitate, coach, provoke, and co-explore in ways that allow the learner to engage in critical and creative thinking, analysis and synthesis of ideas during the learning process as the teacher assumes the role of co-learner who encourages learners to question, challenge, and formulate their own ideas, opinions, and conclusions.

2.6.2 The nature of constructivist learning theory

From sections 2.3.5 and 2.6.1, the most important thing in constructivism theory is that in the learning process; (1) learners are active in constructing their own knowledge of the information or ideas of subject presented to them rather than passively receiving information from a source, and (2) social interactions are important in this knowledge construction process.

Thus, a constructivist view assumes that knowledge is created, identified, or constructed, individually and/or collectively. In other words, learners must actively develop their knowledge, not the teachers. What this means is that information cannot be merely deposited into learners heads. Constructivism tells us that information must be discovered through some activity on the learner's part in order to have meaning for him or her. Within

this perspective, teaching should promote experiences that would require learners to become active learners, and participants in the learning process. Such experiences may include inquiry activities, dialogue with peers and teachers that encourage making sense of the subject matter, or when exposed to other sources of information, and opportunities that would enable them demonstrate their understanding and the different sources they are exposed to for learning.

Constructivism has been accepted widely as a theory of learning and teaching (Ogunniyi, 2002, p. 11-70). In addition empirical studies such as Wu & Tsai (2005) and Uzuntiryaki & Geban (2004) have demonstrated the superiority of constructivist-oriented instruction over traditional teaching in terms of learners' achievements. Proponents of constructivism suggest that learners learn science best when they are actively engaged in doing science or in performing activities that allow them to think like scientists (Driver, 1983; Hipkins, et al, 2002). As such, a major emphasis in the Malawi TTC science curricular reform is a change from a more traditional teacher-based learning to a more inquiry-based, learner-centred teaching (MIE, 2017; National Research Council-NRC, 1996). Thus, the Malawi TTC Science and Technology curriculum (2017) emphasises that its implementation be done through constructivists approaches.

According to literature there are several varieties of constructivism (Liu & Matthews, 2005; Matthews, 2009; Suchting, 1992). To some authors constructivism is not a theory of learning. It is a description of the manner in which learning takes place. Cobern (1996, p.301) for instance, takes constructivism to be a model of how learning

takes place. Similarly, Colliver (2002) considers constructivism to be an important insight into the nature of human learning. In the constructivist perspective learning is using previous knowledge to arrive at new insights. Different learning tasks require different learning skills or strategies. The learner does not need only knowledge of the nature of learning but also knowledge and ability to use various learning skills and strategies as situations demand (Murayama, 2005; Harlen, 2009; Fairbrother, 2000; Wittrock, 1994; Weinstein & Underwood, 1985).

Gul (2016: p. 76) observes that Dewey (1965), Piaget (1971), and Vygotsky (1978) have different perspectives and ideas about constructivism especially around its epistemology and ontology. The three have interpreted constructivism according to their own experiences. In relation to that, the conclusion is that the learners' knowledge is their own life, their style and their life is an experience they get. Therefore, teaching and learning processes should be related to the real practical world. Further, even the classrooms should be designed and formed in a way where not only the teacher talks, but the learners ask critical questions, share ideas and experiences, and exchange knowledge interactively (Brooks & Brooks, 1999).

The basic premise of constructivist theory is that learners create their own meaning through experiences. Thus, constructivist thinking is rooted in several aspects of Piaget's and Vygotsky's cognitive theories. From Piaget, learners learn actively, create schemes, assimilate and accommodate all forms of science, etc. From Vygotsky, there is social constructivism, group work, internships, and so on (Aljohani, 2017, p. 98). Constructivism suggests that the learner needs to be proactive in how he or she learns, taking new

information, and shaping it to his or her understanding, rather than just sitting still and passively absorbing information like a sponge (Brooks & Brooks, 1999).

Vygotsky's sociocultural theory of development treats that learning and development happen through social interaction. The sociocultural theory argues that the role of interaction between a teacher and learners is important for the learners (Mercer, 2001). The importance of dialogic interaction in learning has been emphasised in sociocultural perspectives on learning (Navaz, 2012). Hence, Li (2012) explains that Vygotsky's sociocultural theory stipulates that formal and conceptual knowledge emerges from a repertoire of daily experience and interactions.

As Tsai (2002) asserts, peoples' subsequent actions and thoughts are constructed from their earlier ideas. Cobern cited in Tobin (2002) draws an analogy between the constructivist approach to learning and a construction site. Just as new structures are built on existing foundations at the construction site, new learning is constructed on the foundation of prior learning and experiences.

In the constructivist perspective learning takes place when learners use their prior learning to interpret and make sense of their surroundings (Tobin, 2002, p. 43). Thus, teaching is not a matter of transmitting information but of engaging learners in active learning, building their knowledge in terms of what they already understand. Learning Science and Technology in TTCs today may not only involve acquiring the content of the subject but also learning how to learn it, learners developing meta-cognitive awareness, developing

appropriate epistemological beliefs about Science and Technology , acquiring self-regulated learning skills and gaining self-efficacy beliefs about science learning.

Constructivism as Tobin (2002, p. 32) states is the current paradigm in science education. The constructivist perspective offers ways of making sense of commonly observed things in classrooms such as learners' persistent mistakes (Trumbull, 1990). Identifying sources of persistent errors has become more important in science than merely giving learners correct answers. Thus, knowledge is an inter-subjective interpretation. The learner must consider the information being taught and – based on past experiences, personal views, and cultural background – construct an interpretation.

Ausubel (1968) believes that learning of new knowledge relies on what is already known. That is, construction of knowledge begins with observation and recognition of events and objects through concepts people already have. People learn by constructing a network of concepts and adding to them. Ausubel (1968) also stresses the importance of reception rather than discovery learning, and meaningful rather than rote learning. He declares that his theory applies only to reception learning in school settings. However, he didn't say that discovery learning doesn't work; but rather that it was not efficient. In other words, Ausubel (1968) believes that understanding concepts, principles, and ideas are achieved through deductive reasoning.

Meaningful learning occurs as learners consciously and explicitly link their new knowledge to existing knowledge structure (Ausubel, 1968; Wittrock, 1994). This implies that effective instructional approaches have to be based on what is already known by the

learner. Therefore, the diagnosis of learners' pre-existing knowledge is important for teachers in order to plan subsequent teaching activities and help learners link the new material to what they already know. Determining learners' existing ideas and conceptions has been recognised as an important variable in science teaching and a necessary part of teaching strategies developed (Ausubel, 1968; Driver, 1983; Osborne & Freyberg, 1985). Hipkins, et al. (2002) argue that teaching science is effective when learners' existing ideas, values and beliefs, which they bring to a lesson, are elicited, addressed and linked to their classroom experiences at the beginning of a teaching programme.

Constructivism is split into two main camps: cognitive and social (Glaserfeld, 1995; Solomon, 1994). Cognitive constructivism proposes that the process of constructing knowledge is dependent on the individual's subjective interpretation of their active experience while social constructivism affirms that human development is socially situated and that knowledge is constructed through interaction with others. The epistemological background of learner-centred teaching (LCT) is connected to sociocultural approach to learning and it originated from the work of Vygotsky (1987).

Salomon and Perkins (1998) consider knowledge to be equally an individual and a social phenomenon. Social learning to them is a meaningful concept sufficiently distinct from individual learning to warrant attention. Dismissing the notion of individual learning all together would be to throw out the baby with the water by blurring important distinctions (Salomon & Perkins, 1998, p.16). The implication here is that both concepts are necessary if learning is to be understood more fully. Packer and Gioia (2000) hint that learners do not only construct knowledge, they also construct themselves using

information that is available to them. The differences in performance of learners in the classroom may be a consequence of the kinds of constructs each learner constructs about him or herself as a learner. Such constructs depend upon the environment in which the learners find themselves. Brown, et al. (1997) and Gregory (2002) suggest that schools should be considered to be communities where learners learn to learn.

Driver's (2008) perspective is that children construct their own ideas about the behaviour of the natural world, as a result of their observations of things happening and the ways that people talk about them. This perspective is consistent with a constructivist view of learning. Driver (2008) shows that children are capable of abstract reasoning in some contexts - while they find 'simpler' forms of reasoning extremely difficult in contexts that are counter-intuitive. She points out that the children's ideas are shaped by the experiences and ideas that they encounter in everyday life.

Driver (2008) argues that if children are to develop an understanding of the concepts of science as accepted by the scientific community, they need to be offered more than just practical experiences. They need teachers' guidance to help them develop new ways of thinking about their experiences. This often involves children making an intellectual leap by abandoning personal 'alternative frameworks' which, up until then, works well for them. During discussions designed to help children make this leap, teachers prompt them to make their thinking explicit, and support them in engaging with new ideas.

Driver's (2008) research highlights the importance of teachers knowing what the learners already know and understand in order to identify suitable starting points for learning.

Offering learners the opportunity to talk through their ideas together was seen as an important way of making learners' alternative frameworks explicit. Driver (2008) concluded that giving learners the chance to conduct their own investigation was important for introducing them to the scientific method. He found the idea that scientific knowledge that emerges from our sensory experiences, as unsatisfactory. Her main contention though, was that learners brought their own reasoning grown from their everyday experiences of science, to their study of science. She quoted the views of the educational researcher Ausebel (1968) who agreed with Piaget (1971) that each individual organises and structures their own knowledge.

Because of the emphasis on learners as active learners, constructivist strategies are often called learner-centred teaching (LCT) instruction. In their description about LCT, Barr and Tagg (1995) observe that in a learner-centred classroom the teacher becomes the guide on the side instead of the "sage on the stage," helping learners to discover their own meaning instead of lecturing and controlling all classroom activities. Sage on the stage is associated with teacher centred teaching practices or traditional teaching. This is the type of teaching where the teacher acts like an expert who owns all the knowledge and transmits it to the learners. On the other hand, guide on the stage means the teacher taking a less central role and is more concerned with facilitation of learning and to guide learners in their learning and discovery-LCT.

Brooks and Brooks (1993) observe that a teacher cannot pour information into a learner's brain and expect them to process it and apply it correctly later. This means the teacher facilitates, moderates and suggests while allowing the learners to experiment, asks

questions or plans activities that require the learner's full participation. The teacher may also provide tools such as problem solving and inquiry-based activities with which learners formulate and test their ideas, draw conclusions and inferences, and convey their knowledge collaboratively.

Brooks and Brooks (1999, p.25) hint that the teacher's role in a constructivist classroom isn't so much to lecture at learners but to act as an expert learner who can guide learners into adopting cognitive strategies such as self testing, articulating understanding, asking probing questions, and reflection. From the preceding paragraphs of this section, it can be concluded that the role of the teacher in constructivist classrooms is to organise information around big ideas that engage the learners' interest, to assist learners in developing new insights, and to connect them with their previous learning. The activities are learner-centred, and learners are encouraged to ask their own questions, carry out their own experiments, make their own analogies, and come to their own conclusions.

2.6.3 Teachers' classroom practices and constructivism

As facilitators of learning, teachers mentor and guide learners to construct their own meaning (Piaget, 1980; Jones & Brader-Araje, 2002). The task of the teacher is not to dispense knowledge but to provide learners with opportunities and incentives to build it up (von Glasersfeld, 1996, p. 7; Hackthorn, et al., 2011). Authentic classroom experiences that are meaningful are provided for learners so that they may explore, discover and solve problems based on their prior knowledge. Chaille (2008, p. 3) notes that constructivism underlies all aspects of learners' activities and experiences in the classroom.

Teachers also encourage learning by doing (Hackthorn, et al., 2011) which includes problem solving activities, inquiry based learning (Kirschner, et al., 2006) and cooperative learning (Friend & Cook, 2010) so that learners can be involved in direct engagement (Tobias & Duffy, 2009; Taber, 2016, p. 116) to share, collaborate and negotiate with each other (Kagan, 1994; Johnson & Johnson, 2009). A conducive environment (Tobias & Duffy, 2009) and the necessary resources are provided to support learning for each individual learner. Teachers promote cognitive and social development by using constructivist principles as learners are scaffolded to their next level of learning (Vygotsky, 1978; Beyhan & Köksal, 2013). Literature is replete with examples of the tendency of teachers to teach the way they were taught as learners (Fosnot, 1996; Kennedy, 1999; McCrea, 2012, p. 11). The endurance of traditional classroom practice derives in part from the fact that teachers are highly likely to teach in the way they themselves were taught (Kennedy, 1999, p. 55).

2.6.4 Key components of a constructivist classroom

Constructivism sees knowledge acquisition as a dynamic and social process in which learners actively construct meaning from their prior understandings and social setting (Prabha, 2010). According to Lorschach and Tobin (1997), constructivism asserts that knowledge resides in the learner and cannot be transferred from the head of teachers to the head of learners. The following tenets summarise key components of a constructivist classroom in context of Science and Technology teaching and learning processes (Bybee, et al., 2006; Weimer, 2013; Prabha, 2010; Brooks & Brooks, 1999):

a. Active involvement of the learner :

In the constructivist model, the learners are actively involved in their own process of learning. Learners' opinions and ideas are accepted and encouraged. Their experiences and voices are valued. They are allowed to ask questions, make mistakes and correct those mistakes. Focus is given on what learners are learning rather than what the teacher is teaching (Bybee, et al., 2006).

b. Learning based on learners' prior knowledge:

Learners come to the classroom with many experiences about their surroundings and natural phenomena, which may be correct or incorrect (Weimer, 2013; Prabha, 2010). Explanation of scientific phenomena from books is often different from their real life experiences. In a constructivist classroom this cognitive conflict of learners is appropriately handled by the teacher, who facilitates learners to reconstruct their knowledge by relating it to previous knowledge via asking open ended and probing questions or concept mapping.

c. Interactive and cooperative classroom environment:

Meaningful learning of Science and Technology cannot take place by just reading or memorisation of facts in the text books or just by listening to the lectures of a teacher. It requires real talk and interaction between the teacher and the learners (Prabha, 2010). Teacher creates interactive situations for understanding learners' concepts and then refines those concepts by asking questions, posing contradictions, engaging them in inquiries.

d. Process approach of learning:

In this approach a context is created by the teacher that helps his/her learners to become inquisitive learners and they are encouraged to generate tentative hypotheses, making observations, collecting data and drawing conclusions (Weimer, 2013). They may reject

some observations and accept other observed information to arrive at a correct conclusion on their own under the guidance of a facilitator of learning i.e. the teacher. The process of learning science is more emphasized than the product of learning science.

e. Democratic classroom:

Democratic environment in a constructivist classroom is maintained by sharing the responsibility in learning and decision making between the teacher and the taught (Weimer, 2013). Learners are directly involved in all activities of the classroom. The teachers encourage their learners to ask and share their ideas and thoughts freely. Learners and the teacher together, develop teaching aids and materials (Prabha, 2010). The teacher controls the class indirectly by ensuring active participation of all learners in classroom activities.

According to Brooks and Brooks (1999), in a constructivist classroom, the teacher searches for learners' understandings of concepts, and then structures opportunities for learners to refine or revise these understandings by posing contradictions, presenting new information, asking questions, encouraging research, and/or engaging learners in inquiries designed to challenge current concepts. Duffy and Cunningham (1996) explain that constructivism has come to serve as an umbrella term for LCT approaches and hence the key concerns of constructivism are (a) learning is an active process of constructing rather than acquiring knowledge and (b) instruction supports construction of knowledge but not communication of knowledge. This indicates that constructivism could be a suitable theory to explain the underlying theory for learner-centred teaching (LCT).

2.7 Conceptual Framework

In this study, Bybee's, et al., (2006) BSCS 5Es instructional model has been used as a conceptual framework for analysing the Science and Technology lecturers' classroom practices as well as data from individual interviews. The model is an instructional model based on the constructivist approach to learning, which says that learners build or construct new ideas from their old ideas.

According to literature (Bybee et al. 2006; Coulson, 2002) the Biological Sciences Curriculum Study (BSCS), a team whose principal investigator was Roger Bybee developed an instructional model for constructivism, called the 5Es. The BSCS team adapted the learning cycle described by Atkin and Karplus (1962). Their model was used in the elementary school program Science Curriculum Improvement Study (SCIS) developed at the Lawrence Hall of Science in Berkeley, California. Thus the BSCS 5Es instructional model builds on the works of other instructional models and is supported by current research on learning (Bybee, et al., 2006).

Briefly, the 5Es learning cycle begins with the active engagement of learners in investigating the natural phenomena. During exploration, the teacher acts as a facilitator, providing materials and directions, guiding the physical process of experiments. After the exploration, the teacher promotes a discussion period in which learners share their observations with classmates. This is the time in which the teacher connects learner experiences to the target Science and Technology concepts including the identification of scientific vocabulary. Once the concepts have been labeled, learners engage in additional

activities in which they apply or extend their recently formed understandings to new situations (Settlagh, 2000, p. 43–50). The BSCS has a long history of developing curriculum materials that reflect the most recent research about learning and teaching (Marek & Cavallo, 1997; Musheno & Lawson, 1999). The 5Es inquiry model aims to promote curiosity and elicit prior knowledge, provide shared experiences to explore concepts and allow opportunities for new understandings to be applied to different contexts (Bybee et al. 2006).

According to Bybee (2013), the BSCS 5Es learning model is an evidence-based approach, effective in guiding teaching and learning of science because it supports active, constructivist learning; learners draw on their prior knowledge, pose questions, participate in hands-on experiences, and conduct exploratory and formal investigations, to develop their own explanations about scientific phenomena (Marek & Cavallo, 1997; Musheno & Lawson, 1999). Learners are given opportunities to represent and re-represent their developing understanding using literacy skills. They are actively engaged in the learning process. Learners develop science inquiry skills and an understanding of the nature of science. Bybee (2013) hints that each phase of the 5Es has a specific function and contributes to the teacher's coherent instruction and the learners formulating a better understanding of scientific and technological knowledge, attitudes, and skills. The model has been used to help frame the sequence and organisation of programs, units, and lessons.

The researcher, therefore, chose Bybee's BSCS 5Es learning model as a lens for this study because it emphasises on what learners have to do to construct knowledge, which in turn suggests the sort of learning activities that teachers need to address in order to lead learners

to achieve the desired learning outcomes. Furthermore, Bybee's, et al., (2006) choice of key concepts in LCT and in the transformation from teacher-centred to LCT is useful in understanding the classroom practices of LCT methods. The learning cycle model provides a comprehensive basis for analysing teachers' learner-centred teaching (LCT) classroom practices by indicating classroom aspects that can help the researcher to identify whether the design (and redesign), development, implementation and assessment of a learning process focuses on LCT philosophy/ methods.

Bybee's, et al., (2006) BSCS 5Es learning model is based on Bruner's (1966) constructivist theory of learning (Lawson, 1995). Scharmann (1991: p.100-104) conducted a descriptive study to investigate the role of the 5Es learning cycle as a tool for identifying and addressing misconceptions. The author stresses the necessity of using minds-on as well as hands-on activities in the exploration phase. Activities described as minds-on included the use of analogies, the formation of opinion statements, and the formation of independent decisions.

Several comparative studies suggest that the BSCS 5Es instructional model is more effective than alternative approaches at helping learners master science subject matter (e.g., Akar, 2005; Coulson, 2002). Coulson (2002) also explored how varying levels of fidelity to the BSCS 5Es model affected learner learning. Coulson found that learners whose teachers taught with medium or high levels of fidelity to the BSCS 5Es instructional model experienced learning gains that were nearly double that of learners whose teachers did not use the model or used it with low levels of fidelity. Some findings indicate that the BSCS 5Es instructional model had a positive effect on scientific reasoning (Boddy, et al., 2003)

and on interest and attitudes toward science (Akar, 2005; Boddy et al, 2003; Tinnin, 2001). In his research, Lawson(1995) supports the effectiveness of the 5Es learning cycle in encouraging learners to think creatively and critically, facilitating a better understanding of scientific concepts, developing positive attitudes toward science, improving science process skills, and cultivating advanced reasoning skills.

Bybee's, et al., (2006) 5Es learning model suggests that learners construct knowledge and meaning from experiences. In a Science and Technology classroom, constructivism requires the teachers to build inquiry, exploration, and assessment into their instructional approaches. The teacher plays the role of a facilitator, guiding learners as they learn new concepts.

The 5Es learning cycle is a hands-on and minds-on teaching strategy that makes learners aware of their own reasoning by helping them reflect on their activities (Bybee, et al., 2006). Thus, the 5Es fit well with Science and Technology which is a practical subject and has to be taught using both hands-on and minds-on teaching strategies. This makes the 5Es fit well as a lens for data analysis in this study. Once learners become aware of their own reasoning and apply new knowledge successfully, they are more effective in searching for new patterns. The 5Es learning model augers well with the LCT philosophy which emphasises on the learner and learning. Bybee's 5Es learning cycle is a constructivist model for planning and implementing science lessons in the classroom. This model embraces personal and social constructivist learning emphases (Yore, et al., 2005). Investigating scientifically, with an emphasis on science inquiry skills, is embedded in the cycle, as are diagnostic, formative and summative assessment practices.

The 5Es learning cycle require teachers' and learners' roles that contrast with those found in more conventional science teaching and learning classrooms. Harlen (2009) has identified these roles in her conceptualisation of a pedagogy, which she argues will achieve scientific literacy outcomes for learners. Her pedagogy draws on four different perspectives that have emerged from research about effective science learning. These are a personal and socio-cultural constructivist perspective, a discussion, dialogue and argumentation' perspective, an inquiry perspective and a 'formative use of assessment' perspective. Hence, the choice of Bybee's, et al., (2006) BSCS 5Es learning model as a conceptual framework.

2.8.The BSCS 5Es Instructional Model

2.8.1 Bybee's BSCS 5Es Instructional Model

Bybee's, et al., (2006) BSCS 5Es instructional model provides a built-in structure for creating a constructivist classroom. It sequences learning experiences so that learners have the opportunity to construct their understanding of a concept over time. The model describes a teaching sequence that can be used for an individual lesson. The BSCS 5Es instructional model plays a significant role in the curriculum development process as well as the enactment of curricular materials in Science classrooms. Bybee's, et al., (2006) 5Es learning model has been designed to incorporate all Science and Technology aspects of inquiry learning environments by engaging learners and allowing them to explore the concepts being introduced, discover explanations for the concepts they are learning, and elaborate on what they have learned by applying their knowledge to new situations. Throughout the process the model offers multiple opportunities for evaluation of learners'

understanding. Thus, Bybee's et al. (2006) 5Es learning model describes the phases of an LCT lesson.

In trying to make sense of phenomena learners use both their prior experience and the first-hand knowledge gained from new explorations. The structure of the learning environment should promote opportunities and events that encourage and support the building of understanding. Bybee, et al. (2006) successfully devised a model of LCT classroom practices based on five components: engagement, exploration, explanation, elaboration and evaluation. The researcher now illustrates how the 5Es are implemented across lessons in the following paragraphs;

a) Engagement: Bybee, et al. (2006) argues that the purpose for the engagement stage is to capture (pique) learners' interest, make them curious about the topic and concepts and get them personally involved in the lesson, while pre-assessing prior understanding. In this stage, the learners first encounter and identify the instructional task/activity. Here they make connections between past and present learning experiences, lay the organisational ground work for the activities ahead and stimulate their involvement in the anticipation of these activities. For example, asking questions, defining a problem, showing a surprising event and acting out a problematic situation are all ways to engage the learners and focus them on the instructional tasks.

The teacher or a curriculum task assesses the learners' prior knowledge and helps them become engaged in a new concept through the use of short activities that promote curiosity and elicit prior knowledge. The activity should make connections between past and present learning experiences, expose prior conceptions, and organise learners' thinking toward the

learning outcomes of current activities. This stage provides the opportunity for teachers to find out what learners already know or think they know about the topic and concepts to be developed. It also gives each learner the opportunity to consider what his or her current ideas and thoughts about the topic are. The engagement phase enables teachers to invite learners to raise their own questions about concepts or ideas and express what they know or think about a concept or topic. The teacher encourages learners to compare their ideas with those of others, and assesses what learners do or do not understand about the stated outcomes of the lesson.

The learners express their current understanding of a concept or idea. In this phase Bybee, et al. (2006) proposes that a teacher should take into consideration learners' prior knowledge when planning a lesson. However, in the researcher's view this could pose a great challenge more especially in situations where the class is very big. In other words, precisely how the learner's ideas can be taken into account in planning suitable restructuring activities is a cause for concern. In principle the suggestion that teachers should plan activities on the basis of what the learner already knows and understands seems like an obvious way to proceed. The problem comes in with the sheer practicality of attempting to do that with a class of 30 or more learners (the case of Malawi). Even if the teacher has adequate information about the learners' initial ideas, according to the researcher, attempting to respond to their individual ideas can become an impossible exercise in classroom management.

b) Exploration: The learning experiences at this stage provide learners with a common base of activities within which current concepts (i.e., misconceptions), processes, and skills

are identified and conceptual change is facilitated. Learners may complete activities that help them use prior knowledge to generate new ideas, explore questions and possibilities, and design and conduct a preliminary investigation. During this phase, learners actively explore the new concept through concrete learning experiences. They might be asked to go through the scientific method and communicate with their peers to make observations. This phase allows learners to learn in a hands-on way.

In this stage learners have the opportunity to get directly involved with phenomena and materials. They investigate the nature of scientifically testable questions. Learners engage in short readings and generate their own set of testable questions. The lesson provides a common set of experiences within which learners can begin to construct their understanding. By involving themselves in these activities learners develop a grounding of experience with the phenomenon. As they work together in teams, learners build a base of common experiences which assist them in the process of sharing and communicating. The teacher acts as a facilitator, providing materials and guiding the learners' focus. The learners' inquiry process drives the instruction during an exploration. In this case the teacher's role is to encourage learner-to learner, learner to teacher and learner to materials interactions; observe and listen to the learners as they interact amongst themselves and with the materials; ask probing questions to help learners make sense of their experiences and provide time for learners to puzzle through problems.

c) Explanation: The explanation phase focuses learners' attention on a particular aspect of their engagement and exploration experiences and provides opportunities to demonstrate their conceptual understanding, process skills, or behaviours. This phase also provides

opportunities for teachers to directly introduce a concept, process, or skill. Learners explain their understanding of concepts. An explanation from the teacher or the curriculum may guide them toward a deeper understanding. This is a teacher-led phase that helps learners synthesise new knowledge and ask questions if they need further clarification. For this phase to be effective, teachers should ask learners to share what they learned during the engagement as well as the exploration phases before introducing technical information in a more direct manner. This is also when teachers utilise videos, computer software, or other aides to boost understanding. The explanation phase provides opportunities for learners to connect their previous experiences with current learning and to make conceptual sense of the main ideas of the concepts/lesson. This stage also allows for the introduction of scientific terms, and content information that might make learners' previous experiences easier to describe. This stage is the point at which the learner begins to put the abstract experience through which she/he has gone into a communicable form.

d) Elaboration: In this stage teachers challenge and extend learners' conceptual understanding and skills. Through new experiences, the learners develop deeper and broader understanding, more information, and adequate skills. Learners apply their understanding of the concepts to the world around them by conducting additional activities. They apply or extend/expand on previously introduced concepts and experiences to new situations. Teachers may ask learners to create presentations or conduct additional investigations to reinforce new skills. This phase allows learners to cement their knowledge before evaluation. The learners make connections to other related concepts and conceptual connections between new and former experiences; use scientific terms and descriptions; and communicate their understanding to others. Learners use what they have learned to

explain a new object, event, organism, or idea. They communicate their understanding to others.

e) Evaluation: The purpose for evaluation is for both learners and teachers to determine how much learning and understanding has taken place. Evaluation is an on-going diagnostic process that allows the teacher to determine if the learner has attained understanding of concepts and knowledge. Evaluation and assessment can occur at all points along the continuum of the instructional process. This phase allows for both formal and informal assessment. During this phase, teachers can observe their learners and see whether they have a complete grasp of the core concepts. It is also helpful to note whether learners approach problems in a different way based on what they learned. Other helpful elements of this phase include self-assessment, peer-assessment, writing assignments, and exams.

The teacher observes and records as learners demonstrate their understanding of the concepts and performance of skills. He/she provides time for learners to compare their ideas with those of others and perhaps to revise their thinking. He/she interviews learners as a means of assessing their developing understanding and encourages them to assess their own progress. This phase encourages learners to assess their understanding and abilities and provides opportunities for teachers to evaluate learner progress towards achieving the lesson/curriculum objectives. This phase only provides a “snapshot” of what the learners understand and how far they have come from where they began. In reality, the evaluation of learners’ conceptual understanding and ability to use skills begins with the engagement stage and continues throughout each stage of the instructional model. When combined with

the learners' written work and performance of tasks throughout the lessons, however, the evaluation phase provides a summative assessment of what learners know and can do.

McCombs and Miller, (2007) observe that teachers in learner-centred classrooms interweave evaluation in the learning process. They demonstrate what they understand about the concept(s) and how well they can implement a skill. They compare their current thinking with that of others and perhaps revise their ideas. The learners assess their own progress by comparing their current understanding with their prior knowledge. They ask new questions that take them deeper into a concept or topic area. In a learner-centred teaching (LCT) environment, the processes and purposes of assessment shift from only assigning grades to include constructive feedback and to assist with improvement (Weimer, 2013). LCT uses assessment as a part of the learning process. Assessment activities should be used to promote learning and to develop self and peer-assessment skills in learners.

2.8.2 How the BSCS 5Es learning model has been used as a conceptual framework in this study

In using the elements of Bybee's, et al., (2006) 5Es learning model as a framework, the researcher examined TTC Science and Technology lecturers' understanding and classroom practices of LCT methods in order to determine how the (LCT) approaches are used. Mushi (2004) notes that effective implementation of LCT will be determined by the lecturers' understanding of the approaches and their pedagogical motivation to engage learners in the instructional practices. The researcher used the 5Es learning model as a lens to determine the extent to which LCT is practiced in the classroom and the form of learner-centred teaching existing in teacher training colleges (TTCs).

The 5Es learning model as a conceptual framework was used to answer the following research questions;

1. What are the classroom practices of TTC Science and Technology lecturers?
2. Why do they choose those classroom practices?
3. How do such classroom practices show the learner-centredness of the lessons?

2.9 Key lessons from literature review

According to literature, learner-centred teaching (LCT) is practiced all over the world (O’Sullivan, 2004; Vavrus, 2009). Many authors and researchers believe it promotes deep and lifelong learning in learners if well implemented (Schweisfurth, 2011). Hockings (2009) mentions a number of studies (Lonka & Ahola, 1995; Hall & Sanders, 1997; Cannon & Newble, 2000; Honkimaki, et al., 2004 in Hockings, 2009) that have shown that learner-centred learning encourages deep learning that is associated with searching for meaning in the task and the integration of task aspects into a whole (Beausaert, et al., 2013, p. 2). It is also said that learners develop critical thinking skills and become autonomous. To achieve these traits in learners, they must be actively involved and engaged in the learning process (Weimer, 2013). Learners must be seen as contributors of knowledge and learning partners. There must be learner-learner, learner-teacher and learner-content interactions (Weimer, 2013). In developing countries Malawi inclusive LCT has been sponsored by international aid agencies (Sriprakash, 2010).

Literature also indicates that too few countries in Africa as well as outside the continent have successfully implemented LCT approaches in the classroom (Schweisfurth, 2011). In other words, majority have failed to transform the traditional classrooms into LCT

classrooms. This observation is supported by Schweisfurth (2011) who warned that while LCT approaches are seriously encouraged by its proponents, their implementation have mostly failed. There are studies (Herington & Weaven, 2008) that explored how more LCT methods encouraged deeper learning and self-regulated learning behaviours but found out that whilst the LCT methods motivated the learners' participation in the classroom it did not prove that any deeper learning style had been achieved.

Some have described learner-centred instruction as *tissue rejection* (Harley, *et al.*, 2000) meaning failure to implement it. Teachers have been unable to make the paradigm shift for a myriad of reasons some of which are detailed in this study, including the fact that some teachers predominantly embrace the form rather than the philosophy of the learner-centred approach.

In developed countries such as the United States of America (USA) and most European countries, LCT approaches are practiced to a large extent as compared to several developing countries (Metto & Makewa (2014). However, Sablonnière, *et al.* (2009) observed that in Western societies, teachers and learners have experienced both teacher-centred and learner-centred approaches. Some scholars and researchers believe that there are situations that teachers may think that they are using LCT methods but in reality, they are still using teacher centred pedagogies (Ebert-May & Derting, 2011). Against this background teachers should, therefore, be given continuing training for the benefits of LCT.

In countries where LCT has taken root to a larger extent such as the United States, Canada and the European Union considerable amounts of resources are spent to promote learner-

centred teaching (LCT) classroom practices at all levels of education. Mohammed and Harlech-Jones (2008) report that some professionally trained teachers are not able to apply LCT they learned because of the reality of the schools.

2.10 Chapter summary

In summary, LCT could be conceptualised as an instructional approach that focuses on helping learners to construct understanding of concepts and principles using their prior knowledge and experiences from their day to day life. Effective dialoguing, learners' engagement and active participation in the classroom processes become the defining features of LCT practices. This means that effective LCT classroom practices should result in the learners' knowledge construction. Learners should be involved in activities which stimulate creativity, critical thinking, and problem solving skills. Therefore, the researcher makes a case that in order to promote learners' participation in knowledge construction; much attention should be focused on how teachers understand LCT and its implications for classroom processes.

Teachers' classroom practices should not only be reflected by learners' participation, they should also engage learners in the instructional practice /knowledge construction using their diverse experiences. Learners' active engagement in a lesson does not guarantee their learning i.e. knowledge construction. Learning objectives will be realised by active collaboration between the teacher and learners whereas learners are promoted to make sense of the topic using their prior knowledge and varied instructional experiences.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

3.1 Chapter overview

In the following sections the researcher discusses the research design, the procedures used to identify the respondents, data generation instruments and process as well as the plan for data analysis.

3.2 Research Design

Design of a study is an advanced plan showing how data will be generated and analysed, including the techniques that will be used for data analysis (Kothari, 2004; 2008). Creswell (2013) identifies three main research designs which can be used in any scientific research. These are quantitative, qualitative and mixed methods research designs.

Quantitative research is an approach for testing objective theories by examining the relationships among variables (Creswell, 2013). These variables, in turn, can be measured, typically on instruments, so that numbered data can be analysed using statistical procedures. The question format for quantitative design is close ended. Close-ended questions seek for specific answers. A qualitative research is an approach for exploring and understanding the meaning individuals or groups ascribe to a social or human problem (Creswell, 2013). The process of research involves emerging questions and procedures, data typically generated in the respondent's setting, data analysis inductively building from

particulars to general themes, and the researcher making interpretations of the meaning of the data. The instruments used are more flexible, iterative style of generating and categorising responses to questions asked by the researcher (Creswell, 2013), that is data generation and research questions are adjusted according to what is learned during the study. Semi-structured methods are used. Qualitative research questions and data tend to be open-ended without predetermined responses. This allows the respondents to talk more about the phenomena under study. In qualitative research, the researcher becomes the main instrument for data generation and analysis (Creswell, 2013).

A mixed methods research is an approach to inquiry involving generating both quantitative and qualitative data, integrating the two forms of data, and using distinct designs that may involve philosophical assumptions and theoretical frameworks (Creswell, 2013). The core assumption of this form of inquiry is that the combination of qualitative and quantitative approaches provides a more complete understanding of a research problem than either approach alone (Creswell, 2013).

3.3 Design of this study

According to Babbie and Mouton (2008), a qualitative research approach is related to phenomenology or interpretivism. In this study, the researcher adopted an interpretivist qualitative research design in order to obtain an in-depth information and also to develop a holistic understanding of the perceptions, experiences and practices of 8 TTC Science and Technology lecturers during their interactions with learners and the Science and Technology curriculum as they implemented LCT methods in their classrooms (Cohen, et al., 2011; Creswell, 2007). This involved generating different but complementary data

from respondents on classroom practices in Science and Technology. According to Denzin and Lincoln (2003) an interpretive qualitative research is naturalistic; it attempts to study the everyday life of different groups of people and communities in their natural setting; it is particularly useful to study educational settings and processes. Qualitative research involves an interpretive, naturalistic approach to its subject matter; it attempts to make sense of, or to interpret, phenomena in terms of the meaning people bring to them (Denzin & Lincoln, 2003). Naturalistic inquiry is a methodology that underscores the importance of first-hand observations to understand human action from the point of view of the actor in an uncontrived context (Guba, 1978; Guba & Lincoln, 2005; Schwandt, 2001).

Interpretive qualitative research employs a theoretical sampling strategy, where study sites, respondents, or cases are selected based on theoretical considerations such as whether they fit the phenomenon being studied, whether they possess certain characteristics that make them uniquely suited for the study, and so forth (Tuli, 2010). Convenience samples and small samples are considered acceptable in interpretive research as long as they fit the nature and purpose of the study. In some methods such as respondent observation, the researcher is considered part of the social phenomenon, and his/her specific role and involvement in the research process must be made clear during data analysis (Wellington & Szczerbinski, 2007).

Using interpretive qualitative methods in this study provided the researcher an opportunity for systematic reflection on the TTC Science and Technology lecturers' classroom practices. By using the interpretive approach, the researcher's aim was to uncover meaning

toward a better understanding of the LCT classroom practices. Interpretivism was a method that could provide the researcher with an insight to understand the lecturers' classroom practices by maintaining a view of pedagogy as an expression of the whole, and a view of the experiential situation as the common theme of real pedagogic acting (van Manen, 1990, p. 7). With an interpretivism perspective, the researcher tended to gain a deeper understanding of LCT and its complexity in its unique context instead of trying to generalise the base of understanding for the whole population (Creswell, 2007).

Through individual interviews and classroom observations, the LCT experiences of the TTC Science and Technology lecturers could be understood. Post lesson individual interviews and lesson observations, as the methods of investigation into the classroom practices of the TTC Science and Technology lecturers, allowed the respondents to express or display their classroom experiences, which in turn, allowed the researcher to uncover the essence of the classroom experiences (van Manen, 1990).

3.3.1 Understanding Interpretivism

Interpretivism refers to the approaches which emphasise the meaningful nature of people's character and participation in both social and cultural life (Elster, 2007; Walsham, 1995). It denotes that the methods of the research which adopt the position that people's knowledge of reality is a social construction by human actors, and so it distinctively rules out the methods of natural science (Eliaeson, 2002; McIntosh, 1997). It has its roots in the philosophical traditions of hermeneutics and phenomenology, and the German sociologist Max Weber (1864-1920) is generally credited with being the central influence. Interpretivists look for meanings and motives behind people's actions like behaviour and

interactions with others in the society and culture (Whitley, 1984). Similarly, cultures can be comprehended by studying people's ideas, thinking, and the meanings that are important to them (Boas, 1995).

Interpretivism is one form of qualitative methodology. It relies upon both the researcher and the human subject as the instruments to measure some phenomena, and is based on naturalistic approach of data generation such as interviews and observations (Schutz, 1967). Secondary data research is also popular with interpretivism philosophy (Elster, 2007). In the view of interpretivism, it is argued that value free data cannot be obtained, since the enquirers use their own preconceptions in order to guide the process of enquiry, and furthermore, the researcher interacts with the human subjects of the enquiry, changing the perceptions of both parties (Walsham, 1995). However, Lin (1998) explained that interpretivist researchers not only look for the presence or absence of a causal relationship, but also the specific ways in which it is manifested and the context in which it occurs. Thus, these researchers are able to go beyond from what has occurred to see how it has occurred (Kelliher, 2005; Lin, 1998). One advantage of interpretivism is that the researcher generates data which is seen as natural rather than artificial.

3.3.2 Interpretive research design

Interpretivism, by its nature promotes the value of qualitative data in pursuit of knowledge (Kaplan & Maxwell, 1994). In essence, this philosophical and research paradigm is concerned with the uniqueness of a particular situation, contributing to the underlying

pursuit of contextual depth (Myers, 1997). Interpretive research is recognised for its value in providing contextual depth (Perry, 1998; Eisenhardt, 1989).

The researcher used an interpretivist approach in order to learn from the TTC Science and Technology lecturers and real classroom situations regarding the lecturers' classroom practices in the face of the prevailing institutional constraints. Since qualitative research is primarily an exploratory research (Wyse, 2011), the researcher used it to gain an understanding of underlying reasons, opinions, and motivations behind the TTC lecturers' classroom practices as they implemented LCT. One advantage of the interpretive qualitative approach is that it provided a forum for respondents to express their diverse beliefs and views (Myers, 1997). In this study, an interpretive qualitative approach enabled the respondents to express in their own words or through their classroom behaviours how they perceived, understood and experienced LCT methods in their classrooms. The researcher selected the interpretive qualitative design in order to identify the pattern of interpretation and implementation of LCT methods.

3.4 Research Setting

At the time of this study (2016- 2022), there were 16 primary teacher training colleges (TTCs) in Malawi; 8 public and 8 privately owned. Four public and 3 privately owned TTCs were in the southern region, while 3 public and 2 private TTCs were in the central region, 1 public and 3 private TTCs were in the northern region. The distribution of the TTCs across the country has been tabulated in table 3.

Table 3: Distribution of TTCs in Malawi

Type of TTC	Geographical location		
	South	Centre	North
Public	4	3	1
Private	3	2	3
Total	7	5	4

The researcher conducted this study at Ophunzira Teacher Training College (OTTC), a public TTC in the southern region of Malawi. OTTC was selected for convenience purposes and was also the college of interest to the researcher. Teacher educators were targeted because they use learner-centred teaching (LCT) methods when teaching in the classroom; hence it was necessary to learn from them about their classroom practices.

3.5 Target Population

Borg, et al. (1996) define a target population as all the members of a real or hypothetical set of people, events and objects to which a researcher wishes to generalise the results of a study. The aim of this study was to obtain data that would enable the researcher to understand the learner-centred teaching (LCT) classroom practices in TTCs and how it is practiced despite the presence of institutional constraints. The target population for this study was TTC Science and Technology lecturers. Generally, it would not be feasible to involve the whole population of the TTC Science and Technology lecturers in the study. The Science and Technology lecturers from the teacher training colleges (TTCs) participated in this study because of their experiences in teaching and knowledge about LCT methods.

The researcher selected respondents who had experienced the phenomenon being researched (LCT classroom practices), and were willing to be observed and describe it in an audio recorded interview (Eddles-Hirsch, et al., 2012; Eddles-Hirsch, 2013). Thus, the researcher selected individuals who had significant and meaningful experiences of the LCT classroom practices being investigated to participate in the study (Creswell, 2007; Moustakas, 1994). Therefore, the researcher used a purposeful sampling strategy of selecting the respondents since they could understand learner-centred teaching; thus, the researcher decided whether respondents shared significant and meaningful experiences concerning the phenomenon under investigation.

3.6 Sampling technique

Gay (1987) defines sampling as the process of selecting a number of individuals for a study in such a way that the selected individuals represent the larger group from which the sample is taken. Ophunzira TTC was purposively selected as a research site because it had more than 5 lecturers teaching Science and Technology subject. This was because the researcher wanted to have a reasonable number of respondents from which data could be generated for research credibility and trustworthiness. Second factor considered when selecting Ophunzira TTC was that its staff had received training in learner-centred teaching (LCT) methods. Lastly considered was proximity of the research site. Due to financial constraints and time limitation the researcher selected a research site which was economically viable in terms of transportation costs. In this case the researcher purposively sampled Ophunzira TTC for the study.

According to Punch (2005), purposive sampling is a deliberate method in which a sample is drawn from the population in a deliberate or targeted way according to the logic of the research. Using a purposive sampling technique, the researcher selected the respondents using set criteria so that the sample would provide maximum insight and understanding of the study (Ary, et al., 2002). This method of sampling helped to create a homogenous sample of respondents that had all experienced the phenomenon- LCT. The researcher selected the sample based on personal judgment and the purpose of the research (Greig and Taylor, 1999; Schwandt, 2001), looking for those who have had learner-centred teaching(LCT) experiences being researched (Krueger, 1988).

Based on Punch's (2005) definition of purposive sampling only those lecturers with not less than five years teaching experience, received training in LCT methods and had a concentration in Science and Technology subject qualified as respondents (see appendix 4, p. 363). Creswell (2007) observed that respondents in a study need to be carefully chosen to be individuals who have all experienced the phenomenon in question, so that the researcher, in the end, can forge a common understanding.

The researcher used semi-structured questions (see appendix 4, p. 363) to interview 12 Science and Technology lecturers to find out about their profiles for selection purposes of individuals considered the best candidates to become respondents. Out of 12 lecturers, 2 did not qualify but were also not teaching Science and Technology at the time of this study. Two other lecturers qualified but were not teaching Science and Technology at the time of the study. Therefore, in total 4 lecturers were left out because they were not teaching Science and Technology at the time of the study. Thus, only 8 lecturers qualified as

respondents in this study. Boyd (2001) regards 2 to 10 respondents as sufficient to reach saturation. Based on the situation on the ground the researcher modified the criteria for picking the respondents (see table 6, page 149 for details). In the modified criteria respondents with the following characteristics qualified to participate in the study; Science and Technology lecturers with at least one year teaching experience, have had some knowledge in the subject, and have had at least one year teaching experience using LCT methods in their lessons. Table 4 shows the number of times each respondent was observed during the study period.

Table 4: Number of lessons observed per respondent during the study period

Research respondent	Number of times observed
Lecturer 1	2 lessons
Lecturer 2	3 lessons
Lecturer 3	3 lessons
Lecturer 4	4 lessons
Lecturer 5	3 lessons
Lecturer 6	3 lessons
Lecturer 7	6 lessons
Lecturer 8	5 lessons

3.7 Data generation procedures

Data generation represents a situation that researchers arrange in order to produce data

that they should find useful for subsequent data analysis given the stated research interest. Data generation emphasises on a researcher's intentional act to create situations that produce qualitative data.

3.7.1. Data generation methods

Being an interpretive qualitative research, the researcher used a number of data generation techniques. These included structured lesson observations, document analyses of lesson plans and schemes and records of work and pre- as well as post lesson observation interviews. The purpose of the interviews was for the respondents to describe the learner-centred teaching (LCT) classroom practices and experiences that several individuals engaged in (Marshall & Rossman, 2006). The researcher listened very carefully to the respondents' views and experiences in order to learn from them about the LCT classroom practices experienced in teaching Science and Technology in TTCs. The researcher asked some probing questions to explore further on some important ideas. The generated data were handwritten in a diary during the interview process and recorded electronically in the computer using Microsoft Word after each interview session.

Frequently, in interpretivist studies, multiple interviews are conducted with each of the respondents (Creswell, 2007). The researcher could start the interviews with a social conversation in order to create a relaxing and trusting atmosphere with the respondents (Moustakas, 1994). One of the challenges the researcher faced was to come up with suitable questions relevant for the study. Both supervisors' and Chancellor College School of Education staff members' comments and advice helped the researcher in editing and/or deleting some questions in order to correct the situation. Another challenge was that some

respondents did not provide detailed answers to the questions as is the case in an interpretivist study. This challenge was overcome through asking supplementary follow up or probing questions.

The researcher observed 29 Science and Technology lessons using a structured lesson observation guide (see appendix 6, p. 369). Isore, M (2009) hints that the most common data source of teachers' practices in real classroom settings is observation. Each lesson observation was either audio or video recorded. Both the research environment and classroom activities were video recorded. The researcher audio-recorded the interviews and took notes during the interviews (Legard, et al., 2003). This allowed him to pay full attention to the respondents and to engage in in-depth probes. There was also a smooth flow of discussions, as the interviewer did not have to write down the answers to the previous question before moving on to the next one.

In note-taking, a risk of bias arises, as the researcher is likely to make notes of comments which make immediate sense or are perceived as being directly relevant or interesting. Audio-recording ensures that the whole interview is captured and allows for complete data analysis later, so cues that were not taken cognisance of in the interview situation can be recognised when listening to the recording. Interviewees may also feel inhibited when the interviewer suddenly starts writing and the respondents wonder whether what they have mentioned was of interest (Hancock, 2002). This method allows a researcher to record interviews verbatim and with precision, as well as the language used by respondents, which includes their hesitations and tone, in more detail than when the researcher takes notes only. Audio-recording becomes a more neutral and less intrusive

way of recording the interview than note-taking, as note-taking gives respondents cues such as that they should slow down or pause if the researcher is writing or that they have said enough if the researcher is not writing (Legard et al., 2003)

The reason for video-recording the lecturers' classroom practices was to capture both the lecturer's and learners' classroom actions and behaviours which might have been missed out as the researcher jotted down data in the research diary during the lessons. One challenge faced by the researcher in this method of data generation was that he could at times misinterpret the respondents' classroom behaviours. This challenge was overcome by checking with or asking the concerned respondent if what the researcher had jotted down regarding the observed behaviour was correct. Later the data was entered in the computer using Microsoft Word software. In summary the researcher used multiple data generation methods in order to triangulate in this study to increase the possibility of obtaining credible and trustworthy data and drawing useful conclusions about the problem (Creswell, 2013; Silverman, 2004; Hammersley, 2003). Table 5 is a summary of the methods, sources of data and the type of data the researcher sought.

Table 5: Research methods, data source and type of data sought

Research Method	Data source	Type of data sought
Lesson observation	TTC Lecturers	Textual data
Post lesson observation interviews	TTC Lecturers	Textual data

Pre lesson observation	TTC Lecturers	Textual data
interviews		
Document analysis	Lesson plans, schemes and records of work.	Textual data

3.7.2 Data generation instruments

Data generation instruments refer to devices used to generate data such as interview guides, tests, structured interview schedules and checklists (Polit, et al., 2001). Pre lesson observation semi-structured questions, lesson observation guide and post lesson observation interviews guide were used as data generation instruments in this study.

3.7.2.1 Pre-lesson observation individual interview guide

In order to gain knowledge about each respondent's perceptions, views, understanding and experiences about learner-centred teaching (LCT) classroom practices, the researcher used a pre lesson observation interview guide with each one of them (respondents). The pre-lesson observation individual interview guide consisted of several key questions that helped to define the areas to be explored in the study (see Appendix 1, p. 359). The semi-structured interview guide allowed the interviewer to pursue the responses in more details in order to gain a deeper understanding of the respondents' LCT classroom practices and experiences. It helped to get the views and perceptions of teacher educators on their classroom practices of LCT methods in Science and Technology teaching (research questions 1, 2 and 3, p. 26). The researcher used an interview guide to keep the interview focused on specific issues in order to get the expected results.

The goal of an interpretive qualitative research is to understand and describe an experience of a phenomenon. The Science and Technology lecturers who participated in the research as respondents were individually interviewed to get their views and opinions about their teaching experiences of LCT approaches and implementation (see appendix 1 for the interview guide). The researcher conducted the interviews before the lesson observations exercise began. Interviews are one of the most important sources of information. In an open-ended interview, key respondents are asked to comment about certain ideas. Giorgi (1997) stated that *questions are generally broad and open ended so that the respondent has sufficient opportunity to express his or her view point extensively, which reflect a general approach*. Individual interviews were necessary as the researcher wanted to find out what was in the mind of a respondent.

3.7.2.2 Structured lesson observations guide

In this study, the researcher generated data mainly through structured observations of lessons. Specifically, the researcher explored the lecturers' classroom practices. Features of learner-centred teaching (LCT) classroom practices have been suggested by the framework- Bybee's 5Es learning model (see sections 2.7 and 2.8, p. 87 and 91 respectively).

Lesson observation method has the advantage of directly evaluating learners' involvement and engagement in the learning environment and with the learning activities. As Berra (2010) puts it, *You can observe a lot just by watching*. By watching the learners in different instructional practices (class discussions, group work, active learning exercises, or

discussion forums), the researcher could explore how the learners learned - how they interpreted and made sense of the lessons, where they stumbled, what they did when they did not understand the material, and so on. The researcher used the first two weeks of the study for informal structured observations in order to develop an understanding of the general setting for the study. The researcher observed the physical arrangement of the classrooms and laboratories, Science and Technology lessons deliveries, the lecturers and learners, and interactions between the learners and the lecturers and amongst the learners themselves. During the informal lesson observations exercise, each respondent was observed twice.

The researcher was guided by the following lesson aspects in the lessons observation exercise; the classroom environment, lessons presentation, how learner-centred teaching (LCT) approaches were used, learner empowerment, the selection of classroom practices to construct knowledge according to the learners' needs, the use of formative assessment in classroom activities (Weimer, 2013; Blumberg and Pontiggia, 2011; McCombs and Miller, 2007), the classroom practices mostly used, if knowledge was mostly constructed or transmitted, the place of formative assessments, and the classroom roles of both the learners and the teacher. These elements align well with the 5Es learning model-framework of this study (see section 2.8, p. 91)

The researcher recorded first impressions in the researcher's journal, and no formal lesson observations summaries were recorded at this time. Using the same structured observation guide as used in the informal observations, the researcher began data generation activities in the third week of the study. The lessons observation guide had some indicators to

measure the learner-centredness of each lesson. Through structured lesson observations, the researcher was able to record events and activities by looking at them rather than just asking the respondents. During the first formal lessons observation, the researcher recorded in the researcher's journal everything that had been happening in the lessons in order to establish a starting point. The lessons observation stage was guided by the following research questions; What are the classroom practices of TTC Science and Technology lecturers? How do such classroom practices show the learner-centredness of the lessons?

The respondents themselves determined the time available for the classroom observations. The researcher gave them freedom to choose whichever class and topic they wanted to teach and be comfortable to be observed. Thus, the lecturers determined the appointments. The only thing asked of them was that the period after the lesson observation be a free period to enable a post lesson interview/discussion on what had been observed. Generally, the time available for each lesson was about 60 minutes as specified in their timetable. The main aids to the structured lesson observations were lesson observation guide, video/audio recordings of the lessons observed and post lesson interviews respectively and field notes of the activities of the respondents.

The researcher's initial plans were to observe 6 lessons for each respondent to ensure large amount of data was generated. This implies that there would be a total number of forty eight lesson observations for the whole study period. However, in practice due to unforeseen circumstances, the researcher observed 2 to 6 lessons only per respondent for the whole research period. This was due to respondents' excuses and interruptions such as college activities, workshops, etc which required the presence of the same lecturers. Due

to time limitation factor (the academic term was coming to an end- learners were supposed to go into the primary schools for teaching practice), it was not possible to find catch up time with the lecturers who were absent during the data generation period. Lecturers 7 and 8 never missed their lessons as a result they were observed in more lessons than the rest. However, the differences in number of lessons observed did not have negative implications for the study findings because the lecturers' classroom practices were more or less the same (see appendices 10 and 11, p. 488 and 766 respectively). In other words, a careful analysis of the classroom observation data indicated that lessons delivery procedures among the 8 lecturers were similar. So total number of lessons observed per respondent had no effect on the results of the study.

The researcher began the data generation exercise on 7th January 2019 and stopped on 1st March, 2019. Class visits were made on a weekly basis for data generation. The researcher's plan was to observe a maximum of 2 lessons for a respondent (lecturer) in a week. This type of observation would be much focused. The researcher focused more on how the lecturers facilitated classroom activities and what the learners said and/or did in response. The researcher noted that in the process respondents displayed the same classroom practices in different lessons, i.e. respondents displayed the same behaviours in different lessons. This was a sign that data saturation point had been reached.

3.7.2.3 Post lesson observation interviews guide

The post lesson observation interviews were guided by the following research questions;

- a) What are the classroom practices of TTC Science and Technology lecturers?
- b) Why do they choose those classroom practices?

The researcher used post lesson interviews guide with the respondents for purposes of clarifications and to establish the reasons for certain behaviours observed during lesson deliveries. This helped the researcher not to end up with wrong conclusions from the lessons observations. In an interpretivist study, the in-depth interview transcript forms the basis of the data. The researcher uncovered the invariant structures or essences of the LCT classroom practices through the respondents' descriptions of the same. Data was generated through individual in depth interviews, carried out in the respondents' classrooms (Eddles-Hirsch, et al., 2012; Eddles-Hirsch , 2013).

At the start of the interviews the researcher reminded the respondents that they could leave the interview process at any time without fear of negative reprisals from the researcher. All interviews in this study were audio recorded and transcribed verbatim. The reason was that the researcher aimed at capturing a large amount of data from each respondent within a short time. Questions in the interviews were concerned with the respondents' perceptions and experiences of LCT classroom practices. The questions devised for this study were intentionally open-ended in order to give the respondents the opportunity to voice their own thoughts and opinions about LCT and classroom behaviours. The use of bracketing by the researcher throughout the interview process further contributed to the process of gathering information from the respondents perspectives (Gearing, 2004).

3.8 Piloting the data generation instruments

The researcher did piloting at Kafoto TTC to try out the research tools, techniques and methods to see how well they could work in practice (Blaxter, et al., 2001). A pilot test is vital to the data generation tools' success, credibility and trustworthy (Cohen, et al. 2011).

3.8.1 Piloting the pre- and post lesson interview guides

Before the main data generation exercise, the researcher tested questions meant for the pre- and post lesson observation interviews. Data generation exercise for the pilot study took place from 5th July 2018 to 27th July, 2018. This included pilot site identification, conducting interviews for selection of respondents, pre lesson observation interviews, unstructured lesson observations and post lesson observation interviews with the respondents.

In this study, piloting the pre- and post lesson interview guides was done to check their validity which Gay (1987) defines as the degree to which an instrument measures what it is supposed to measure. This assisted the researcher to check if there were any problems or misunderstandings with the interview guides which might have affected the results. The pilot study involved 4 respondents who comprised 3 male and 1 female Science and Technology lecturers.

3.8.2 Piloting the classroom observation guide

Since classroom observation was another data generation method, the researcher conducted a pilot study on classroom observation in order to have a feel of the lecturers' LCT classroom practices. During the pilot study an unstructured lesson observation was used. An unstructured lesson observation is used to understand and interpret cultural behaviours. It is based within the interpretivist or constructivists paradigm that acknowledges the importance of context and the construction of knowledge between the researcher and the researched.

By using an unstructured lesson observation, the researcher did not follow the approach of strictly checking a list of predetermined behaviours such as would occur in structured observations. Instead, the researcher entered the field with no predetermined notions as to the discrete behaviours to be observed. The researcher might have some ideas as to what to observe, but these might have changed over time as data was gathered and experience gained in the particular setting. In an unstructured observation the researcher may adopt a number of roles from complete respondent to complete observer, whereas in structured observation the intention is always to stand apart from that which is being observed. An unstructured observation:

- a) Provides insight into interactions between dyads and groups
- b) Illustrates the whole picture
- c) Captures context/process
- d) Informs about the influence of the physical environment

During the pilot study, the researcher conducted the unstructured observations of Science and Technology lessons to understand the lecturers' classroom practices as they implemented learner-centred teaching (LCT) methods; for example, how they facilitated learners' learning, engagement with their learners and how learners interacted with each other, their lecturers and the content. The researcher had Bybee's, et al., (2006) 5Es learning model as a framework at the back of his mind.

3.8.3 Analysing the pilot study data

The questions were open-ended and required respondents to use their own words in answering them. The researcher analysed the pilot study data following the same procedures that were to be used in analysing the main data (section 3.10, p. 125). For example, after generating the data, the researcher read or studied the responses and the textural information and grouped them according to the message that they portrayed. Thereafter, the grouped responses and information were coded using Bybee's 5Es learning model and processed using Microsoft Office Word.

3.9 How the pilot study assisted the researcher

The researcher conducted a pilot study to test the suitability of the data generation items as well as the procedures. In section 3.9.1 the researcher will explain how the pilot study assisted him.

3.9.1 Individual interview questions

The researcher modified the individual interview guide by refining some question items. The researcher ensured that the questions provided valid responses to the research questions. For example, the questions "Do you use LCT? How? When? Why not? What challenges? What benefits? What form does it take? Should LCT methods be applied in teaching Science and Technology ? Why?" in the pre lesson observation guide were combined to come up with the following question "Can you describe to me about your LCT classroom practices?" (Appendices 1 and 9, p. 359 and 485 respectively).

A few questions were added, for example, in appendix 2, p. 359- post lesson observation guide, the following questions were added;

You defined the following concept.....

Why didn't you bring an example or drawing of the

The topic XXXX was taught with/without any teaching and learning resources, can you explain that?

Some questions were modified because they asked the same thing as previous ones. The questions; 'what is your perception about implementing LCT methods? and what is your experience of learner-centred teaching (LCT) classroom practices? looked similar since both required the respondent to express about his/her experiences of LCT. These were modified and edited to become "Can you describe to me about your LCT classroom practices?"

The pilot study assisted the researcher to notice that some questions were difficult to answer. The evidence was that respondents gave irrelevant information or did not attempt them at all. The possible reasons might be that either the questions were too difficult or too ambiguous to answer. Therefore, the researcher either edited or removed them completely. For example, "how motivated have you been to use LCT methods? and what motivates you to use LCT methods? " were combined and improved to be "Describe the reasons for the choice of your classroom practices. Modifying the post lesson interview guide helped to align the question items with the aims of this study.

Generally, the results from the pilot study indicated that a few number of the pre and post lesson observation questions were irrelevant or inadequate for the study and unable to get the expected responses from the respondents. Some respondents did not give clear explanations or adequate information about their LCT experiences or reasons for their choice of their classroom practices. The pilot study helped the researcher to assess the approaches and practiced the necessary techniques required for the main study. Thus, the results of the pilot study helped and guided the researcher to plan thoroughly for the main data generation exercise.

Generally, the results from the pilot study indicated that the interview guide was able to get the expected responses from respondents. A pilot study was necessary and useful in providing the groundwork in the research project. It was a learning ground for the actual data generation exercise. It was conducted to identify potential problem areas and deficiencies in the research instruments and protocol prior to implementation during the full study. It helped the researcher to become familiar with the procedures in the protocol, and also helped him decide between two competing study methods, such as using classroom observation rather than individual interviews only.

3.9.2 Lesson observation guide

The pilot study helped the researcher to assess the research approaches in order to practice the necessary techniques required for the main study. It gave him an indication that the main study would work. Unlike in the pilot study, a lesson observation guide was necessary

in the main study to lead the researcher about what to look for in all the lessons to be observed (appendix 6, p. 369).

3.10 Analysing main data

This study generated a large amount of data in the form of qualitative textual as well as audio and/ or video information through interviews and classroom observations. After the researcher had transcribed each interview and lesson observation audio or video recordings, he then read and reread and culled the data for like phrases and themes that were then grouped to form clusters of meaning (Creswell, 2013). Through this process the researcher constructed the universal meaning of the situations or experiences and arrived at a more profound understanding of the lecturers' classroom practices and the reasons why they chose such classroom practices. In other words formulation of meanings followed from the significant statements and phrases.

The researcher studied the generated data to identify the respondents' LCT classroom practices and experiences in lesson deliveries and the key features that emerged from the individual interviews. The researcher analysed the data by reducing the information to significant statements or quotes and combined the statements into themes. The researcher analysed the data basing on the indicators to depict the features of LCT classroom practices according to Bybee's, et al., (2006) 5Es instructional model which acted as a framework for this study. The results from the structured lesson observations helped to have a further understanding about the lecturers' classroom practices in the process of implementing LCT in Malawi TTCs. The researcher compared what respondents reported in the pre- and post lessons observation interviews with what was observed in the classrooms.

Data analysis processes began at the outset of the first data generation, and continued until the researcher stopped attending the Science and Technology classes. Data generation and analysis can proceed simultaneously and iteratively in interpretive research (Wellington & Szczerbinski, 2007). Arhar et al., (2001) agree with Wellington & Szczerbinski (2007) by suggesting that data generation and data analysis are parallel activities in qualitative research. For instance, the researcher may conduct an interview or observe a lesson and code it before proceeding to the next interview or lesson observation. Without ongoing analysis, the data can be unfocused, repetitious and overwhelming in terms of the sheer volume of material that needs to be processed (Merriam, 2001).

The analysed data included responses to semi-structured interviews, the lesson observation summaries/transcripts, audios or videos and the lesson plans. Simultaneous analysis helps the researcher correct potential flaws in the interview protocol or adjust it to capture the phenomenon of interest better. The researcher may even change his/her original research question if she realizes that her original research questions are unlikely to generate new or useful insights. This is a valuable but often understated benefit of interpretive research (Wellington & Szczerbinski, 2007). According to Domegan and Fleming (2007), qualitative research aims to explore and to discover issues about the problem on hand, because very little is known about the problem.

The researcher used a researcher's journal (diary) during the ongoing data analysis procedures, so it served as both a recording place for researcher perceptions during the

study and documentation of the researcher's ongoing data analysis notes. At the beginning of data analysis, the researcher gave attention to anything of possible interest and importance, but as the study progressed, the researcher started discovering things of importance because they either appeared repeatedly in the data, or were connected to the study, or had some cause and effect elements (Arhar et al., 2001). The following questions directed the data analysis process:

- a) How shall the respondents' classroom practices demonstrate understanding of the LCT philosophy?
- b) How shall they demonstrate understanding of learner engagement, participation and assessment?

3.10.1 Interpretive data analysis steps

The researcher now provides a general framework for analysis of this interpretive qualitative research based on Timulak and Elliott (2003). The general procedures included; preparing data for the analysis, reducing the data, delineating and processing meaning units, and finding an overall organising structure for the data. The framework is similar to and influenced by comparable frameworks used by other interpretive researchers (e.g. Hill et al., 1997).

(a) Data preparation

The first step of the data analysis was data preparation. The researcher obtained data in the form of field notes, audio and video recordings. The audio and video recordings were transcribed verbatim. Then the researcher's observational notes and transcribed recordings were combined and interwoven, using different fonts, so that the researcher's voice could

be clearly distinguished from the informant's voice in the data. Each lecturer's set of data (combination of individual interview transcripts, lesson observation notes, audio/video transcripts) were analysed separately.

During this stage of data analysis, the researcher read and reread the whole data set, so that the researcher could get the whole picture of the LCT classroom practices (Colaizzi, 1978). In other words, the researcher had to immerse himself in and identify with the data, to make sense out of it and to identify the LCT classroom practices that were used and the key features that emerged from the lessons. During this initial reading, insights and understandings began to emerge and the researcher wrote them down as memos. This was a kind of pre-analysis that could influence future steps of the analysis because the first relevancies started to unfold. From the transcripts the researcher identified significant statements which pertained directly to the LCT classroom practices. The researcher looked at all data as every statement might have equal value.

During and/or after the initial reading the researcher did an initial editing of the data. He ignored statements which were irrelevant, repetitive or overlapping with respect to the lecturers' learner-centred teaching (LCT) classroom practices and experiences. In other words, the researcher created a list from both the verbatim and audio/video transcripts of the respondents and deleted all irrelevant expressions. For example, if the respondents explained or displayed the phenomena that was outside of the scope of the investigation, those parts were deleted. After cleaning the data, the remaining parts of the data were called horizons. Horizons are the textural meanings or constituent parts of the phenomenon. Moustakas (1994) said that horizons are unlimited and horizontalisation is a never ending

process. The researcher then conducted checks in the form of independent and challenging auditing processes by colleagues.

(b) Delineating and processing meaning units

Next, the researcher started to divide the data into distinctive meaning units (Rennie, et al., 1988; Wertz, 2005). Meaning units are usually parts of the data that even if standing out of the context, would communicate sufficient information to provide a piece of meaning to the reader. As the researcher delineated the meaning units, he shortened them by getting rid of redundancies that did not change the meanings contained in them. The meaning units were the units with which the researcher did the analysis. The researcher made sure to trace them back to the full data protocol, in case he needed to clarify something from the context. For that reason he assigned a consecutive code (in numbers and letters) to each meaning unit. The code localised the unit in the original protocol. The researcher split the data into meaning units so that each of the themes had only one meaning. He then extracted or isolated statements that were seen to illuminate learner-centred teaching (LCT) practices (Creswell, 2007; Holloway, 1997; Hycner, 1999). This step described the LCT classroom practices in textural language.

The researcher also used the constant comparative analysis method to find themes in both the individual interviews and lesson observation summaries (Strauss & Corbin, 1994). Through this process the researcher searched for patterns (Stake, 1995). A constant comparative method is a process in which any newly generated data is compared with previous data that was generated in one or earlier studies (Stake, 1995). First, the researcher

coded each incident in a lecturer's data set for categories. The researcher constantly compared the data throughout this study by means of coding. Through coding the researcher went through the data with a fine toothcomb looking for themes, ideas and categories and then noting similar parts in the text and giving them a code label. As the researcher coded the incidents, he compared them with the previous incidents that were coded in the same category to find common patterns, as well as differences in the data (Glaser, 1965).

After transcribing the interviews and the classroom observation videos/audios, the researcher coded the data line-by-line, which allowed him to look at the data critically and not to impose his ideas on the information obtained (Duchscher & Morgan, 2004). The researcher identified, named and categorised each different idea, which he later grouped, and these became his categories, as recommended by Borgatti (2007) and Bryman and Bell (2007).

Conducting coding early in the research allowed the researcher to learn early in the interview and classroom observation processes what the respondents were saying/doing and were grappling with (Charmaz, 2006). After the researcher had completed the line-by-line coding, he made a list of the most important and most common codes in his initial coding process. In this step, the researcher sifted through huge amounts of data. He applied focused coding, as he wanted to ascertain whether the codes were sufficient or whether he required additional codes. This step proved to be fruitful, as he realised that he required additional information which he had not had sufficient time to probe.

The researcher compared respondents' responses and realised that new information had also surfaced in some of the interviews which he needed more information on. This step also allowed him to decide which codes he would require to conduct his analytical categorisation of the data, as well as which codes could be combined. There were codes that consisted of only one line of data and could be incorporated with other codes (Charmaz, 2006).

As discussed in Merriam (2001), categories emerging from each data set were exhaustive, mutually exclusive, sensitising, and conceptually congruent and reflected the purpose of the study (LCT classroom practices). For example, the following categories were created for each lecturer: respondents' understanding of LCT philosophy/ concept, classroom activities carried out, the lecturers' classroom roles, learner engagement, classroom assessment and feedback, and teaching and learning methods used (details of categories are explained in part **d** of this section on page 133).

After coding the categories, the researcher compared categories for each respondent and recorded memos (Glaser & Strauss, 2017). The researcher then integrated diverse memos with other memos of analysis to discern the impact of LCT classroom practices on teaching and learning processes. In the last phase of the analysis, the researcher defined major themes derived from the data.

The researcher also used thematic data analysis procedures to analyse the data. This is a method for identifying, analysing and reporting patterns (themes) within data (Clarke &

Braun, 2006). The researcher used this approach to search across the generated data (for both classroom observations and interviews) to identify repeated patterns of meaning. The researcher needed to search the data for patterns which could explain or identify causal links in the data base (Yin, 2003). In the process, the researcher concentrated on the whole data first, then attempted to take it apart and re-construct it again more meaningfully. Categorisation helped the researcher to make comparisons and contrasts between patterns, to reflect deeply on certain patterns and complex threads of the data to make sense of them. The researcher followed a six-step process for thematic analysis based on Clarke and Braun (2014 ; 2006) and Braun, et al. (2015, p. 188–189);

- 1.He familiarised himself with the data (texts; transcriptions) and identified items of potential interest;
2. He generated initial codes that identified important features of the data relevant to answering the research question(s); applied the codes to the data-set consistently; collating codes across segments of the data-set.
3. The researcher then searched for themes; examined the codes and collated data to identify broader patterns of meaning.
4. He reviewed themes; applied the potential themes to the data-set to determine if they told a convincing story that answers the research question(s); refined, split, combined, or discarded themes.
5. The researcher defined and named themes; developed a detailed analysis of each theme.

6. He finally produced a report (this thesis); weaved together the analytic narrative and data segments, relating the analysis to extant literature.

These six phases resemble Timulak and Elliott (2003) interpretivist data analysis steps. The themes that emerged from the data were put together to form a comprehensive picture of the collective experiences and classroom practices of the teacher educators about the learner-centred teaching (LCT) practices in Science and Technology.

(c) Finding an overall organising structure for the data

Naturally, different sets of meaning units describe different aspects of the phenomenon (Timulak and Elliott, 2003). The researcher coded the data before developing a formal version of the organising framework. Hill et al. (1997) recommend sorting the data into domains that provide a conceptual framework for the data (Strauss and Corbin, 1998). The researcher was open to using the data to restructure the organising conceptual framework.

(d) Generation of categories

Next, the researcher categorised the meaning units within each of the domains into which they had been organised. The categories evolved from the meanings in the meaning units. Glaser and Strauss, (2017) identify the word category as a means of discerning regularities or similarities in a data set. Hill et al. (1997) conclude that creation of categories is an interpretive process on the part of the researcher in which the researcher is trying to respect the data and use category labels close to the original language of respondents. The researcher constantly compared the meaning units (Glaser & Strauss, 2017) to each other

and to the emerging categories, until all the data were sorted. The researcher reflected whether these would be left out of the findings as not contributing sufficiently to the understanding of the learner-centred teaching (LCT) classroom practices.

The next step in creating the categories was categorising the categories. In this process the researcher was looking for similarities and regularities between the already established categories. The generation of categories ended with a taxonomy that described and interpreted the whole LCT classroom practices as it was contained in the gathered data. The themes that emerged from the data were put together to form a comprehensive picture of the collective experiences and classroom practices of the teacher educators about the learner-centred teaching (LCT) practices in Science and Technology . The researcher compared themes derived from respondents' experiences and classroom practices generated by a particular data generation method such as individual interviews, with other methods, such as lesson observations, field notes, and literature to verify accuracy and clear representation across the data sources.

Some categories and codes that emerged during data analysis

This sub-section provides some major codes that emerged during data analysis from the 8 respondents in seven categories (highlighted).

(i) The classroom conditions

Enough sitting space for all learners.

Immovable benches.

Not enough space for movement of all learners between benches.

The class sizes were not appropriate for LCT (around 30 learners per class).

Group work activities constantly used.

Benches (in rows) not arranged to promote learner-centred teaching.

(ii) The lecturers' Activities

Arranging the learners for different classroom activities

- Clarifying learning objectives
- Giving directions about the procedures and activities
- Using different instructional methods to implement learner-centred teaching (LCT)
- Encouraging learners to become active participants during class activities
- The lecturers were more active than the learners
- The lecturers were active in explaining ideas, monitoring and describing all concepts
- Managing the class for LCT implementation.
- Using questions, tasks and at times exercises to elicit learners' ideas, knowledge and skills.

(iii) Explanation of ideas/concepts.

- The lecturers explained ideas or concepts
- The lecturers repeated explanations or ideas said by the learners
- The learners explained ideas or concepts
- The learners discussed ideas and concepts

(iv) Learner engagement in lesson activities

- Participating in problem solving activities

- Playing active roles during lesson delivery, e.g. making presentations, answering or asking questions, writing, listening, e.t.c.
- Discussing or brainstorming ideas/ concepts in pairs, small groups and in class
- Peer teaching
- Collecting specimens from the local environment (Not frequent)
- Learners doing experiments/ practical work (Not frequent)
- Individual work/ tasks

(v) Utilisation of Teaching and learning resources

- Both learners and lecturers used charts, posters, diagrams, drawings, books, internet, local environment.
- Ideas, concepts or points illustrated with the help of different instructional materials, e.g. specimens from the local environment.

(vi) Learner assessment

- The lecturers gave individual, pair or group work
- The lecturers moved around the classroom to follow up on learners' participation and progress in activities
- The learners critiqued each other's work
- Learners engaged in letter to the author and author's chair
- The lecturers asked questions
- The learners asked and/ or answered questions
- The lecturers gave exercises to the learners (not frequent)

- The lecturers elicited responses from the learners instead of supplying answers
- The lecturers checked and gave constructive feed back to the learners' work
- The learners were listening passively during the lesson.

(vii) Questioning techniques

Mostly low level questions- recall, at times yes/no questions

The lecturers mostly asked the questions

Most questions were structured

(e) The synthesis of all the narratives for the group as a whole

The researcher created two narratives for each respondent, including texture describing “what” occurred and structure describing “how” it occurred. The researcher listed the meaning units for each respondent and clustered the formulated meanings into themes allowing for the emergence of themes common to all of the respondents' transcripts. After that, the researcher created meaning units common to all respondents and created a composite textural and structural descriptions based on these shared meaning units. In the composite textural and structural descriptions, the researcher eliminated individual meaning units in order to create the essence of the LCT classroom practices. The researcher wrote composite narratives from the third person perspective representing the group as a whole. This step is the synthesis of all the narratives for the group as a whole. The composite structural description was combined into the composite textural description to create a universal description of the phenomenon of the investigation- in this case lecturers'

learner-centred teaching classroom practices. The purpose of the step was to reach the essence of the classroom practices.

3.11 Limitations of the study

There is no research activity without limitations (Marshall & Rossman, 2006). Marshall and Rossman (2006, p. 42) emphasise the assertion as, *there is no such a thing as a perfectly designed study*. In agreement with this observation Patton (1987; 2002, p. 162) also write; *There are no perfect research designs. There are always trade-offs*. According to these scholars, study limitations may derive from the conceptual frameworks and the study's designs used. Implied is that framing the study in specific research and theoretical orientations place limits on the research. This means that any study conclusion or generalisation need to consider the limitations encountered. In undertaking the study, the researcher encountered the following limitations:

(a) Research design limitation: This study design was confined to 8 Science and Technology lecturers only all from one research site. Its findings may thus not be generalised to other lecturers from other TTCs. The results may not be representative of all TTCs in Malawi. By using Science and Technology only, the findings may not be automatically relevant to other subjects. Since the research was carried out in one college only it is not automatically guaranteed that what worked for the college will also work in the same way with the other colleges. However, as observed by Marshall and Rossman (2006), although qualitative studies are not generalisable in the statistical sense, their findings may be transferable. Alternatively, similar studies may be conducted using quantitative designs thus increasing possibilities for generalisation;

(b) Conceptual limitation: the study framework has been drawn from the works of Bybee, et al. (2006) to examine Science and Technology lecturers' classroom practices and experiences in the implementation of LCT methods. The thesis has thus been developed based on the view points of the framework lenses. It is possible that using other conceptual traditions, the same study would be developed differently resulting in presentation of different understanding of LCT classroom practices.

(c) Absenteeism of respondents- At times respondents were found engaged with other college duties against the data generation schedule. The college activities required the participation of the same lecturers so they could excuse themselves to attend to such functions/activities. This reduced the number of planned lesson observations for the respondents.

(d) Some lecturers did not have all the three attributes demanded in this study. In an ideal situation, a respondent to participate in this study ought to have been trained/ oriented in LCT, have had a concentration of Science and Technology in their studies and must have taught the subject for at least five years. However, on the ground the situation was not as it was expected.

3.12 Researcher's experiences and biases

In 1995, the researcher graduated as a secondary school science and mathematics teacher from Chancellor College -the University of Malawi and started teaching in one of the

secondary schools in the same year. Then from the year 2003, the researcher started working as a science and mathematics teacher educator in primary teacher training colleges (TTCs), preparing primary school teachers in teaching science and mathematics. In 2013, the researcher became a TTC principal. One of the researcher's duties as TTC principal is that of an instructional leader and observes and monitors teaching and learning activities in the classroom. From his classroom experiences as a science teacher or teacher trainer and an instructional leader, the researcher noticed that learners had difficulties in understanding scientific concepts, more especially when explanations and group work only were used during the teaching and learning process. This has been the case despite the curriculum promoting the use of LCT methods in the classrooms.

As a teacher, the researcher's focus, however, was on getting the learners to understand what was being taught because the researcher felt bad if after teaching nobody or a few learners understood the concepts. As a science teacher, the researcher faced difficulties in teaching some science concepts partly due to lack of or inadequate teaching and learning aids/resources and insufficient content in the textbooks. Besides, the researcher's understanding of learner-centred teaching (LCT) was to put learners in groups and assign each group a task or tasks to discuss or perform. As long as learners appeared very busy working on the assigned tasks, the researcher was satisfied that learning was taking place and LCT was being implemented.

Having taught and observed Science and Technology lessons in TTCs since 2003, the researcher witnessed firsthand the struggles fellow teachers face to effectively teach some

scientific concepts and ideas although the curriculum is learner-centred. Consequently, learners end up having difficulties to understand the scientific concepts and ideas. As an aside, a fair number of the researcher's learners struggled with learning Science and Technology ; although, a number of affluent learners were also evident, usually those who had a strong background in science. This latter group generally displayed good scientific knowledge and manipulative skills, and could also demonstrate errors that are typical of learners. Nevertheless, the researcher sympathised with learners' frustrations, such as absenting themselves from Science and Technology classes, and often questioned how these learners could master the concepts before leaving TTC. Fortunately the Ministry of Education, Science and Technology introduced LCT in schools and colleges. The goal was to improve the quality of teaching and learning. This initiative by the Ministry of Education was a timely opportunity for the researcher to make a difference for learners in the TTCs. The researcher, therefore, decided to conduct a research on classroom practices.

The researcher's experiences are not unique; they could be similar to those of many science teachers in science classrooms in Malawi. Given such a scenario, questions arise: is there a way in which science teacher educators can prepare primary school teachers in initial teacher education programmes on what to do if they find themselves in classrooms where learners seem not to understand the scientific concepts and ideas? What is it that science teacher educators offer now to equip prospective teachers for teaching in their classrooms? These experiences and unanswered questions sparked the researcher's original interest in the field of learner-centred teaching (LCT) methods in science classrooms. For some time the researcher had observed that teachers faced difficulties to teach some science concepts despite the curriculum highlighting learner-centred teaching (LCT) methods. If these

concepts which are difficult to understand for the teachers are taught to learners, they will be transferring the scientific knowledge and/or skills incorrectly and it will create a lot of misconceptions in learners.

The common belief is that teaching science should not be limited to the transmission of scientific facts and ideas, but it should aim at developing a scientific mentality in the learners that is the same as the mentality of well-known scientists. But, as Matthews (2016) indicates, this does not mean to expect the learners to be prominent scientists, but it means that instead of transmitting scientific data a scientific mentality should be developed in learners so that they can attain a more complex and complete understanding of science and above this goal their epistemological awareness would be developed throughout their lifetime. In the same line, Matthews (2016) believes that the procedure of education is not adhering to accurate beliefs but it is maintaining adequate logic for the beliefs.

This study stems from an urgent need the researcher felt as a TTC instructional leader to address the problem of learner disengagement and from a professional responsibility to encourage LCT classroom practices in TTCs as laid down in national policies (MIE, 2006). There is very scant literature on the TTC Science and Technology lecturers' classroom practices and little specifically directed at implementing LCT in Malawi TTCs. Thus, the focus of this research was to explore the classroom practices of lecturers using LCT in TTCs.

3.13 Research ethics

Following Creswell's and Creswell's (2018) hint, the researcher had indicated to respondents before signing the consent form ([appendix 3, p. 365](#)) that they had the right to

participate or withdraw voluntarily at any time of the research phase. The researcher developed a specific informed consent agreement guide in order to gain the informed consent from respondents based on Bailey's (1996) recommended items, namely:

- a) That respondents were participating in research
- b) The purpose of the research (without stating the central research question)
- c) The procedures of the research
- d) The risk and benefits of the research
- e) The voluntary nature of research participation
- f) The procedures used to protect confidentiality

In adhering to Creswell's and Creswell's (2018) suggestion, the researcher sought respondents' consent before the interviews and classroom observations. The researcher had sought permission to conduct this study from the principal of the respective teacher training college (TTC). However, the permission granted by the principal had not been considered to be a right of access to the respondents. The respondents were treated as autonomous agents as stated above; their participation in the study was negotiated with the respondents themselves.

When conducting the research, respondents needed to be protected (Fraenkel & Wallen, 2009). While there were different ways to ensure protection of the lecturers, in this study the researcher used pseudonyms to protect the identity of both the respondents and the TTCs that were involved in the research. In order to create a conducive environment for the respondents, and to avoid bias from the respondents in a bid to get truthful information

bearing in mind that most of them knew that the researcher was a principal of another TTC, the researcher did the following; letting the respondents understand the purpose of the study, maintaining a non-threatening safe environment for the respondents during each interview and class observations, and establishing a positive rapport with the respondents to ensure a clear understanding of how data would be used.

3.14 Credibility and trustworthiness of the study

Ary, et al. (2002) maintain issues of credibility and trustworthiness are important in qualitative research. Credibility is defined as the confidence that can be placed in the truth of the research findings (Holloway & Wheeler, 2002; Macnee & McCabe, 2008). It establishes whether or not the research findings represent plausible information drawn from the respondents' original data and is a correct interpretation of the respondents' original views (Graneheim & Lundman, 2004; Guba & Lincoln, 1985).

Since this was a qualitative study, the researcher adopted the following credibility strategies: prolonged and persistent engagements in the field, reflexivity (field journal), triangulated methods and analysis to corroborate evidence; respondent validation (informant feedback), experienced peer debriefing; and checked data interpretations with the respondents (Guba & Lincoln, 1985), recording of detailed field notes and an audio or video recorder for accuracy.

The researcher used the application of verification and validation for data credibility purposes (Meadows & Morse, 2001). Verification is the first step in achieving credibility of a research project. This standard was fulfilled through literature searches, adhering to the interpretivist method, bracketing past experiences, keeping field notes, using an

adequate sample, identification of negative cases, interviewing respondents and observing lessons until saturation of data was achieved (Frankel, 1999; Meadows & Morse, 2001). Validation, a within –research project evaluation, was accomplished by multiple methods of data generation (lesson observations, interviews, and lesson plans analysis), data analysis, coding and audit trails. Credibility is the outcome goal of research and is based on trustworthiness and external reviews.

In addition, the researcher had been consulting his supervisors to check the suitability of the research instruments before using them in actual data generation exercise. The responses got from the respondents allowed the researcher to review and fine-tune questions/items for data generation tools.

3.15 Beneficence

The researcher adopted the principle that respondents should not be left behind with greater anxiety or lower levels of self-esteem than they had been before (Cohen et al., 2011). The study included a general debriefing session in which the participating Science and Technology lecturers had been informed about the various LCT methods in teaching Science and Technology and the nature of the subject was also explained to them.

The principle of beneficence requires the researcher not only to protect persons from harm but also to secure their wellbeing. Making respondents aware of the state of their understanding of conceptions of learner-centred teaching (LCT) and Science and Technology teaching could be an upsetting experience to many of those who initially thought they had a good grasp of these concepts. Similarly some respondents might have

felt distressed when they discovered that there was much that they could have done to improve their Science and Technology LCT classroom practices.

3.16 Demarcation of the study

Many studies have investigated the implementation of learner-centred teaching (LCT) in Malawian schools and teacher training colleges (TTCs). Some studies, for example Mmela (2006) sought to discover how lecturers learn to teach English using LCT methods, Kasakula (2017) investigated the learner-centredness of strategies used in the teaching of Science and Technology in primary schools, and Chipshiko and Shawa (2014) sought to interrogate how primary school teachers in Malawi implement LCT methods to instruction. The point of departure of this study is the realisation that the results of these studies and others did not have the TTC lecturers' LCT classroom practices well documented. Recommendations made in the studies have not resulted in improvement in the general classroom practices of lecturers in the TTCs. Studies done so far have had no explanation for better teaching in Science and Technology in Malawian context.

Again many studies on LCT in TTCs have been done across the subjects. In this study the researcher wanted to investigate LCT classroom practices by interrogating and observing TTC Science and Technology lecturers. According to my knowledge, this is one of the very few studies in the history of TTCs in Malawi when such a research has been carried out focusing on Science and Technology subject. Assuming a constructivist view of learning, the study investigated Science and Technology lecturers' conceptions of LCT methods and its application to instruction through interviews and observing classroom practices. In doing this, the study did not seek to determine causes of the failure to

implement learner-centred teaching (LCT) methods in Science and Technology . The study did not seek to examine or identify causal relations. Causes of things are normally established through experimental studies and not through interviews and classroom observations.

3.17 Chapter summary

The researcher adopted pre- lesson observation interviews, classroom observations and post lesson discussions as data generation strategies within an interpretivist method of inquiry. Data generation and analyses activities took place side by side to illumine the specific experiences to identify the LCT classroom practices that were perceived and displayed by the TTC Science and Technology lecturers in a particular situation. To this end, the researcher needed to understand LCT from a historical and philosophical stand point. The researcher adopted interpretivism data analysis steps. Commonly identified validation techniques used in this study included data source triangulation to corroborate evidence, bracketing to clarify bias, and member checking (informant feedback). Member checking, identified as the most critical validation technique, was conducted with respondents to determine the credibility and trustworthiness of the findings and interpretations.

CHAPTER 4

FINDINGS AND DISCUSSION

4.1 Chapter overview

In this chapter the researcher presents respondents' profiles, the classroom practices of Science and Technology lecturers, a discussion of the research findings related to Science and Technology lecturers' classroom practices and the reasons behind their choices of some learner-centred teaching (LCT) classroom practices.

Data pertaining to how the Science and Technology lecturers practiced learner-centred teaching (LCT) in the classroom were generated mainly through structured lesson observations, post lesson discussions and reflections from the researcher's diary. At times, however, data from post lesson discussions were needed to gain a better insight of the lecturers' classroom practices and to compare it to their philosophy of LCT. The study was carried out in two phases. In the first phase the researcher looked into the lecturers' impressions about and understanding of LCT and in the second phase the lecturers' enactment of LCT methods in their classrooms.

This study took place at a time when TTCs in Malawi were still facing institutional constraints such as inadequate or lack of teaching and learning resources, an overloaded curriculum, an examination oriented system that demands memorisation of subject matter content rather than critical-thinking or problem-solving skills, fixed classroom sitting arrangements (MIE, 2007; Khomani, 2003), just to mention a few. Khomani (2003) observes that since the curriculum is examination driven, teachers concentrate on teaching

content that is examinable at the expense of other equally important topics. In addition because of the examination orientation and curriculum overload, teachers rush through the content to cover the syllabus (MIE, 2007; Chilora, 2007; Ministry of Education Science and Technology, 2006). Teachers thus focus on teacher centred methods and on teaching at the expense of learning (MIE, 2007; Chilora, 2007; Ministry of Education Science and Technology, 2006).

4.2 Respondents' profile

The study was conducted with 8 Science and Technology lecturers teaching at Ophunzira Teacher Training College (OTTC). All respondents were holders of bachelor's degrees in primary education. Table 6 presents the profile of the respondents involved in the study.

Table 6: Respondents' profile

Respondent	Teaching experience in		Subject specialisation	How lecturer knew about LCT
	Science Technology qualification	and and		
Lecturer 1 (female)	1 year experience	teaching	Major: Science and Technology Minor: Mathematics	Inwent networking on LCT in 2010, Orientations and workshops at workplace, Reading LCT orientation manuals

Lecturer 2 (female)	B. Ed (Primary). 2 years teaching experience	Major: Applied Science Minor: Mathematics	Read critical thinking books by MIE. No training nor orientation on LCT Orientation by fellow
Lecturer 3 (female)	B. Ed (Primary). 5 years teaching experience	Major: Science and Technology Minor: Mathematics	lecturers, by attending TFAC lessons. Had CPD and trainings on participatory methods/ LCT in 2016, 2017 and 2018 Had formal training on
Lecturer 4 (Male)	B. Ed (Primary). 7 years teaching experience	Major: Science and Technology Minor: Mathematics	LCT in 2007. Inwent networking on LCT in 2010, orientations and workshops at workplace, read about LCT orientation manuals CPDs at TTC and in college
Lecturer 5 (Male)	B. Ed (Primary). 9years teaching experience	Major: Human Ecology Agriculture Minor:	through lecturers. Got oriented in LCT during critical thinking workshops. Reading books about LCT

Lecturer (Male)	6	B. Ed (Primary). 2 years teaching experience	Major: Mathematics Minor: Science and Technology	Oriented by fellow lecturers. Has had no formal training in LCT
Lecturer (Male)	7	B. Ed (Primary). 7 years teaching experience	Major: Agriculture Minor: Science and Technology	Got oriented in LCT during critical thinking workshops. Reading books about LCT
Lecturer (Female)	8	B. Ed (Primary). 3 years teaching experience	Major: Mathematics Minor: Science and Technology	Had formal training on LCT in 2007. Inwent networking on LCT in 2010, orientations and workshops at workplace, Read about LCT orientation manuals

Table 6 shows that out of the 8 respondents; 3 majored in Science and Technology subject, 1 in Human Ecology, 1 in Agriculture, 2 in Mathematics and 1 in Applied Science. Three out of the 5 respondents who did not major in Science and Technology learnt it as a minor subject. However, all the 8 respondents had taught Science and Technology for a number of years and had knowledge of learner-centred teaching (LCT) practices even though some did not go through formal training on LCT (see table 6).

In this study the researcher intended to use respondents with the following characteristics; Science and Technology lecturers with not less than five years teaching experience, have had a concentration in the subject, and received training in LCT methods. However, upon administration of an interview meant for selection of respondents (appendix 4, p. 367), it was discovered that lecturers 1,2,6 and 8 had less than 5 years teaching experience in Science and Technology subject (see table 6, p. 149). Table 6 shows that only lecturers 3 and 4 had met all the criteria. So the researcher modified the criteria to have respondents with the following characteristics; Science and Technology lecturers with at least one year teaching experience, have had some knowledge in the subject, and have had used LCT methods for at least one year in their teaching. The researcher picked all the 8 lecturers as respondents since LCT classroom practices was the main theme about this study.

4.3 Findings of the study

4.3.1 LCT classroom practices of Science and Technology lecturers

Question 1: What are the classroom practices of TTC Science and Technology lecturers?

Before the researcher details the findings/ classroom practices displayed during the lesson observations, he will present one sample lesson first, the way it was delivered. All the 29 lessons observed were presented in more or less the same way (the lecturers followed almost the same style of lesson delivery), so any lesson could be presented as a sample. The researcher, therefore, presents lecturer 1's lesson 1 as a sample lesson so that the reader can have a feel and an insight of what happened in the classrooms;

Lesson1 lecturer 1

The lesson was on the topic of animals and their environment. The lesson duration was 1 hour and the class size was 30 learners. Following is a description of the classroom talk and/or activities;

Lecturer: *We all have seen animals whether in our homes or in the bush. I would like you to mention some of the animals you see in your homes.*(Volunteer learners raised hands up to respond to the question. Lecturer pointed at some learners for responses. Five learners reported their answers to class as follows);

Learner 1: *chicken* (note: the learner number represents the number of responses given by the learners. If the same learner gives three responses to three different questions, he/she will be labelled learner 1, learner 2 and learner 3)

Lecturer : *Chicken, Yes (pointed at another learner)*

Learner 2: *Cattle*

Lecturer : *Cattle , yes mmmmh*

Learner 3: *Goats*

Lecturer : *Goats , Yes (pointed at another learner)*

Learner 4: *Pigs*

Lecturer : *Yes, yes, small , small, small animals*

Learner 5: *Ants.*

Lecturer 1: *There are so many animals that we see in our homes.*

(The lecturer repeated the learners' responses as consolidation).

Lecturer: *Yes .last time we were learning about plants and their environment, plants and their environment. What, how can you define an environment, how can you define an environment?*

(Volunteer learners raised hands up to respond to the question and the lecturer pointed at a female learner for a response, said something but was not heard clearly due to low voice. The lecturer pointed at another learner and said:).

Lecturer: *Yes!*

Learner 6: *Anything around us that's what she says.*

Lecturer : *Any other answer? Any other answer apart from what she has said?*

Learner 7: *Anything around us, thus what she says.*

Lecturer : *Any other answer, any other answer ?*

Learner 8: *Or anything that is around an environment*

(The lecturer continued with the quick review of the previous lesson through asking a number of probing questions on plants and their environment. Volunteer learners gave responses to the questions. The question and answer activity was as follows);

Lecturer : *Aaah. That is environment. We also talked about the plants aaah after they have manufactured their food, that is at the end they have what, aaah glucose and then what, the process of photosynthesis , do you remember it?*

Learner 9: *said something*

Lecturer : *Aaah the end product , what are they?*

Learner 10: *Oxygen*

Lecturer : *Aaaah what did we say is the use of oxygen? (Learners raised up hands) Yes.*

Learner 11: *It's used in the process of respiration.*

Lecturer : *Where is it on the plants? Do we need oxygen?*

Learner 12: *Yes we do need oxygen.*

Lecturer : *Thank you very much. Why do you think are animals important in our everyday life?*

Do we need them, what are their importance? (Learners raised hands up. Lecturer pointed at learners for a response). Yes, eeemmmm how, what are the importance?

Learner 13: *We eat them as food, others are dangerous.*

Lecturer : *Yes (Pointing at another learner)*

Learner 14: *Like dogs are for protection.*

Lecturer : *Yes*

Learner 15: *They provide manure for agriculture activities*

Lecturer : *What else?*

Learner 16: *Source of income.*

Lecturer : *So really they are really important*

(Volunteer learners raised hands up to answer the question. Lecturer pointed at learners for responses. Learners responded to questions. Then lecturer introduced the day's lesson- animals and their environment. She took learners through a question and answer activity as follows);

Lecturer: *so today we are going to look at animals and their environment , and their environment. (wrote the topic on the chalk board). What do we know about animals? Okay, I want you to go back in time , go back in time when you were in primary school level. When I say back in time, aaah, in primary school, I want you to tell me when you heard about animals, what came into your mind when you were at primary school? What are the importances of animals?* (individual learners raised hands up. Lecturer pointed at learners for a response). *Yes*

Learner 17: *animals we eat at home*

Lecturer : *To him he said the animals he knew were those he eats at home, were those he used to eat maybe like chicken, goats , sheep etc . What about you?*

Learner 18: *harmful animals*

Lecturer : *Animals are harmful to us for example, what?*

Learner 19: *a lion*

Lecturer : *Yes, a lion. Did you ever see it as you were young? Have you ever seen the lion that*

Time? Maybe this time but in pictures. Have you ever seen a lion face to face? Okay thank you so much.

Learners: *No (chorus answer)*

Lecturer: *This time find somewhere to write. I want you to have a writing pad. Somewhere you are going to write. I want you to think about the misconceptions about animals and their environment. I want you to think first then you write. We are going to use think –ink-*

share method. I want you to write about the misconceptions about animals. I am giving you a minute , a minute. I said write the misconceptions that you have about animals please (each learner was seen busy writing something in their notebooks. Then after 1 minute);

Lecturer : *Okay thank you. Now, be with a friend and share. Can you share with your friend what you have written? Share with a friend* (Briefly pairs shared notes. Then lecturer interrupted). *Okay thank you, thank you, I hope you have shared the ideas. I want a pair to tell us what you have discussed. Tell us what you have shared.* (some learners raised up hands. Lecturer chose a pair to share with the class what they had discussed). *Yes! can you share.*

Learner 20 (female): *When you see an owl is a bad omen.*

Lecturer : *Misconceptions, misconceptions please!*

Learner 21: *Animals like frogs making sound, they mean that it will be raining soon.*

Lecturer : *Yes, this pair* (pointed at another pair).

Learner 22: *Some birds when you see or hear them it means it is going to rain, rain is about to come.*

Lecturer : *Yes*

Learner 23: *Some parts of animals are not eaten by children for example eggs. Eggs must not be eaten by children.*

Lecturer : *Yes! very bad*

Learner 24: *Animals like frogs are fallen from heaven during rainy season, and some animals are holy , very sacred*

Lecturer : *Alright, some animals are holy , very sacred , yes like python, very sacrificed. Can you clap hands for yourself for the good work? (Hand clapping by learners-reinforcement). Some animals , they produce fire when you look at them. They produce fire. When you see a snake , or a black cat it's a bad omen, which is not true, those are just misconceptions. Thank you very much. (lecturer added some misconceptions, learners listened and jotted down some notes).*

(Next lecturer distributed primary school standard 5-8 text books to learners. Lecturer moved around the groups to monitor the group discussions).

Lecturer : *Alright, I have given you the books, have given you the books, the learners' books and teachers' guide. I want you to examine them then you have to find out what is taught about animals and their environment. I want you to find out, what actually is taught about animals and their environment. Open up where there are animals and their environment, explore what is taught. When you find them, just write them somewhere so that you don't forget. Write them somewhere (Learners flipped through the primary school learners' books and teachers' guides. They analysed the books to check if they contained topics about animals and their environment. They jotted down some points. Lecturer moved around the groups to monitor the group discussions).*

Lecturer : *I hope you have identified the class and the name of the topic in standard 5 and 6. Have you done it?*

Learners: yes! (chorus answer)

Lecturer: *I want you to do another thing. After you have identified them I want you to identify the strategies you are going to use to teach the topic. Identify the strategies to use for teaching the topics.* (Learners discussed and worked on the task in their groups as the lecturer was moving around to check work progress. After 5 minutes lecturer stopped the activity and invited volunteer learners to present their responses). *Have you found them? I want volunteers to come up and write what they have found. First of all which class? Yes.*

Learner 23: *In standard 7.*

Lecturer : Yes

Learner 24: *In standard 8.*

Lecturer : *So in standard 8 they are teaching about animals and also in standard 7. What about in standard 6?*

Learner 25: Yes

Lecturer : *Now have you identified the strategies that you are going to use or have they written them? Anything from the book?*

Learner 26: No

Lecturer: *Now as teachers, we need to use learner-centred methods to teach our learners, is it? They have not indicated them so as teachers we need to use them. What can we use then? What can we use as teachers, are we going to use lecturer method?* (Some learners raised hands up). *Yes!* (lecturer pointed at one learner for a response)

Learner 27: *KWL*

Lecturer: *What is it, KWL?*

Learner 27: *I know, I want to know and I have learnt*

Lecturer: *Eeeeh thank you very much, very good, clap hands for him* (Hand clapping by learners). *Yes!* (Lecturer pointed at another learner)

Learner 28: *Can use group discussion.*

Lecturer: *Eeeeh yes they used discussion, what else? Yes!*

Learner 29: *Think-ink-share*

Lecturer: *What else? Yes!*

Learner 30: *Quick write*

Lecturer: *Yes, what else?*

Learner 31: *Excursion, walk around talk around*

Lecturer : *Yes!*

Learner 32: *Ball bearing.*

Lecturer : *Yes*

Learner 33: *Jigsaw.*

Lecturer : *There are many of them and as teachers we have to use them. We are going to eeeh teach from standard 1 to 8, so as teachers we are going to use them as teachers. So I just want us to go out, just for three minutes , try to find out if you can see animals. Animals from the environment. If you find it you have to kill it bring it dead or so maybe it might be dangerous. A minute to go , okay can we go back?*

(After 5 minutes learners went back to the classroom carrying animals)

Lecturer : *Alright we went around to our local environment. We went around to find some animals in the environment. Which animals have you come across? Please share with the class the animals that you saw when you went outside.* (Volunteer learners raised hands up).

Learner 34: *Spiders*

Lecturer: *Spiders eeeeh , yes*

Learner 34: *Butterfly*

Lecturer: *Butterfly, yes!*

Learner 35: *Ants, grasshoppers*

Lecturer : *Thank you very much. Yes, you have seen those animals but what challenges can learners meet as they go outside into their environment?* (Some learners raised hands up). *Okay, no no no , I want you to find somewhere to write, using the walk around methods. When you hear a clap, when you hear a clap. When I clap hands once, walk around, when I clap hands twice, then stop and talk to a friend.* (Lecturer clapped hands, learners walked around, then she clapped hands twice and learners stopped to share ideas and jotted down some points. Lecturer encouraged each learner to contribute towards the discussion. This process was repeated several times).

Lecturer : *Okay, yes talk. (Clapped hands) Yes, it's walk around! Okay go back to your places. Can you tell me what have you discussed? We are dealing with challenges. Have you found? I want anyone to talk. Talk around. clapp hands for yourselves.* (Hand clapping

by learners- reinforcement. Both learners and lecturer talked to each other during the activity and presentations).

Learner 35: *Scarcity of some animals, some animal you we cannot find them, some animals are dangerous. Some animals are poisonous.*

Lecturer : *They say scarce of some , some animal you we cannot find them in our environment. Yes , Some animals are dangerous. Yes some animals are poisonous to our lives and hazardous to our life as well. Now some animals that are very dangerous you cannot touch them. Yes , clap hands for yourself (Hand clapping by all learners). If you bring them to the learners, they will just run away. Yes some animals are dangerous, harmful, and difficult to catch, so what are the solutions to the challenges found? Yes how can we do it?*

Learner 36: *Use of illustrations, drawings and just explaining to them*

Lecturer : *By use of illustrations. Mind you any illustration is the last option to be done but you have to use real objects. As a teacher start by real things, as a teacher the first thing is to use the real object. So have concrete things. Can you bring a snake or a frog , or a lion to the class? So what are you going to do? (Learners raised hands up). Yes! Okay what can you do?*

Learner 37: *Preserve the animals*

Lecturer: *Yes with some of the situations we need to preserve the animals for example we have a snake, if preserved it's easy for learners to come and use it because it is dead. For*

a grasshopper, can you catch it? It flies away so you can have it and preserve it. Then , so for a chameleon , can you catch? You can only preserve it for learners to use. We need as teachers to be more resourceful for example this one, you want the intestines what are you going to do? Can you kill your own goat, ohhh no but by the time we are eating it you can just have a piece and preserve it. So we are saying some of the solutions can be by preserving. (The lecturer introduced terminologies from learners' work. She asked the learners to define and give examples for the terminologies. The lecturer asked probing questions, illustrated some concepts and consolidated the activities).

Lecturer: Alright , thank you so much, now we are going into our home groups. Aaaah before we go into our home groups we want to talk about animals, animals, what do we mean? We need to talk about classifying animals, and also classifying them further according to their groups. After that we are going to talk about how they survive and why are they important. Please in your groups, in your groups. Can we go into our groups, I want to give you some tasks. Please into your groups we have 5 groups. (Learners went into groups. Lecturer distributed chart papers and pentel pens to each group through group secretaries). *Can I have 5 groups please? Please? Come on we are going to use the teachers' guides, make sure there is a teachers guide for standard 7. No, no no, wait, this group, two groups, can you move, another group should move to the back. Group number 3 eeeh this is your work, this is your work number 1, number 1. Number 2 this one, number 3 eeehoohhh this is number 4. I have given you work to do. Do it fast, faster* (lecturer assigned a task to each group. Each group had a different task).

Lecturer: *Group number 1 classify animals, classify animals, group number 2 classify vertebrates animals to their body temperature, group number 3, you are going to write a summary about the units we have have done, a summary, eeeeh this is group number 5, you are going to do survival mechanisms of the animals, how do they survive. And the last one the importance of teaching learners about animals and their environment. Here there are 2 units, you are going to get the important facts. Do it fast , we are remaining with 5 minutes, 5 minutes. Bring in the ideas so that we have good participation (the learners, in their groups, discussed/ worked on the assigned tasks. The lecturer moved around to check work progress, assist those with some problems, etc). If you have finished you can paste, whatever you have done, stop discussing your tasks, you can paste on the walls.*

Lecturer: (after 5 minutes) *If you are through you can paste your work. Paste paste, paste (Group leaders pasted their chart papers on the walls). Okay, can you take your seats? Will start with this presentation and the summary will come at the end. I want people to come to talk about what they have done. Just one at a time .we are going to start with group number 1, classifying animals, classifying animals, okay. A volunteer from each group should present what each group has.*

Learner 38: (Group 1 leader presented). *Animals are classified as vertebrates and invertebrates animals. (the rest of the learners were attentively listening and jotted down notes)*

Lecturer: *Can we clap hands for them (hands clap by learners!). Can group 3 present on cold blooded animals classificatios?*

Learner 39: (Group 3 learner presented on behalf of her group) *Protozoa, nematodes, anthropods*

Lecturer: *Can we clap hands for them* (hands clap by learners!). *Group number 2 on classifying vertebrates according to their body temperature.*

Learner 40: (Group 2 leader presented). *Cold blooded and warm blooded animals*

Lecturer : *Okay can we clap hands for her, her? The next to present are the importance noo, no, no survival, mechanism for in animals,*

Learner 41: (Group 5 leader presented). *Animals run away, camouflage, hiding, producing hissing sound*

Lecturer: *Can we give them a Mandela wave?*(Learners did the Mandela wave). *Okay now let's talk about the importance of teaching learners about animals and their environment. Is it good that learners should know them, is it good to teach them?*

Learner 42: (Group 4 secretary presented). *For learners to know animal behaviours, for learners to appreciate why animals exist*

Lecturer: *Can we give them reinforcement? Okay stand there, because of that we need to clap hands* (Hands clapping by learners). *The last group has summarised what we have learnt today, just stand there, because of that ,clap hands for them* (Hand clapping by learner. Both female and male learners presented).

Lecturer: *They have stated the types of vertebrates and further classified them into warm blooded and cool blooded animals because of that, clap hands for them (Learners clapped hands). They have also done the invertebrates, and they have classified them into four groups, protozoa, nematodes, anthropods etc. Thank you. Okay that is about animals and their environment. Now we have seen the two groups of animals based on vertebral column , is it? We are just taking one character of vertebral animals. Vertebral animals are animals that have an endoskeleton and exoskeleton . What is an endoskeleton ?*

Learner 43: *Animals whose skeletons are inside the body*

Lecturer: *Good, what is an example of an endoskeleton, one word. (Learners raised hands up).*

Lecturer: *Yes*

Learner 44: *Human beings*

Lecturer: *Yes it is human beings, I wanted one word vertebrates or invertebrates, thus what I wanted of animals which have the skeleton inside their body, inside the skin?*

Learner 45: *They are vertebral animals.*

Lecturer: *What about the exoskeleton?*

Learner 46: *In exoskeletons, the bones are outside the body*

Lecturer: *In vertebral animals so the example of the endoskeleton is the man. I do not have the example of the exoskeleton, maybe next time. Okay after looking at that , what are vertebrates animals? (Learners raised hands up) Yes!*

Learner 41: *Are animals with a backbones.*

Lecturer: *Do you agree, do you agree?*

Learners: *Yes*

Lecturer: *How about the invertebrates?* (Learners raised hands up) *Yes!*

Learner 42: *Animals without a backbone*

Lecturer: *Yes animals without a backbone. Can all of you touch where there is your backbone, a backbone, do you have a backbone.* (Learners touched their backs). *So under what group are we?*

Learners: *Under the vertebrates.*

Lecturer: *Under the vertebrates, thus where we are. Most of the times, we do not put man as an example of vertebrate animals. We always put other things. Okay, eeh I had this in mind, I also had some summaries but because you have done good work it is very well, so you are going to paste this in your classroom. I also have the summaries, have also classified them in vertebrates and invertebrates, cold and warm blooded.*

(After each group had finished with its presentation, the lecturer asked them to clap hands for their colleagues. The lecturer explained some concepts and ideas for quiet a long time while learners were listening. She displayed a chart paper with examples of vertebrate animals on them. She also used artificial materials or models of a human skeleton).

Lecturer: *Alright, now can we mention the challenges that a teacher can find when dealing with the animals in their environment, in their environment, you have learnt it* (The learner raised

hands up), *yes*

Learner 43: *Some animals are scarce.*

Lecturer: *Yes*

Learner 44: *They are dangerous.*

Lecturer : *Yes*

Learner 45: *They are poisonous*

Lecturer: *Very good, very good. Can we define, aaah what is an invertebrate animal? Yes*

(Pointed at a learner).

Learner 46: *They are animals without a backbone*

Lecturer: *(Hang her own chart paper). Compare your answers with my work and see where we agree or disagree. I will leave this chart paper in this class for you to continue studying or using it. What are the challenges that learners face as they learn about animals? Can we define what is meant by invertebrates? What have you learned? I have these questions and answer them orally.*

Learner 47: *Animals without a backbone.*

Lecturer: *Thank you for being a nice audience and thank you for your participation that is the end of my presentation or lesson.*

4.3.2 How the 5Es were shown in the lecturer's lesson

Engagement: According to Bybee, et al. (2006), this phase engages learners in the learning task(s). The learner mentally focuses on an object, situation, or event. The engagement activities introduce a new problem that learners have to solve. The activities of this phase should make connections to past and future activities. The connections depend on the learning tasks and may be conceptual, procedural, or behavioural. From a teaching

point of view, asking questions, demonstrating a task, defining a problem, providing a brief description of a natural phenomenon then ask learners to explain the situation, and acting out a problematic situation are all ways to engage learners and focus them on the instructional activities. Bybee, et al. (2006) observe that the role of the teacher is to present a situation and identify the instructional tasks and learning outcomes. The teacher also sets the rules and procedures for the activity. Here the word activity refers to both mental and physical activity.

In the observed lesson, the learners made explanations about concepts, ideas and situations. The lecturer asked probing questions or asked the learners to give examples to clarify or justify or expand their (learners') answers/ideas about concepts and situations, etc. The learners responded to the questions in question and answer activities. The lecturer also engaged the learners in the following activities; individual, pair and group work/discussions, class discussions, giving definitions, walk-around-talk-around and think-ink-pair-share. The learners in pairs or small groups discussed and shared with each other their ideas. The classroom activities promoted engagement and participation by all the learners and encouraged each learner to think through their own answers to the question(s) before the questions were discussed and answered by the class.

Groups displayed their work on chart papers and one member from each group explained/presented to the visiting learners what their group had done. The learners answered questions from both their respective lecturer and fellow learners. They defined terms/concepts. The lecturer encouraged the learners to share and compare ideas about concepts and ideas with those of others through discussions, asking or responding to

questions, reading other groups' work, pair or group work, listening to each others' responses and making presentations. The classroom activities allowed the lecturer to elicit ideas from the learners about ideas and concepts.

The learners in small groups read and analysed text books, identified and discussed topics taught in primary schools. The classroom activities made connections between past and present learning experiences, exposed prior conceptions, and organised learners' thinking toward the learning outcomes of current activities. The learners discussed the meanings and types/examples of concepts/terminologies. In the lesson, the lecturer encouraged the learners to argue or ask questions to fellow learners and to make comments/ observations.

The learners critiqued each other's work, added or subtracted ideas/information from presentations based on relevance, explained concepts/ideas to class, discussed concepts/tasks. Group representatives reported their group's work/ responses to class. The learners volunteered to ask or answer questions or give out their ideas by raising up their hands. Each time a learner asked a question or made an observation, the lecturer engaged fellow learners to attempt it first then later she consolidated the learners' ideas. This made the lesson more interactive and also helped the lecturer measure and improve the learners' learning. Asking questions helped the lecturer to increase the learners' participation and encouraged active learning.

Through question and answer activities the lecturer asked the learners to explain what they had learnt about on the lessons. The activities and the learners' responses enabled the lecturer to determine and assess the learners' understanding (previous knowledge) about

ideas and concepts. Selected learners shared with the class their responses. The lecturer mostly used volunteers to answer questions or put forward ideas/suggestions. The lecturer assessed what the learners did or did not understand about the stated outcomes of the lessons through walking around the classroom while listening to the learners' discussions, making observations while the learners performed assigned tasks and through oral question and answer activities. However, the lecturer had challenges mostly with inviting the learners to raise their own questions about concepts or ideas.

The learners' questions were about seeking for clarifications or reminder of what was said but got forgotten. The lecturer mostly used recall questions and rarely asked probing questions to get the learners engaged with the content. She assessed the learners' previous knowledge through questions, pause and name (QPN) techniques only. The lecturer assessed the learners' prior knowledge in order to help them become engaged in new concepts. It was the lecturer herself who guided the lesson by raising questions for discussions by the learners. The chalk board was used most often.

The learners were seated in permanent, linear arrangements of 4- 6 members, facing the chalkboard. The lecturer provided closure for the activities and the lesson. She told the learners when to start and stop working on an activity. The lecturer controlled time and resources, how to do activities and who to respond to the questions. She focussed mainly on volunteers. During the lesson, the lecturer rewarded the learners through thank you, very good, hand clapping.

Exploration: Once activities have engaged learners, they need time to explore their ideas and skills. Exploration activities are designed so that all learners have common concrete

experiences upon which they continue building knowledge and skills. Thus the exploration phase provides concrete, hands-on experiences where learners express their current conceptions and demonstrate their abilities as they try to clarify puzzling elements of the engagement phase (Bybee, et al., 2006). If engagement brings about disequilibrium, exploration initiates the process of equilibration. This phase should be concrete and meaningful for the learners. The aim of exploration activities is to establish experiences that teachers and learners can use later to formally introduce and discuss scientific concepts and skills. During the activities, the learners have time in which they can explore their knowledge and skills (Bybee, et al., 2006).

Bybee, et al. (2006) hint that the exploration phase may require learners to recognise new situations, investigate phenomena, learn new tasks, technologies, and procedures. As a result of their mental and physical involvement in the activities, the learners establish relationships, observe patterns, identify variables, and of necessity, must adapt. The teacher's role in the exploration phase is that of facilitator or coach. The teacher initiates the activities and allows the learners time and opportunity to investigate objects, materials, and situations based on each learner's own ideas of the phenomena or problem. If called upon, the teacher may coach or guide learners as they begin proposing explanations or solutions. Use of tangible materials and concrete experiences are essential in the exploration phase. A portion of the exploration phase may centre on cooperative learning (Johnson & Johnson, 2009; Johnson, et al., 2008; Maruyama, et al., 1983). The opportunity for learners to interact, discuss, and even argue in a supportive environment about goal-centred activities enhances their skills in adapting, for example, to different communication

styles and personalities. In addition, they will have to communicate their ideas in order to build a shared understanding of the problem and proposed solutions.

From the lecturer's observed lesson, the learners discussed and shared ideas and concepts using previous experiences and observations. They interacted with instructional materials and ideas through pair, classroom and small-group discussions. They considered different ways to find solutions to different misconceptions and challenges. Through small group discussions and classroom activities the learners acquired a common set of experiences so that they could construct their understanding about ideas and concepts and compare results and ideas with their classmates. The learners described, recorded, compared and shared ideas and experiences and expressed their developing understanding of misconceptions about ideas and concepts.

The learners worked with one another to explore ideas through minds-on activities. However, the lecturer did not engage the learners further to verify their claims. The lecturer asked the learners to read primary school text books and then analyse them. As the learners worked together in teams, they built a base of common experiences which assisted them in the process of sharing and communicating ideas. The lecturer, as a facilitator, provided teaching and learning materials and guided the learners' focus. She observed and listened to the learners as they interacted with materials. She asked probing questions (though not often) to help the learners make sense of their experiences. The lecturer provided time for the learners to discuss assigned tasks, for example, on animals and their environment, etc. The lecturers encouraged the learners to interact with materials, ideas and fellow learners.

The lecturer created a need to know setting. However, she provided 5 minutes only for the learners to discuss concepts or ideas to activities to make sense of their experiences (see lesson 1, p. 153). For example, the lecturer told the learners to stop doing an activity or group discussions once the allocated time had elapsed. The lecturer controlled class activities and processes by assigning the learners tasks to do, giving directions and instructions to follow, determining time for doing an activity, told the learners what to learn and for how long. The lecturer allowed a maximum of 5 minutes only for the learners to make sense of their experiences.

Explanation: According to Bybee (2013), explanation means the act or process in which concepts, processes, or skills become plain, comprehensible, and clear. The process of explanation provides the learners and the teachers with a common use of terms relative to the learning experience. The concepts, practices, and abilities with which learners were originally engaged and subsequently explored are now made clear and comprehensible. In this phase, the teacher directs learner's attention to specific or key aspects of the engagement and exploration experiences and first asks learners for their explanations (Bybee, 2013). Explanations are ways of ordering and giving a common language for the exploratory experiences and, for example, specific skills the teacher wishes to emphasise. Thus the teacher should base the initial part of this phase on the learners' explanations and clearly connect the explanations to experiences in the engagement and exploration phases (Bybee, et al., 2006).

Using learners' explanations and experiences the teacher introduces scientific or

technological concepts briefly and explicitly. Key to this phase is to present concepts and skills briefly, simply, clearly, and directly, and then continue on to the next phase. The explanation phase is teacher-directed and in today's parlance would be referred to as "direct instruction" (Bybee, et al., 2006). Educators commonly use verbal explanations, but there are numerous other strategies, such as video, films, and educational courseware (Bybee, et al., 2006).

From the observed lesson, the lecturer asked the learners to explain or report (present) their understanding about concepts and ideas (in their own words), for example, about animals and their environment. Figure 1 shows group secretaries making a presentation to class.

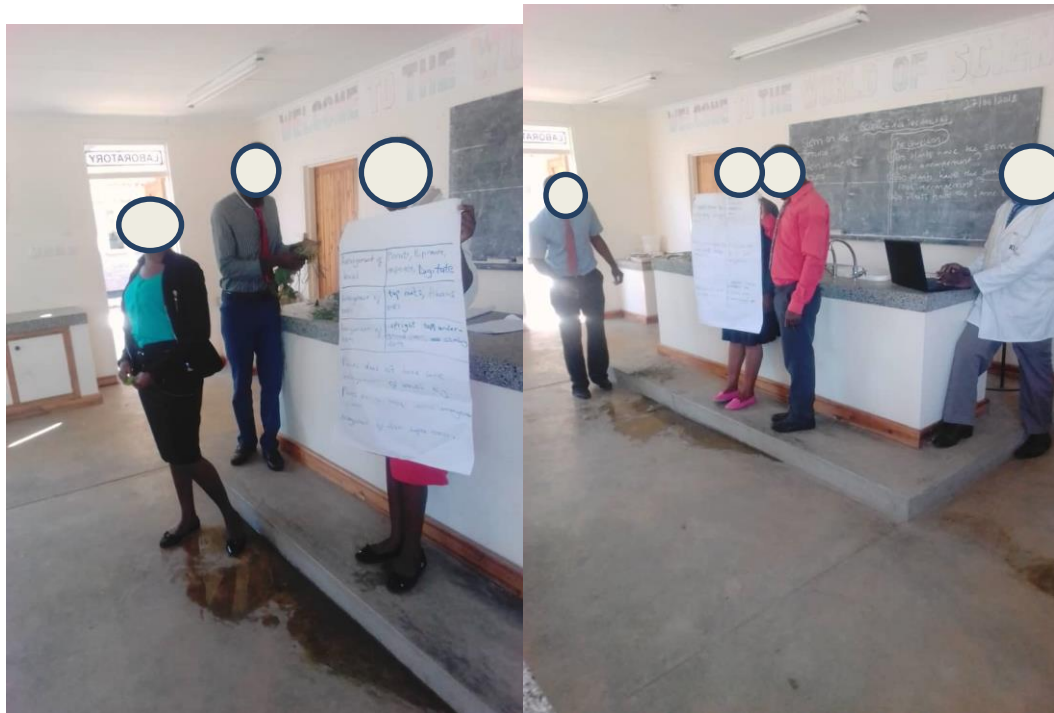


Figure 1: Group leaders making presentations to class after small group discussions.

The lecturer consolidated the learners' responses/ presentations. The learners listened to and compared the explanations of others with their own during group discussions as well as class presentations. They became involved in learner to learner discourse in which they explained their thinking to others and debated their ideas thereby revising their ideas. The lecturer encouraged the learners to make comments/observations and /or ask questions about a particular group's work soon after each group had made a presentation or after a class activity such as walk-around-talk-around, e.t.c. The learners asked questions about their colleagues' work for clarifications and further explanations. Fellow learners answered the questions and gave further clarifications about the concept they discussed in their groups.

The learners recorded their ideas and current understanding of concepts. Through pair or group discussions as well as the class presentations they compared their current thinking with what they previously thought about the concepts. Some learners went to the chalk board to write their responses while the other learners and their lecturer looked on (see figure 1, p.175). Thus, communication skills and self expression skills were being developed between and amongst the learners. The lecturer added some points and gave further examples for clarifications. Through the class activities, the lecturer encouraged the learners to use their common experiences and data from both the engagement and exploration stages to develop explanations. She asked questions that helped the learners to express understanding and explanations of concepts and ideas and to clarify their ideas and/ or answers.

The lecturer helped the learners to clarify their understanding about concepts/ideas and introduced information related to the concepts. She asked follow up or probing questions (though not often) to guide the learners with their explanations and/or for clarifications. The lecturer provided time for the learners to compare their ideas with those of others and perhaps to revise their thinking through group presentations and asking each other questions. Volunteer learners raised their hands up to respond to questions.

The lecturer used the learners' previous knowledge/ experiences as the basis for explaining concepts, for example; animal protective/survival mechanisms. When a learner responded to a question, the lecturer asked the other learners to comment if they were convinced with the response (s). At times the lecturer consolidated the activities by asking selected individuals to share their responses with the whole class and she corrected misconceptions. However, the lecturer was challenged with heavily controlling time and deciding who to answer a question or give an idea. A lot of time was spent on presentations and consolidations (lecturer explaining concepts and ideas) rather than small group discussions or learners doing tasks. The lecturer provided definitions and answers in an attempt to clarify ideas. This behaviour contradicted the essence of learner-centredness. The lecturer introduced new ideas and concepts during lesson deliveries. She dominated explanations of activities or after the learners' reports/ answers contrasting the essence of learner-centredness.

Elaboration: According to Bybee (2013), once the learners have an explanation, it is important to involve them in further experiences that apply, extend, enrich or elaborate the

concepts or skills developed. Elaboration activities provide further time and experiences that contribute to learning. Champagne, A. (1987, p.82) in Bybee (2013) discusses an example of the elaboration phase; learners engage in discussions and information-seeking activities. The group's goal is to identify and execute a small number of promising approaches to the task. During the group discussion, learners present and defend their approaches to the instructional task. This discussion results in better definition of the task as well as the identification and gathering of information that is necessary for successful completion of the task. Figure 2 shows learners engaged in group discussions.



Figure 2: Learners sharing ideas during small group discussions in class

As a result of participation in the group's discussion, individual learners are able to elaborate upon the conception of the tasks, information bases, and possible strategies for

its (the tasks) completion (Champagne, A., 1987, p.82 in Bybee, 2013). The use of interactions within learner groups is considered as a part of the elaboration process. Group discussions and cooperative learning situations provide opportunities for learners to express their understanding of the subject and receive feedback from others who are very close to their own level of understanding. Learners get information from each other, the teacher, printed materials, experts, electronic databases, and experiments which they conduct.

The elaboration phase also is an opportunity to involve learners in new situations and problems that require the application of identical or similar explanations. Transfer of learning and generalisation of concepts and skills is the primary goal of the elaboration phase (Bybee, 2013). From the lesson observed, the learners went outside the classroom on an excursion or field trip to see animals and their environment. The excursion or field trip gave opportunity to the learners to build on their understanding of concepts about animals and their environment, use knowledge of the concepts to investigate further, apply explanations and skills to new, but similar, situations and provide practice and reinforcement. The lecturer encouraged the learners to explain further the applications of ideas and concepts in real life situations using what they had learned.

The learners studied through excursions/field trips to observe some specimens' behaviours. They recorded observations and explanations and checked for understanding among peers. The lecturer also engaged the learners in class discussions and question and answer activities. She focused the learners' attention on conceptual connections between new and

former experiences. These activities challenged the learners to apply what they had learned and extended their knowledge, understanding and skills. They applied explanations and skills to new, but similar, situations.

The lecturer reinforced the learners' use of scientific terms and descriptions previously introduced. She asked questions that helped the learners draw reasonable conclusions from evidence and data. The lecturer referred the learners to existing data and evidence and asked probing questions (though not often). For example, in the lesson, the learners went outside the classroom to see and carry with them animals. Here the learners drew reasonable conclusions from evidence and data. The activity helped the learners to deepen their understanding of concepts and ideas under study. No assignment components or tasks were given to the learners for them to reflect, analyse and critique what they had learnt and how they were learning it.

Evaluation: According to Bybee (2013), in the evaluation phase learners receive feedback on the adequacy of their explanations and abilities. Informal evaluation can occur from the beginning of the instructional sequence. The teacher can complete a formal evaluation after the elaboration phase. As a practical educational matter, science teachers must assess educational outcomes. This is the phase in which teachers administer tests to determine each learner's level of understanding, skills and abilities. This also is the important opportunity for learners to use the skills they have acquired and evaluate their understanding and communicate their solutions (Bybee, et al., 2006).

From the lesson observation, the lecturer checked on the learners' discussions- how discussions and sharing of ideas on concepts was done by the learners. She engaged the learners in asking questions, presenting ideas and giving responses throughout the lesson. The learners also displayed their work by hanging them on classroom walls. The lecturer engaged the learners to read, check and analyse peer work. Peers functioned as expert providers of information to others and in the process fellow learners asked questions and made corrections where possible. The lecturer provided time for the learners to compare their ideas with those of others and perhaps to revise their thinking through group discussions, their responses/ideas, reports or presentations and asking each other questions. She encouraged the learners to assess their own learning/progress and group process skills through discussions, performing tasks, asking and responding to questions.

The lecturer walked around the classroom to observe, supervise and monitor small group discussions. She asked questions and listened to the quality of the learners' small group discussions as a means of assessing the learners' developing understanding. This encouraged the learners to assess their own progress and made the lesson more interactive and also helped the lecturer measure and improve the learners' learning. The lecturer observed (but did not record) the learners demonstrating their understanding of the concepts and performance of skills about concepts being taught. She assessed the learners' knowledge and skills through observations, questioning and listening to their ideas/arguments. Both verbal and written questions were asked but not graded.

The lecturer looked for evidence that the learners had changed their thinking or behaviours

through question and answer technique, listening to the learners' discussions and presentations. She pasted a chart paper on the walls of the classroom. This acted as reference materials for the learners to compare their answers with. It was a form of feedback to learners' responses. The lecturer rewarded the learners who gave correct answers or ideas to a question/task by saying thank you, very good or hand clapping. She used informal assessment tasks to assess and promote learning –this was done in the course of a series of events carefully orchestrated to realise as much of the learners' learning potential as possible. Individual/pair/ group work helped the learners to create self awareness of learning in them i.e. as a means for learners to understand how they learned and discovered their strengths and weaknesses thereby helping them to discover themselves as learners.

At the end of the lesson, the lecturer asked the learners to explain what they had learnt in the lesson, for example, *what challenges are to be faced when teaching about animals and their environment?* The learners just listed the ideas/ information of what was learnt in the lesson. This could be regarded as group interview to learners as a means of assessing their developing understanding. At times the lecturer looked at and checked the learners' responses and said yes/no as feedback and reinforcement. At times the lecturer accepted chorus answers from the learners. She rejected wrong answers and gave right ones. The learners displayed their work and group leaders presented them by reading out to the whole class. The lecturer consolidated the learners' work as a form of feedback. She encouraged them to correct their work (see lesson 1, page 153).

The lecturer concluded each activity and the lesson by asking learners if they had questions. She rarely encouraged the learners to assess their own learning/progress and group process skills. The lecturer rarely assessed the learners' skills (see lesson 1, page 153). The learners had very limited time to ask questions and discuss their peer's work. The lecturer had no rubrics determined hand-in-hand with the lesson design. The lecturer's classroom observation was not structured by a checklist, no portfolios designed with specific purposes. She was challenged with asking leading and factual questions, for example, *we talked about the plants aaah after they have manufactured their food, that is at the end they have what? and then what? the process of photosynthesis , do you remember it?* (see lesson 1, page 153).

4.4 Overall summary of the 8 lecturers' classroom practices

This section answers question 1 with respect to all the 8 lecturers' classroom practices. Using the 5Es as a lens for data analysis of the 29 observed lessons, the findings had shown that all the 8 lecturers' classroom practices depicted use of learner-centred teaching (LCT) methods. This was the case eventhough 6 out of the 8 lecturers had demonstrated the use of the 5Es in most but not all of their lessons. Table 7 shows an overall summary of how the 8 lecturers implemented classroom activities related to the 5Es during lesson presentations (see appendix 10, p. 484, for the lessons).

Table 7: The 8 lecturers' use of the 5Es in the observed lessons

Responden t	Lesson s	Engagemen t	Exploratio n	Explanatio n	Elaboratio n	Evaluatio n

Lecturer 1	Lesson 1	√	√	√	√	√
	Lesson 2	√	√	√	√	√

Lesson √ √ √ **X** √

1

Lecturer Lesson √ **X** √ √ √

2 2

Lesson √ √ √ **X** √

3

Lecturer 3	Lesson 1	√	√	√	√	√
	Lesson 2	√	√	√	X	√
	Lesson 3	√	√	√	√	√

Lesson √ √ √ √ √

1

Lesson √ √ √ **X** √

2

Lecturer Lesson √ √ √ √ √

4 3

Lesson √ √ √ √ √

4

Lecturer 5	Lesson 1	√	√	√	√	√
	Lesson 2	√	√	√	√	√
	Lesson 3	√	√	√	√	√

Lesson √ √ √ **X** √

1

Lecturer Lesson √ √ √ **X** √

6 2

Lesson √ √ √ **X** √

3

Lecturer 7	Lesson 1	√	√	√	X	√
	Lesson 2	√	√	√	√	√
	Lesson 3	√	√	√	X	√
	Lesson 4	√	√	√	√	√

	Lesson 5	√	X	√	X	√
	Lesson 6	√	X	√	X	√
Lecturer 8	Lesson 1	√	√	√	X	√
	Lesson 2	√	√	√	X	√
	Lesson 3	√	√	√	X	√
	Lesson 4	√	√	√	√	√
	Lesson 5	√	√	√	√	√

Key

√: Lecturer used an element of the 5Es

X: Lecturer did not use an element of the 5Es

From table 7 on page 183, only lecturers 1 and 5 had demonstrated the use of all the 5Es in all of their lessons but the other lecturers missed some elements of the 5Es in some of their lessons. For example, lecturer 2 did not demonstrate the use of elaboration in lessons 1 and 3; lecturers 3 and 4 did not demonstrate it in lesson 2; lecturer 6 did not demonstrate

elaboration in all the three lessons observed; lecturer 7 did not demonstrate it in lessons 1,3,5 and 6, and finally lecturer 8 did not demonstrate the use of elaboration in lessons 1, 2, 3 and 4. Similarly, lecturers 2 and 7 did not demonstrate the use of exploration in lessons 2 and 5 respectively. However, based on table 7 on page 183, the general pattern shows that all the 8 lecturers used the 5Es in their lessons. These findings, therefore, suggest that all the 8 lecturers used learner- centred teaching (LCT) methods in their lessons despite the total number of observed lessons per lecturer not being the same. The researcher now presents the classroom findings (for all the 8 lecturers) based on the 5Es;

(a) Engagement

Learner engagement was evident through a number of ways. It was done at all levels of the lessons (see table 7, page 183). The lecturers and in some isolated cases the learners asked open-ended questions. However, most of their questions demanded revision or repetition of what was already said in class. Most learners asked questions because they had either missed a point/an idea or did not understand it fully. Thus, the source of the learners' questions could be a gap or discrepancy in the learners' knowledge or a desire to extend their knowledge in some direction. The questions may have stemmed from curiosity about the world around them as well as events and interactions with real-world issues. For example, in lesson 3 of lecturer 8, learner 5 asked the following question, *what is the difference between a gas and air?* Similarly, in lesson 4 of lecturer 8, learner 28 asked the following question, *does the brain control digestion? How about blood circulation?* (see appendix 10, p. 488).

Most learners lacked the skills to ask higher order questions according to Bloom's taxonomy (Anderson & Krathwohl, 2001). The reason could be that they were not trained by their lecturers how to ask/frame such types of questions. The lecturers involved the learners in individual writing, drawing, acting out understanding of concepts and ideas through displays and responses/presentations, individual work and pair or small group discussions to reveal their existing ideas and beliefs so that the lecturers were aware of their current conceptions. This helped the lecturers to plan what to do next—a form of diagnostic assessment. The lecturers also engaged the learners through classroom demonstrations.

The lecturers engaged the learners in the following activities; think-pair-share (lecturers 1, 3, 4, 8), ball games (lecturers 2, 3, 5), card collecting and clustering (lecturer 2), freeze-mix-pair, gallery walks (lecturers 3, 5, 6, 8), know-want to know-learn (K-W-L), walk around talk around (lecturers 4, 5), ball bearing (lecturer 5), quick write (lecturers 6 and 8), one stays three stray, jigsaw (lecturer 6), author's chair, bus stop (lecturer 7), individual, pair and group work/discussions (all lecturers) [see appendix 10, p. 488]. During a post lesson interview, this is what lecturer 1 said;

Researcher: *In your lesson what activities did you use to engage learners?"*

Lecturer 1: *I used explanation and group work, it was there, I also used think-ink-pair-share it was also there. I also used move around and talk around. I also used group discussion, presentations.*

Through think-pair-share activities, the lecturers wanted to establish the learners' previous knowledge about their misconceptions about concepts and ideas. Using ball bearing activities the lecturers asked each learner to present his/her ideas to a partner, the other learner in the pair complimented the explanation. However, in almost all the lessons, the lecturers asked the learners to do or discuss tasks without follow up/ probing questions to make the learners think critically. The learners just listed or discussed what they already knew or read about. New knowledge was rarely constructed (see appendix 10, p. 488).

In the ball game activities each learner became mentally engaged as they anticipated the ball to be thrown on them. The lecturers involved the learners in gallery tours for them to see what their peers had written. The aim was to encourage peer to peer learning through group work as the lecturers allowed the groups to go around each other's work. The lecturers encouraged them to ask questions/ or to make observations on other group's work after the gallery tours.

Through the activities like demonstrations (e.g. lecturer 1 demonstrated sample mixtures, lecturers 3 and 5 demonstrated plants and the human skeleton models, lecturer 6 demonstrated pictures of invertebrates animals, and lecturer 7 demonstrated properties of light and air pressure- see appendix 10, p, 488) the lecturers piqued learners' curiosity and generated interest to know more about the concepts and ideas under discussions (see appendix 10). This was evidenced as most of the learners raised their hands up either to ask or respond to questions or say something about the topic under discussion.

In all the 29 lessons for all the 8 lecturers the learners were instructed to work individually, in pairs and /or in small groups through several collaborative or learner-centred teaching classroom practices such as mix-freeze-pair, think-ink-pair-share, e.t.c. During the small group discussions or activities, the learners were seen discussing among themselves (see figure 3). Figure 3 shows learners in small group discussions about a concept.



Figure 3: Learners discussing a concept in small groups

In figure 3, the learners are discussing a concept and/or a task in small groups. However, the groups were in linear arrangement. Figure 3 shows fixed benches arranged in rows that do not promote learner-centred learning. The physical environment can promote or hinder learner-centred teaching (LCT) approaches (Tengku Kasim, 2010: Burns & Myhill, 2004). Thus, to engage learners in learning activities the classroom should be well equipped with furniture meaning that there should be movable desks for learners to use different lay outs in the classroom (Burns & Myhill, 2004).

The classroom activities provided the opportunity for the lecturers to find out what the learners already knew or thought they knew about the ideas and the concepts to be developed. The lecturers determined the learners' current understanding (prior knowledge) about different concepts or ideas within the lessons mainly through question and answer techniques, know-want to know-learn (K-W-L), group discussions and learners' responses as they (lecturers) listened to the small group discussions, asked questions and observed learners as they worked on assigned tasks. This observation agrees with what lecturer 5 said during a post lesson interview;

Researcher: *I observed that you started your lesson by asking questions, why did you do that?*

Lecturer 5: *I introduce my lessons by asking learners to share their experiences or knowledge acquired from previous lessons which are related to the day's lesson. This is done because introduction should always be interesting to learners and provide continuity at the same time. By asking them to answer questions or to explain or to describe their prior knowledge on particular scientific concept I try to assess how much they know about previous knowledge. This can also happen through observing how they do tasks. In this case I am able to notice challenges or misconceptions learners have about particular concept or topic. If I find out that their previous knowledge is falling short I make some explanations or giving relevant examples and also using illustrations and resources (see appendix 7, p. 372).*

Each lesson began by orienting the learners' thinking and learning in a particular direction.

In 89.7% (26 out of 29) of the lessons observed review of the previous lesson initiated engagement. In one lesson the classic KWL (i.e., what do I Know, what do I Want to learn, what have I Learned) initiated engagement. This afforded the lecturers an opportunity to draw out and learn about the learners' prior knowledge, metacognitive awareness, and reasoning abilities. In 89.7% (26 out of 29) of the lessons observed the lecturers started lessons by asking questions (appendix 10, p. 484). In 6.9% (2 out of 29) of the lessons observed the lecturers started by an explanation of the previous lessons. This could be followed by either another question or a demonstration/display/ illustration. The lecturers used demonstrations in 3 lessons, ball games in 3 lessons and card collecting and clustering activities in 2 lessons. All questions guiding the lessons came from the lecturers except for lecturer 7's lesson 2 where the lesson guiding questions were formulated by the learners. The lecturers asked open ended questions to review the previous lesson and to guide the current lesson.

In 51.7% (15 out of 29) of the lessons observed the lecturers asked the learners to read from and analyse text books or modules in order to come up with the expected responses. Lecturer 2 used learners previous knowledge and experiences only in her lessons. Learners were also engaged in finding out of text-based materials (for example, modules, web-based materials, and related books) with consideration given to verify the scientific claims made in the texts. They (learners) just isolated or listed or identified topics and ideas which the lecturers wanted them to present to class. The learners were engaged in just finding out about what was already known. Thus, the engagement which was there was about asking the learners about prior knowledge, tried to make them think about concepts or topics being

taught, etc. but deep engagement was minimal as the lecturers did not create an environment for it (see transcribed lessons in appendix 10, p. 488). The lecturers could have asked probing questions or administer tasks which could make the learners think beyond what they already knew about and come up with their own ideas. The following extract from lecturer 6 lesson 3 justifies the observation;

Lecturer 6: *There have been misconceptions about animals by learners. This time I want you to think of the misconceptions that learners have towards animals not only in primary school learners even us. Write at least one misconception in your notebooks,* (paused for a moment). *Can you write them quickly? Compare your work with your friend next to you. Is it a misconception or truth? What is the misconception? Right, what are the misconceptions?.*

Learners: Quickly wrote the answers in their note books, raised up their hands and shared the answers with the class. Some of the answers were;

Frogs fall from the sky during rainy season Some eyes of animals produce fire. For instance, cats, lion. Some animals do not feed. For instance, snail Some animals, for instance an owl, foretell bad omen, e.t.c., e.t.c.,,,,,, (see appendix 10, p. 638).

(The learners extracted these answers from their text books).

Lecturer 6: Explained the learners' responses, asked questions to learners to clarify their answers and/or findings. Wrote points on the chalk board as learners explained them. Wrote both right and wrong examples for learners to either reject or accept them. In the

lesson extract, lecturer 6 could have asked questions like; how would you assist learners who had such misconceptions? What could be the possible reasons for children to develop such misconceptions in them? How do the misconceptions impact the daily life of the children?

The lecturers allowed the learners to ask questions/ or to make observations/comments on other learners' work after activities such as gallery tours, bus stops, one stays three stray, e.t.c. The lecturers involved the learners in making observations first before they (lecturers) came in for clarifications/ consolidations (see appendix 10, p. 488). Using lecturer 6's lesson 1 as an example this is how part of the lesson was conducted; he engaged the learners by directing them to the concept that there are different modes of reproduction in plants. He asked a simple question: *Can you write individually the modes of reproduction in plants?* Lecturer 6 repeated the question several times while encouraging the learners to write the answers as quickly as possible. He then told the learners to form pairs and share/discuss what they had written. The lecturer told the learners to sit down after sharing/discussing their ideas (see appendix 10, p. 621).

This phase was the beginning of the process of recognising the learners' ideas about the topic presented through the process of engagement. There was no other stimulus at his starting point. This was the style of starting lessons observed in all the 8 lecturers. However in 10.3% (3 out of 29) of the lessons observed the lecturers used ball games to start a lesson. What followed was a series of questions where the learners were engaged and actively participated in different classroom activities in order to come up with solutions and/or

answers. Thus, the lecturers' view of learner engagement is that they should pose questions to learners to have the lesson delivered. Teachers must also challenge learners' thinking, allow them to ask questions, make hypotheses and test their validity (Fosnot, 2005) as required in Science and Technology. In some cases instead of asking lesson opening questions to the learners, the lecturers just summarised the previous lesson and introduced a new one. This was observed in 10.3% (3 out of 29) of the lessons by 2 lecturers. For example this is how lecturer 4 started his lesson 2;

.....last time, we looked at plants and today, we are going to look at animals. In animals, we have groups as well as in plants. The groups are put based on similarities and their differences.

There have been misconceptions about animals by learners. This time I want you to think of the misconceptions. Can you write quickly? Right what are the misconceptions? (see appendix 10, p. 576). The topic was teaching of animals and their environment. Each learner quickly wrote something in his/her note book. Later each learner was asked to say to class what they had written.....

The researcher observed that all the lecturers involved the learners in collaborative work/learning in all the classes conducted. This finding is in tandem with Hahn (2015) who reported that Danish Civic Education and English teachers adopted democratic practices such as group work and project work in civic classes. Democratic practices in the classroom bring about transformation and social change which translates into grooming socially responsible and active citizens who can critically reflect on societal

issues (Banks, 2017). For example, figure 4 shows learners in pairs sharing views about the previous lesson.



Figure 4: Learners in a think-pair-share activity during a lesson

As seen from figure 4, the lecturers allowed the learners to discuss concepts and ideas. This classroom practice resulted in a more equitable power balance in class since the learners were at liberty to make contributions, ask or answer questions from fellow learners, agree or disagree with fellow learners. The learners felt empowered when the lecturers listened to their arguments. The lecturers assisted the learners to develop learning skills like communicating, listening to peers, guessing meanings of concepts, analysing situations, plus many more skills. Learner-centred teaching (LCT) should encourage collaboration (Weimer, M. 2002).

Learner engagement shown (in table 7, page 183) by the lecturers can be categorised into four;

Intellectual engagement: The lecturers created lessons, assignments, or experiments that appealed to the learners' interests or that stimulated their curiosity. For example, the lecturers introduced a unit of study with a problem or question that learners needed to solve or answer. The learners were asked to discuss or investigate a problem, determine the responses/findings or design an experiment. The lecturers also engaged the learners in asking questions during lessons.

Behavioural engagement: The lecturers established classroom routines that fostered the learners' behaviours conducive to learning. For example, during walk-around-talk-around activities, lecturers clapped hands which signalled to the learners that it's time to stop talking or discussions, return to their seats, or begin a new activity. The class regularly went into small groups or formed a circle for a group discussion, or the lecturers asked the learners to lead certain activities, or the lecturers asked the learners to clapp hands for a learner who had answered a question correctly. By introducing variations into classroom routines, the lecturers reduced the monotony and potential disengagement that might have occurred if the learners did similar things for extended periods of time.

Physical engagement: The lecturers used physical activities or routines to stimulate learners' learning or interest. For example, the use of physical motions and activities during the learning process. Instead of asking learners to answer questions aloud, the lecturers asked the learners to walk up to the chalkboard to answer a question or present a report

verbally while also writing the answers on the board. The learners were also involved in gallery walks, bus stop, ball bearing, freeze-mix- pair activities just to mention a few (in this case, the theory is that learners are more likely to remember information when they are using multiple parts of the brain at the same time—i.e. the various parts dedicated to speaking, writing, physical activity, etc.). The lecturers introduced short activities.

Social engagement: The lecturers used a variety of strategies to stimulate engagement through social interactions. For example, the learners were paired or grouped to work collaboratively on tasks. In addition, strategies such as demonstrations or experiments which required learners to make presentations of their work to the class. In these cases, participating actively in the activities improved engagement.

(b) Exploration

In the lessons, the lecturers had demonstrated the use of exploration mainly through engaging the learners in reading text books and group discussions. The purpose of the exploration phase is to engage learners mentally to organise the experiences they have acquired by forming connections with similar previous experiences and by discovering new applications for what they have learnt. This is where learners apply what they have learnt by expanding examples or providing additional exploratory experiences for stimulating learners' science enquiry skills, encouraging them to investigate further.

The learners were involved in very few experiments to experience phenomena, collect evidence through observations and measurement, tested ideas and tried to answer related

questions. For example, figures 5 a,b show learners investigating if light travels in straight lines and whether it can be refracted.



Figure 5a: Learners doing an experiment during class time to find out if light travels in straight lines



Figure 5b: Equipment the learners used during a lesson to investigate if light can be refracted.

The learners did experiments in 20.7% (6 out of 29) only of the lessons observed to explore new ideas. These lessons were for lecturers 1, 4, 5, 6 and 7. The learners (in small

groups) did some experiments, e.g. separation of mixtures in lecturer 1's lesson 2, lecturer 5's lesson 2, and properties of light in lecturer 7's lesson 4 (see appendix 10, p. 504, 612 and 682). This means no investigations or experiments were carried out in most lessons as per Science and Technology demands, e.g. the learners did not do any experiment in all three lessons for lecturer 2 (see appendix 10, p. 512).

In some lessons no exploration activities were done, e.g. in lesson 2 for lecturer 2 and in lessons 2, 5 and 6 for lecturer 7. In some lessons, the lecturers provided no specimens or materials during group discussions, e.g. in lesson 2 of lecturer 4 and lesson 3 of lecturer 6, no specimens were used as learners discussed about plants (see appendix 10, p. 576 and 638). In lecturer 2's second lesson, exploration was missed because it was observed that it was a consolidation lesson. The learners had an experiment/investigation in the previous lesson. So the lesson which followed was for presentations only and the lecturer explaining some concepts/ideas.

The learners read, analysed, discussed and identified topics which are taught in primary schools from standard 5 to 8 text books and teacher's guides (for example, in lesson 1 for lecturers 1, 4, 5, 6 and 7; in lesson 2 of lecturers 1, 3, and 8 and in lesson 3 for lecturer 3- see appendix 10, p. 488). The lecturers asked learners to discuss and identify scientific knowledge, skills, attitudes and values from topics under plants and their environment. They encouraged and observed learner to learner interactions through small group discussions, i.e. the lecturers promoted sharing of ideas among the learners. The learners went outside the classrooms on field trips/excursions to collect different plants or animals

for classification purposes (for example, lecturer 4: see appendix 10, p. 563). Figure 6 shows the learners collecting plants from the local environment in one of the lessons.



Figure 6: Learners collecting plants from the local environment as part of a learning process during class time.

The learners also formulated questions meant to investigate plants for further classifications and as a guide to the day's lesson (e.g. Lecturer 4, lesson 4, p. 592). The researcher wanted to know why these classroom practices were carried out by the lecturers, and, therefore, asked lecturer 1 in one of the post lesson interviews for clarifications;

Researcher: *During your lesson I observed that you asked learners to go outside the classroom for an excursion, you involved them in small group discussions, in pairs and at times you asked them to walk around and then talk around. I also observed that you were moving around in the classroom during small group discussion. Why did you do that?*

Lecturer 1: (Laughs). *You see, during teaching and learning processes the learners must be fully engaged in the lesson. All learners must be allowed to participate in the lessons.*

So I used the techniques you saw in order for learners to participate in the lesson. If learners participate in the lesson, they learn to listen to one another, they contribute and share ideas during group discussions. When learners are talking to each other they are actively involved and creatively constructing knowledge. That knowledge which they construct they will not easily forget it and they will use it. They also learn from their peers.

Learner-centred, using learner-centred teaching practices you look at learners, they will be participating in the lesson and you involve them in the activities. Sometimes you can come up with an activity or way of teaching and most of them will participate. The second thing is that it helps one to observe the learners as you know that some learners are reserved then in learner-centred teaching practices they will be free to interact and sometimes come up with ideas which are new to you.

At times some ideas, there are other things which you as a lecturer you have no knowledge of that so some learners may be having that knowledge. They may have got the information through research as demanded by the new curriculum. Eeeem, I feel relieved because we learn as a class and we construct knowledge as a class and that knowledge they construct they own it and do not lose it. I feel we are moving together and doing the thing together, as they are engaged in research and everyone does the work so we work together”.

The learners were engaged in activities (form) but not necessarily involved cognitively in the constructivist notion of building understanding based on previous knowledge (substance). This was evident as the lecturers engaged the learners in various LCT activities

within a lesson but stopped them (learners) from proceeding with a task/activity before they finished doing it once the allocated time to an activity had elapsed (all lecturers did this- see appendix 10, p. 488).

From these results it can, therefore, be concluded that hands-on activities were rarely carried out in the lessons. Although the learners conducted some experiments, it was observed that they were not made to think hard about what was identified or found out. For example, the learners were told to list topics/ideas, to read text books or to conduct an experiment about plants or animals or any other concept; but no probing or follow up questions were asked to the learners to make them think beyond what they observed (see lecturer 7's lesson 4, p. 682). Learners were just picking or verifying ideas and then report to class. There was little learning as the exploration was just about picking ideas or finding out but did not engage learners to think beyond what they observed (see appendix 10, p. 488).

Explorations in Science and Technology fulfils a variety of functions: to illustrate, verify or affirm science concepts or principles; to engage learners positively with the science enterprise (Hofstein & Lunetta, 2004); and to develop understandings of investigative methods in science, involving the gathering and use of evidence (Gott & Duggan, 1995). Exploration-based learning maximises teachers' time by providing real-time, meaningful data and analytics on learner performance and point-of-use, individualised instructional strategies, while time on learning is increased due to sustained learner motivation to learn. Targeted feedback forms the backbone of the success framework. Lecturers used hands-on

learning (though not most oftenly) to keep learners engaged in learning. Few questions that the lecturers asked were of higher-order (see appendix 10).

(c) Explanation

As for explanation, the learners got involved in small group discussions and/or doing tasks to generate explanations, compare ideas and relate evidence to explanations. Individual writing and drawing helped the learners to clarify ideas and explanations. The lecturers requested for justification for the learners' answers and /or ideas and explanations, for example in lecturers 2's and 3's second lessons, and in lecturer 4's lessons. However, in some cases the lecturers did not request for justification (evidence) for the learners' explanations, e.g. lecturers 1 and 7 displayed this type of behaviour. The learners were encouraged to reject/accept fellow learners' ideas with justifications (see appendix 10, 488).

All the 8 lecturers displayed the behaviour of dominating explanations of activities or after the learners' reports/ answers (appendix 10, p. 488). The lecturers were challenged with asking some yes/no questions which limited the learners from expressing their ideas fully, e.g. lecturer 3. Teacher's yes/no questions are mainly used to get general feedback from learners (Farahian & Rezaee, 2012). Lecturers 4 and 5 invited learners to raise their own questions and to express what they thought or knew about plants and their classifications and properties of light. Learners in groups discussed and designed experiments on properties of air pressure (in lesson 3 of lecturer 7) [see appendix 10].

The learners were engaged in small group writing/design to generate a communication

product (for example, poster, oral report, formal written report or presentation) with attention to form of argumentation and audience, and with integration of different modes for representing science ideas and findings. The lecturers trained the learners how to explain procedures for carrying out activities/experiments but to a smaller extent (done only in lesson 3 of lecturer 7: see appendix 10, p. 675). The lecturers explained almost everything including what the learners had said or reported about even if it was correct, a departure from learner-centredness. For example, in lecturer 8's fifth lesson instead of reminding the learners about alternate explanations the lecturer explained to the learners each and every point/idea that was raised by a learner (see appendix 10, p. 755). The following extract confirms this observation.

Researcher: *I observed that as the lesson progressed most learners gave correct answers to your questions as well as from fellow learners. However, you repeated all answers despite the fact that the answers were correct. Why did you do that? Why wouldn't you just tell the learners that all answers/ideas given by their colleagues were correct?*

Lecturer 5: *You are right. Some learners trust the teacher very much. When a fellow learner gives an answer or idea they don't take seriously unless they hear the same from their teacher. So there is a need for me to consolidate, I call it consolidation. You gave them the task/activity then you need to consolidate. When the teacher repeats the learners' responses, other learners certainly understand and take the points as correct.....sometimes it's a habit. Teachers do that because they are used to it. We feel we are the only ones with the information/knowledge. We feel that once we say*

something learners automatically understand. However, the best practice should have been that once learners give the correct answer/idea the teacher should simply say that's correct, that is a good idea, ... then I proceed with the lesson. Finally I have to emphasise that some learners believe and expect the teacher to say something about the answers/ideas given by fellow learners.

At times the lecturers immediately answered questions before the learners' inputs, for example in lecturer 8's third lesson and in lecturer 4's lessons, the learners were not given the opportunity to try out giving their opinions before the lecturer answered the questions. The tendency deviated from learner-centredness and had a potential to decrease learners' morale to give responses to class thereby leading to development of laziness and dependency on the lecturers. Weimer (2013) hints that teachers must do less telling so that learners can do more discovering. It was important to leave the explanation to the learners to find out how they understood the concepts.

(d) Elaboration

Elaboration was achieved through engaging the learners in few experiments, writing exercises or assignments (not often), working on problems or tasks to provide them with an opportunity to apply, clarify, extend and consolidate new conceptual understanding and skills. Some lecturers gave the learners class exercises or assignments to improve on their (learners') understanding of ideas and concepts. They encouraged the learners to do some research through reading in order to extend their knowledge and understanding on the concepts covered in the lessons, e.g. lecturer 5 did this in his lesson 2 (see appendix 10, p.

612). The lecturers made the learners prepare lessons and teach them to fellow learners applying the teaching methods which they had learnt in the classroom, e.g. lecturer 7's second lesson had this element.

The lecturers encouraged the learners to use what they had learned to explain or model some teaching and learning resources, e.g. sense organs, and to discuss about some ideas and concepts. For example, in lecturer 4's lesson 2, the learners discussed in pairs how they could teach about flowering and non flowering plants to standard 7 learners. The learners developed assessment tools on their own on some topics. The lecturers encouraged the learners to use what they had learned about assessment to explain a new event or idea on evaluation of primary school learners (e.g. lecturer 2, lesson 2, p. 523).

Further reading, individual and pair/group discussions were used to introduce additional concepts and clarify meanings. There were very few questions or activities that suggested extending or applying ideas/concepts to new situations by the learners. Almost all the questions or activities that lecturers assigned to learners required them (learners) to list/produce exactly what they had read from text books or were told in class by their lecturers (see appendix 10, p.488).

From these observations it is clear that the lecturers did very little to encourage or assist their learners to apply or extend what they had learnt to new situations and so develop a deeper understanding of the concepts or greater use of the knowledge and skills acquired/learnt. Therefore, the researcher concludes that in TTCs the lecturers' use of elaboration is at elementary level. Elaboration is the gist of the learning process (Bybee,

et al., 2006). When people learn it's when they should be able to use the knowledge and skills learnt. As learners use or apply the knowledge and skills, they learn new things, a process called knowledge construction.

In this phase learners transfer or apply their new knowledge and skills to new issues and problems (Bransford, et. al., 1999). In 48.3% (14 out of 29) of the lessons observed, the lecturers had shown elaboration. In lessons where lecturers had shown elaboration, it was not fully exploited by the lecturers. The evidence was that the lecturers had observable challenges with identifying additional questions or tasks for the learners to investigate, collect pertinent evidence and connect their newly constructed knowledge to the evidence through such processes as classifying, relating, inferring, predicting, and explaining (see appendix 10, p. 488). Thus, the learners were deprived of the opportunity to use their investigative skills to clarify and support their personal thinking. The pressure to cover the curriculum, especially prior to national examinations, did not encourage lecturers to often create the time needed to create the necessary conditions for transfer to occur. The learners were rarely exposed to experiments or enquiry activities which would build their capacity for science enquiry skills.

(e) Evaluation

Evaluation for learning was done through engaging the learners in discussions of open ended questions or writing and responses to open ended questions. In some cases the same/similar questions were used to those used in the engagement phase to generate additional evidence of the extent to which the learning outcomes had been achieved. The learners were engaged in reflections on changes to explanations generated in engagement

and evaluation phases to help learners be more metacognitively aware of their learning (see appendix 10, p. 488).

Evaluation in Science and Technology like in any other subject should involve use of assessment data to discover what learners are learning or not learning and to provide feedback to modify lesson plans and teaching methods where necessary. Formative feedback through asking questions, observing and judging the performance and products of learners, and administering assessment tasks of various designs assist teachers probe learners' understanding, consider how misconceptions and alternative theories are affecting their learning, and determine how they are able to apply what they know in new situations (Bybee, et al., 2006). The lecturers engaged the learners in formative assessment to provide feedback to the lecturers and the learners about development of experimental skills and conceptual understanding (see appendix 10, p. 488). In formative assessment informal observations, formal performance tasks, and written work are used during the inquiry lessons to assess the learners' developing understanding of concepts, principles, theories, and explanations to determine the level and growth of inquiry abilities (Bybee, et al., 2006).

The learners actively participated in the assessment and evaluation of their peers' understanding of concepts and ideas through learner-centred teaching (LCT) practices such as think-pair-share, gallery walk, bus stop and group discussions (see lecturer 4's lesson 1 in appendix 10, p. 563). The lecturers also engaged the learners in pens at the middle and authors chair activities where each learner said something or responded to a

question or shared with the whole class what they had learnt from a particular lesson (as in lecturer 1's lesson 2). The learners critiqued their colleagues' work and made additions or subtractions to the ideas raised or explanations made. In this way, the learners were able to peer assess each other. They shared their current thinking with each other (see appendix 10, p. 488).

In some lessons, the lecturers marked or checked the learners' responses/work, assisted individual learners on how best to answer questions, e.g. in lecturer 8's fifth lesson (see appendix 10, p. 755). Figure 7 shows lecturers (in white) assisting learners during group discussions.



Figure 7: Lecturers assisting learners while doing group work during a lesson in class

The lecturers observed the learners as they modelled or made (improvised) teaching and learning resources, e.g. human sense organs. The lecturers asked probing or follow up questions during presentations for the learners to clarify their ideas/explanations or guide the discussions.

During activities such as gallery walks, small group discussions, bus stops, freeze-mix-pair, experiments, e.t.c. the lecturers walked around to; check the learners' work progress, assist the learners who had problems, clarify the questions where need arose, to observe as the learners demonstrated their understanding of the concepts and performance of skills (All lecturers did this. See appendix 10). The lecturers invited the learners to raise their own questions about concepts or ideas. They invited learners to express what they knew or thought about concepts on the topics under study through the activities and question and answer techniques, e.g. plants, coordination in animals, properties and states of matter, animals and their environment. For example, in her lesson 1, lecturer 2 engaged learners in a ball game activity (see appendix 10, p. 488).

At times the lecturers instructed each group to visit other learners' groups to learn about what colleagues had done. Through activities such as gallery walks, bus stops, freeze-mix-pair, experiments, e.t.c. the lecturers encouraged the learners to assess each other and their own progress. The learners moved around from one work station to another where they observed, read or discussed what others had done/written, listened to peer presentations, made comments/observations or asked questions, and brainstormed some points/ideas about the work of their peers. Figure 8 shows learners moving around from station to station

during a gallery walk.



Figure 8: Learners moving from one station to another station to learn from one another during a lesson

Figure 8 shows learners moving from one place to another in order to learn from their colleagues' work. It was observed that all the lecturers allowed the learners to move freely in the classroom (see appendix 10). The practice of allowing learners to move freely in the classroom is a hallmark of LCT (McCombs and Whistler, 1997). It reflects and reinforces both values and practices of democracy, whereby learners take responsibility for their own learning. In a classroom where LCT methods are used, learners have the freedom to move freely in the classroom. By allowing the learners to move freely in the classroom, the researcher, therefore, concludes that the TTC Science and Technology lecturers practiced one of the main features of the learner-centred methods of teaching. Besides, by moving from one work station to another the

learners had the opportunity to assess fellow learners' work and were able to ask questions, make comments, add or subtract some information to their colleagues' work and answer questions from fellow learners. Peer-assessment help learners become self-directed learners.

The lecturers provided feedback and comments though not detailed or constructive. During in class questions and after learners' presentations, the lecturers gave feedback as well as explanations to the topics/concepts under discussion as one way of clarifying the matter or emphasising on the point. Phrases like well done, good, thank you, clap hands for him/her or re-explaining/repeating learners' responses were used as feed back to learners (see appendix 10, p. 488). This type of feed back was not helpful to the learners. The lecturers needed to explain about what learners had done well, what was not done well and what was expected from learners to do well. Furthermore, the lecturers needed to give the learners questions or tasks which would guide them (learners) arrive at the right answers other than just telling the learners what the correct answer was.

The lecturers also asked the learners to make observations or comments on fellow learners' work/responses. It was observed that feedback was mainly directed toward the person, not the performance, lecturers used evaluative, rather than descriptive language (All lecturers did this. See appendix 10, p. 488). The feedback was immediate and well-timed. Grades were not assigned to class discussions, answering of oral questions or presentations. This observation agrees with Randall and Zundel's (2012) observation that assessment is much more than grading. Randall and Zundel (2012) hint that assessment

represents defining the criteria that can be observed, observing the performance, judging the performance, informing the learners of the results and giving advice on how to improve.

In this study the lecturers mainly used reflective evaluation where learners were expected to respond to a wide range of intellectual tasks. For example, learners recalled essential information, analysed information that was provided, applied what they had learnt to new but related situations (though rarely done), and intergrated information to construct answers to unusual situations (see appendix 10). The lecturers followed the principle of reflective learning because they gave the learners chances to summarise their own work but without their (lecturers') guidance. For example in lecturer 6's lesson 1 (p.621); the learners were made to make a summary of their small group discussions and then make presentations to class (see appendix 10). In addition, this classroom practice was observed in all the 29 lessons (see appendix 10, p. 488). Reflective learning as analysed by Mc Combs (2008) is not just telling learners what is right and/or wrong answers but through helping them to come to the understanding of the concepts for themselves. In this study, however, classroom observation had shown that the lecturers rarely helped the learners to come to the understanding of the concepts for themselves (learners). For example, in the observed lessons, class exercises were rarely administered to the learners. However, in his lesson 1, lecturer 5 gave an assignment to the learners (see p. 596). Therefore, it is assumed that the lecturers by not giving class exercises nor frequent assignments to the learners to do and not marking their (the learners') work, they (the lecturers) missed the principle of reflective learning, which is one of the elements of learner-centred approaches.

Hands on evaluation was rarely shown by the lecturers (see appendix 10, p. 488). Hands-on evaluation is where learners manipulate materials from the lesson to complete tasks that enable them to demonstrate what they understand. Hands-on evaluation permits teachers to observe how well a learner can perform.

4.5 Question 2: Why do they choose those classroom practices?

This part of the study sought to generate data about the lecturers' reasons for their choices of the observed classroom practices (see appendix 7, p. 372). Table 8 gives a summary of respondents' responses about their choices of the classroom practices which were observed as the lessons progressed. The lecturers' responses matched with Bybee's 5Es: Engagement, Exploration, Explanation, Elaboration and Evaluation.

Table 8: Summary of respondents' reasons for their choice of the displayed classroom practices

Bybee's 5Es element	Classroom practice	Respondent's reason(s) for the displayed classroom practice
	Lecturer asking questions	Learner engagement, lecturer interacts with learners, learners share their experiences or knowledge, for assessment, to assist learners link new experiences with existing knowledge when the new concept is being introduced- it is reflected from what they already know

	Learners listening to explanations	To make the lessons learner-centred
	Learners discussing activities	To make the lessons learner-centred
Engagement	Learners working in pairs, small groups, and walk around, talk around.	To fully engage learners in the lessons- learners participate: listening, make contributions, share ideas, learn from their peers
	Group work	Large content coverage within a short time, assists learners to speak or share ideas freely, learners help each other, encourages and promotes team spirit in learners, a teacher can get some new information from learners.
	Jig saw	Learners own content and become experts, full participation
	Walk around talk around	Learners share information, learn from each other, get many different views from fellow learners
	A letter to the author	All learners get engaged. Each learner becomes very busy writing in his/her notebook. High learner engagement.
	Bus stop	Different concepts are done in different spots, learners share and contribute ideas, learners

	allowed to add or subtract ideas, learners are very free to express themselves, learners assess each other
Small group work, walk around talk around, gallery walk activities, think-pair-share, jigsaw, mix-freeze-pair activities.	To promote learners' participation in the lessons- allow learners an opportunity to take part in the lesson. Promote sharing of ideas and learning from one another, ask each other questions, learners may develop critical thinking
Pair work, speaking in chains, classroom discussions	All learners get involved in class activities, all learners are given chances to contribute to the discussions/speak,
Role play	Does not need teaching and learning resources Done if inadequate resources are available, if
Demonstrations	the task poses danger to learners, for teacher to control lesson activities
Quick write activity	To find out if learners had enough information on the topic understudy
Group leaders distributing resources in class	To train learners to be responsible enough

Learners collecting teaching and learning resources	To have adequate resources available, resources
One stays three astray	Learner interaction improved, each shares what they have learned, learners learn from one another
Taking learners outside the classroom into the local environment	For learners to know how animals live and their (animals) real habit/behaviour, to study the local environment- to see nature. For learners to collect and interact with the teaching and learning resources, data collection, observing and classifying nature, discussing concepts/ideas, reporting
Learners working in pairs, small groups, and walk around, talk around.	For learners participation: listening, make contributions, share ideas, learn from their peers
Use of teaching and learning resources	Caters for diverse learning in learners, enables learners to learn through hearing, smelling, feeling as well as sight, easy explanation of concepts, make the work easy, make the meaning of a concept to be easily understood,

	understanding by the learner also becomes very easy, promotes learner engagement
Learners asking questions	To make the lessons learner-centred, seek for clarification of a concept or idea, teacher is not the only source of knowledge, to give them an opportunity to seek clarification, learner had full understanding of the concepts but have interpreted the concept more than it should be, lack of information.
Exploration	
Learners reading other learners' work	To learn from each other, assessment
Giving learners tasks to do in pairs or in small groups	Help learners generate the content
Experiments, field trips or excursions	Inquiring and development of the learners' skills, shaping learners into future scientists who will be able to carry out science research on their own.
Learners searching for information and come up with responses	Empowering learners
Learners making presentations	To make the lessons learner-centred, learners assess each other

Lecturer repeating learners' answers	Learners trust the teacher very much. Learners don't take seriously an answer or idea given by a fellow learner. They understand and take the points as correct if teacher says it. Sometimes it's a habit- teachers are used to repeating learners' answers. Teachers feel they are the only ones with the correct information/knowledge. They feel that once they say something learners automatically understand. some learners believe and expect the teacher to say something about the answers/ideas given by fellow learners.
Explanation	To convince other learners that the answer was correct, some learners are lazy and will wait for the teacher to say something, some learners do not have the capacity to identify the right from wrong, teachers are used to repeating learners' answers
Lecturing	Done when learners seem not to have no knowledge about lesson concepts, to help learners understand the lesson concepts.
Learners doing assignment tasks	To make the lessons learner-centred.

Elaboration	individually and in small groups	Learners practice skills learnt, to give learners a picture of what will be learnt in the next lesson
	Lecturer asking questions	For feedback- to check if learning is taking place, to find out if the learners understand what is being taught, to assess/determine the learners' prior knowledge about a concept. Assessment- to judge whether they have any other experience as related to what the teacher is asking about, to know if learners have mastered what has been practiced in a particular step before moving to another step. Assessing each other
	Learners asking questions	Seeking clarification of ideas or concepts, promotes autonomy and self-learning in learners, to determine whether learners are following or not and help to clear misconceptions arrived at during learning, for learners to assess other group's presentations and facts and come up with correct information
	Learners doing assignment individually	tasks To make the lessons learner-centred
	Pair or group work	Feedback from learners

Evaluation	Teacher moving around the classroom during a lesson	To supervise- to see to it that everybody is working, to check on groups with problems so as to give help to learners. To let learners ask questions for clarification sake. To guide on how to do things. Makes the learners to be serious and attentive. Assessment Evaluating how best a task is done, how best is each and every learner fairing so that teacher can know shortfalls which are required to be improved before the end of the lesson.
	A letter to the author	The focus is on learners who don't pay attention during lesson proceedings, to listen to the discussions to determine whether learners are doing the correct thing or not
	Classroom assessment	Assessment To find out what learners know about concepts in a lesson, and if learners remember anything from previous lessons, teacher to put in corrective measures
	Author's chair	Each learner becomes an expert on concepts/ideas, assessment

Observing learners doing activities	Assessment, teacher is able to notice challenges or misconceptions learners, teacher knows how to assist learners.
Oral questions, written exercises, performance exercises	Assessing learners, for feedback

From table 8, the post lesson interviews with the lecturers revealed several findings about their efforts in implementing learner-centred teaching (LCT) methods through their classroom practices. To ensure that the researcher got adequate information from each respondent, some indirect prompts were offered if a respondent was not forthcoming with information on their LCT classroom practices. For example questions about the types of interactions they experienced with their learners. Further questions were based on the respondents' responses. Using Bybee's, et al., (2006) 5Es the lecturers' responses on why they engaged in the classroom practices as observed during their lessons are outlined as follows;

Engagement

The lecturers have had the learners engaged in lesson activities. Engagement is a prerequisite for a productive learning experience. It gives teachers the moment-to-moment feedback they need to determine how well their efforts to motivate learners are working. Mitchell (1997) in Carmichael, et al., (2009) noted that teaching strategies that promote learner involvement and which learners find meaningful will hold learners' interest.

From table 8, all the lecturers mentioned that they achieved learner engagement and participation through classroom practices such as; excursions/field trips, individual or pair

or group work, classroom discussions, question and answer, walk around talk around, think-pair-share, jigsaw, mix-freeze-pair activities, designing and performing experiments (see appendix 7, p. 372). According to the lecturers, they employed these classroom practices in order to engage learners fully in the lessons and give them (learners) an opportunity to take part/participate in the teaching and learning processes in order to increase their learning and understanding of concepts/ideas. The post lesson interview extract below confirms this assertion;

Researcher: *Why did you use small group work, walk around talk around, and gallery walk activities in your lesson?*

Lecturer 4: *To promote learners' participation in the lesson.....Through participation learners share ideas, listen and learn from others. Yes, the methods simply promote sharing of ideas and learning from one another. In fact they are not critical thinking methods but the way how they are used can allow learners share ideas, ask each other questions. In the process learners may develop critical thinking. The methods just promote critical thinking in learners. It's possible to use the methods but learners do not become critical thinkers. All this methods allow learners to participate actively.*

The lecturers said the aim of the classroom practices (for example; group work, presentations, work stations, etc.) was to enhance learning and give autonomy to the learners and to promote listening, communication and critical thinking skills in the learners (see table 8, page 215; appendix 7, p. 372). The following post lesson interviews extracts confirm these assertions;

Researcher: *During the lesson I observed that you engaged learners in classroom practices such as walk around talk around, mix-freeze-pair, group work,etc. what were the reasons for doing that?*

Lecturer 2: (Laughs) *So I used the techniques you saw in order for learners to participate in the lesson. If learners participate in the lesson, they learn to listen to one another; they contribute and share ideas during group discussions. They also learn from their peers.*

The lecturers measured and interpreted the learners' learning through classroom participation and active engagement in lesson activities. Whenever they observed a learner taking part in an activity, they interpreted it as learning (see appendix 7, p. 372). The extract below confirms this observation;

Researcher: *I observed that the learners were engaged in group work as well as think-pair-share activities. Do you feel learning took place?*

Lecturer 2: *Yes I believe that the learning, teaching took place because the learners are allowed to do the activities.*

Even though learners may be working hard through their participation in various activities, this cannot be a guarantee that learning has taken place since it fails to give the lecturer the class' understanding of the instructional material. Learners can participate but contribute unimportant and irrelevant information (Herington & Weaven, 2008; appendix 7, p. 372). Therefore, there was need for assessment and evaluation accompanied by feedback to the learners. Without these, a lecturer cannot identify holes in learners' understanding of instructional materials.

Exploration

The respondents justified their classroom practices by saying that some classroom activities e.g. small group work, jig-saw, one stays three astray, oral questions, etc. allowed them to cover a lot of work within a short time. The lecturers said that learners contribute and share ideas and in certain instances come up with new ideas which the lecturer might have not known (see table 8, p.215). According to them learners also help each other through these classroom practices. Learners help and learn from peers.

The lecturers hinted that learning activities were also collaboratively done by the learners to train them (the learners) about cooperation, communication skills, argumentative skills, and emotional control skills. The implementation of a scientific approach in the 2017 TTC Science and Technology curriculum (in Malawi) which involves observing, questioning, exploring, reasoning and communicating is expected to transform the learning climate into a more active, collaborative, participatory, and stimulating ability to stimulate learners' critical and analytical thinking skills. In other words, learning is expected to be at a higher level in both the cognitive, affective, and psychomotor aspects.

Explanation

The lecturers indicated that some LCT classroom practices assist learners to speak freely to each other. Even those learners who look reserved and not willing to talk are encouraged and motivated to say something through peer interactions (see appendix 7- lecturer 4, p. 393). For example, think-pair-share, walk around talk around, e.t.c. encourage each learner

to speak to a colleague (see table 8, p. 215). The extract from a post lesson interview with lecturer 2 (p.377) confirms this assertion;

Researcher: *I observed that you used group work in most of the class activities. Why did you do that?*

Lecturer 2: *Group work assists learners to speak freely to each other. Some learners fail to speak freely in class but during small group discussions you find them making contributions. By allowing them to speak or share their ideas during small group discussions, the learners do more learning. Some learners don't like raising up their hands during class discussions. However, in small group discussions they will make an important point to the extent that their colleagues accept it. In so doing such learners feel encouraged and motivated to make contributions again in other lessons.*

During small group activities, learners help each other. Group work encourages and promotes team spirit in learners. Jig saw learning activities, for example, make learners become experts. They learn to do things together and depend on each other. During group discussions, a lecturer can get new ideas which he/she didn't have. A teacher can get some new information from learners.

Lecturer 2 concurred with the other lecturers on the reasons for the use of small group work, walk around talk around, gallery walk, classroom practices in a lesson. The post lesson interview extract with lecturer 8 confirms this assertion;

Lecturer 8: *For learners to get different information from others. They will learn from each other. For example, if its pair work it means I will talk with one person only but if its walk around talk around, it means I will talk with this one then I will leave, pair with another one talk with him/her then I leave again so on and so forth.... So I can get different views. In walk around talk around an individual gets paired with several learners one at a time, this means this learner will interact with many learners and in the process he/she will get different views from different learners. It enables learners of diverse abilities to learn at their own pace, learners are motivated in the process hence making teaching and learning exercise enjoyable (see appendix 7, p. 372).*

What the respondents said agree with Massouleh and Jooneghani (2012) who observe that in a learner-centred classroom, one will not find a teacher standing at the front of the classroom talking to rows of seated learners. Rather, he/she will likely see the learners working in small groups, moving about talking freely. During the lesson observations the learners actively participated in small group discussions as well as classroom activities, asking or responding to questions as well as raising ideas. This helped the learners to speak freely thereby learning to express their ideas in a way that others could understand. This also helped them to improve their communication as well as explanation skills. They asked questions and performed activities which helped them to learn to obtain information to enhance their own understanding of a topic/lesson under discussion.

Elaboration

When asked why they used teaching and learning resources and reasons for engaging learners in field trips or excursions the respondents had this to say;

Researcher: *In the lesson you used teaching and learning resources? Any reasons for doing that?*

Lecturer 2: *Teaching and learning resources cater for diverse learning needs in learners. They also make learners understand concepts and/or ideas easily. Learners have different learning styles. Using teaching and learning resources enables learners to learn through hearing as well as sight. Use of teaching and learning resources help me in easy explanation of concepts, I don't struggle to convince my learners. I don't need to explain much. They make the meaning of a concept to be easily understood (see appendix 7, p. 372).*

Lecturer 7: *Excursions are important because they enable learners to observe specimens in their natural state- i.e. how and where they live, and their habit. They also promote learner participation and all learners get engaged in the activity-this improves listening and communication skills, learner contributions and exchange of ideas. Consequently, knowledge construction gets achieved and learners' learning got enhanced. Besides learners learn with and from one another'(see appendix 7, p. 372). The lecturers hinted that excursions may also help learners to come up with new ideas/ information through their investigations/ research.*

Evaluation

From their explanations during the post lesson interviews (see table 8, p. 215; appendix 7, p. 372), it was evident that the lecturers came up with ways to use evaluation to promote learning and to get feedback from the learners. For example, they asked questions, walked around the classroom and marked learners's work when the lesson was in progress.

Massouleh and Jooneghani (2012) hints that in an LCT classroom one notices the teacher walking around the room, bending over to talk with individual learners and small groups, asking questions and making suggestions. During the lessons, the lecturers used various formative assessment techniques to improve the learners' learning.

When asked why they performed the following classroom activities; supervision, asking probing questions, giving help to learners; the lecturers said the reason was to enhance learning through assessment for learning and to make learners to be very attentive and participate fully in the lessons. Learners become very much involved in the learning processes and in the process they (learners) become experts, e.g. doing jig saw and walk around talk around activities (see appendix 7, p. 372).

When asked why they asked questions or engaged the learners in asking questions during lessons, all the 8 lecturers said the practice was vital for the learners' learning as it assisted them (the lecturers) to assess the learners' prior knowledge and if they (the learners) had grasped the concepts taught, and to seek for clarification about concepts/ideas. The following extracts from post lesson interviews confirm these assertions;

Researcher: *Why did you ask questions during the lesson delivery?*

Lecturer 8: *I ask learners questions during lesson delivery so that they can reflect on their learning. I try to relate concepts with real life situations to help learners to apply the knowledge and skills (see appendix 7, p. 372).*

Researcher: *I observed that you introduced your lesson by asking questions, why did you do that?*

Lecturer 1: *During lesson deliveries I assess learners' prior knowledge by asking questions basing on the previous lesson related to the new lesson because there is need to know what they know. By asking questions that will check for their prior knowledge it helps me to know what they know on the topic to be covered (see appendix 7, p. 372).*

The lecturers indicated that some classroom practices made the learners reflect on their learning through guiding them (learners); giving them (learners) tasks to do; engaging them in question and answer, author's chair and letter to the author activities. The following extracts were the lecturers' responses;

Researcher: *I observed that you used group work in most of the class activities. Why did you do that?*

Lecturer 2: *It's like you want to get feedback from the learners. Group work also allows for a lot of content to be covered within a short time. If a lecturer has a lot of work to be done within a short time then group work is the best strategy. However, ensure that the group work is properly done (see appendix 7, p. 372).*

During the lesson observation it was observed that in some activities, the lecturer asked oral questions and learners used teaching and learning resources.

Researcher: *I observed that during the teaching and learning process you asked oral questions to the learners and at certain points you also asked learners to ask questions. One, why did you ask questions to the learners? Two, why did you ask learners to ask questions?*

Lecturer 2: *Teachers ask questions to learners to find out if the learners understand what is being taught. Are learners learning? Are we moving together? I asked questions to get feedback from the learners. Some questions are asked in order to determine the learners' prior knowledge. This is to find out how much the learners already know about a concept. So I ask questions to find out if they know anything about what I am going to teach. As to why I ask learners to ask questions, I allow them to do that so that they can seek for clarification of a concept or idea should need be. The questions are part of assessment of learning because I check how much the learners have understood what has already been taught. I check if we are moving together in the lesson (see appendix 7, p. 372). On the same question, lecturer 5 had this to say;*

Lecturer 5: *To give them an opportunity to seek clarification where they did not understand. Sometimes learners may ask questions where they had full understanding of the concepts but have interpret the concept more than it should be. So its in two ways either they did not understand, and therefore, need more information or they understood the concept more than expected. So out of interest they ask questions so that the teacher can explain more. Lack of information may lead learners to ask questions in class (see appendix 7, p. 372).*

Researcher: *I observed that you moved around in the classroom during the lesson more especially when learners were doing pair/group work. Why did you do that?*

Lecturer 7: *One, the focus is on learners who don't pay attention to what the other learners are doing. They will sit idle and never make any contributions, no input to what*

their peers are discussing or doing. Secondly, the aim is to listen to the discussions to determine whether learners are doing the correct thing or not. Sometimes, the lecturer may identify a group which is off track. Learners may be doing the given task different from what is expected of them. Learners may also have problems or face challenges to come up with what is required. In this case the lecturer will decide the type of guidance or support to be offered if he/she discovers that learners have have a problem. Thirdly, the lecturer has to check if learners are doing the correct things (see appendix 7, p. 372).

Researcher: *I observed that you engaged learners in a bus stop activity which is one example of the learner-centred teaching approaches. What are the reasons of such a learner-centred teaching approach?*

Lecturer 4: *Using the bus stop method, they were either you observed they were putting question marks on their colleagues work. I would go back to the star grass. Is this so? That was part of the assessment, to say but this cannot be a non-flowering plant but at the same time even as they were going round ah I saw one group actually wrote what, flowering and non-flowering plants to the other group which the other group had actually skipped. So that allowed aa assessment of learners aaa themselves. And even during the presentations right away, from the beginning ah we did say that ah can you ah there was there was there was one who used author's chair to to make a presentation and then I did say if you discover that something has not been indi has been indicated don't say it again, then someone said, no. they yah, so there was, I would say so and on my part I would also say that (see appendix 7, p. 372).*

Researcher: *During the lesson, why did you allow learners to ask questions?*

Lecturer 8: *Learners are also encouraged to ask questions where they are not sure so that the teacher can explain or clarify. This promotes autonomy and self learning in learners. During lessons, I give learners the opportunity to ask or answer questions. The questions would determine whether learners are following or not and help to clear misconceptions arrived at during learning. Learners may assess other group's presentations and facts and come up with correct information. Finally I consolidate the ideas presented by groups (see appendix 7, p. 372).*

The respondents understood their classroom role as that of a facilitator. This observation agrees with Tamelis' (2014) hint that teacher's role is that of the facilitator so the focus should be put on the learner; learners take responsibility for the study processes; the teacher creates study situations for the learners' active participation. The extracts that follow also confirm this;

Researcher: *In the introductory part of the lesson, you started by asking questions to the learners. Can you explain why you did that?*

Lecturer 8: *I introduce my lessons by asking questions in order to assess learners prior knowledge. When introducing the lesson I can ask them what they already know. In this way learners are motivated to learn by the way I introduce my lesson. This may also assist learners link new experiences with existing knowledge when the new concept is being introduced it is reflected from what they already know (see appendix 7, p. 372).*

According to the respondents the mentioned classroom practices encourage and promote team working spirit in learners, learners and their lecturers move and construct knowledge together, learners own and use the constructed knowledge and do not lose it easily. According to them, the learners discover knowledge on their own because of these classroom practices.

4.6 Question 3: How do such classroom practices show the learner-centredness of the lessons?

According to Machemer & Crawford (2007) the learner-centred teaching (LCT) philosophy is based on the premise that the learner is at the heart of the learning process. It promotes the learners' learning and autonomy. The most common classroom practices observed from all lecturers that indicated the learner-centredness of all the 29 lessons were those of engaging learners in cooperative learning where most of the activities were done in pairs or small groups. Individual work was also observed during the lessons. Through these teaching/learning styles learners had some autonomy and responsibility for their own learning (Weimer, 2013) despite the lecturers' control of the learning environment.

Within the cooperative learning style it was also very common in most lessons that the lecturers used verbal (linguistic) teaching style. In this style, learning was through the use of words in speech and print. Van Graan (1998) observed that most teachers were aware of the term learner-centred teaching (LCT) but many perceived it to be mostly group work activities. She, however, noted that the teachers used various techniques in their teaching to support learners in their learning. She further indicated that few of the observed group work activities reflected real co-operative learning where there was an authentic sharing of

knowledge, or support of one another in learning. In most of the observations she conducted, learners worked individually whenever there was an opportunity. She concluded that classroom practice was beginning to change but in most cases, in a superficial way simply by inclusion of group work as a method.

The lecturers also used question and answer approach as a way of instructional delivery. Classroom observations had shown that the lecturers' classroom practices fitted into the framework of this study- the 5Es. Table 9 is a summary of the respondents' classroom practices which showed the learner-centredness of the lessons;

Table 9: Summary of the lecturers' classroom practices which show the learner-centredness of the lessons

Theme	Classroom practices
	1. The lecturers interacted with the learners through asking questions, individual or whole class discussions, giving tasks and /or science practical work, asking follow up questions on the answers and/ or the outcomes of learners' tasks for learners to clarify their responses (the follow up questions were mostly recall questions meant for clarifications or to produce what was already learnt). The lecturers also followed up on the feedback from the learners on their answers or outcomes and allowed learners to ask questions.

Engagement	2. The lecturers actively and attentively interacted with their learners through giving remarks, writing on the chalkboard, giving instructions, distribution of text books, repeating the learners' answers, listening, walking around the classroom, determining time for an activity, giving explanations, rewarding the learners, determining who to answer a question, demonstrations, determining correct or wrong responses, the learners comparing own answers with the lecturers'. 3. The lecturers promoted and encouraged the interaction between and among learners and learner –materials through such activities as; asking or answering questions, mix-freeze-pair, brainstorming, think-ink-pair- share, jig saw, work stations, ball bearing, one stays three astray, writing, listening, reading text books or displayed chart papers, small group discussions, excursions, walk around talk around, classifying specimens, class presentations, making lesson summaries, comparing own answers with fellow learners'.
Exploration	1. Learners were involved in both minds-on and hands-on activities: i.e. instructions and tasks. 2. The lecturers engaged the learners in activities such as observations, research, experiments, small group discussions, excursions, brainstorming, walk around talk around, think-pair-share, jig saw, work stations, brainstorming, mix freeze pair, quick write, one stays three astray, reading text books, etc. Their

	outcomes were shared in class through presentations and discussion of the findings.
Explanation	1. Both the lecturers and the learners explained concepts and ideas during lessons. 2. The lecturers asked follow up questions for the learners to explain or clarify on their answers. Similarly, the learners asked questions to fellow learners or to the lecturers for clarification or further details of ideas and/or concepts.
Elaboration	1. In the lessons, facts or examples were provided in terms of application of scientific concepts in daily life. 2. The lecturers asked questions or assigned tasks that helped the learners to apply or extend their knowledge and skills to new or real life situations 3. In the lessons, the linkage between the lessons or science and daily life were mentioned based on the concrete relationship between learners' immediate learning environment and application of science.
Evaluation	1. No formal assessment was seen. 2. Assessment was superficial: Only a few simple questions which did not cover the lesson contents. The lecturers also moved around to monitor work progress and listen to group discussions

	3. Continuous individual or group type of assessment: Oral or at times written exercises (written exercises were very rare) , small and very few practical activities, experiments were given. 4. Assessment took place with well-structured questions but mostly not according to Blooms taxonomy focusing on individual learners. 5. The lecturers mostly assessed lesson successes and not learners' learning: used question and answer, a letter to the author, pens at the middle, author's chair, hot seat, card collecting and clustering, e.t.c.

Referring to table 9, the classroom practices regarding learner-centred teaching (LCT) displayed by the Science and Technology lecturers were as follows; question and answer, small group or class discussions, field trips, observation, research, experiments, walk around talk around, think-pair- share, jig saw, work stations, brainstorming, mix freeze pair, quick write, one stays three astray, etc (see appendix 10, p. 488). Therefore, all the lecturers' knowledge of instructional strategies involved providing a variety of activities and using multiple classroom practices in their lessons, thus making their lessons learner-centred. It can be concluded that the lecturers' knowledge of instructional strategy involves providing relevant activities and teaching and learning resources which they do during experiments or small group discussions, giving appropriate examples and diagrams in their lessons (Magnusson et al., 1999). An extract from a post lesson observation interview with lecturer 7 supports the observations (see appendix 7, p. 372);

Researcher: *What are the commonly classroom practices which are being used in class?*

Lecturer 7: *Very common are gallery walk, think-pair-share, work stations, walk around talk around, also we use projects. In Science and Technology , we emphasize about inquiry skills, experiments, projects, modified group work in some topics, card collection, brainstorming, and sometimes ball bearing, field work. Ah we take the learners to the field and carry out some observations.*

The lecturers used visual and kinesthetic learning styles where learners did both hands-on (not oftenly used) and minds-on activities (see appendix 10, p. 488). For example, where the lecturers needed learners to share previous knowledge and experiences, they mostly used pair/group work, think-pair-share, bus stop, walk around talk around, one stays three astray, jigsaw, freeze-mix-pair and ball game activities (see appendix 10, p. 488). Generally, the researcher observed the lecturers moving around to groups and clarifying concepts, and even responding to some pertinent questions.

The lecturers also administered questions and activities/tasks which called for the learners' higher order thinking abilities (although not frequent). For example; 5 out of the 8 lecturers gave the learners apparatus to design and conduct experiments, 2 lecturers gave the learners a topic (s) and they (learners) were asked to come up with concepts to be learnt. Four lecturers gave the learners a topic and they (learners) were told to get resources from outside the classroom within the local environment suitable for teaching such a topic, e.t.c.(see appendix 10, p. 488). Some follow up questions such as, *How do you correct misconceptions learners have about? How can you justify.....?* called for

higher order thinking abilities because one needed to explain thoroughly to convince the lecturers.

It was observed that the lecturers used teaching and learning resources in most of the lessons (see appendix 10, p. 488). This classroom practice was in line with MIE (2017) who asserts that teaching and learning resources help the teacher to make teaching realistic and meaningful. In some cases, the lecturers engaged the learners to fetch and identify the resources for a lesson using the local environment eg, classification of plants (for example, lecturer 4 did this- see appendix 10, p. 488). While others engaged the learners to make the resources that could be used to teach a given topic. The learners brought materials and made resources for specific topics eg part of an eye, brain and ear.

The lecturers used both commercial and non-commercial resources. The resources were distributed to the learners to conduct an experiment/ practical work, eg, card boards for properties of light, winged seeds. Figure 9 shows both the learners and the lecturer outside the classroom fetching for and collecting plants (non commercial resources) for a lesson.



Figure 9: Learners collecting plants during a lesson to be used for plants classification

All the 8 lecturers showed the learners resources as they taught eg, human skeleton, central nervous system (see appendix 10, p. 488). This was one way of content delivery. When teaching the topic, ‘Properties of light’, the lecturers distributed apparatus to the learners for them to conduct an experiment. Experiments enable learners to retain what they have learnt in science compared to other learning approaches (Toplis, 2012). This is similar to the views stated by learners during the interviews conducted by Toplis (2012) in which the learners mentioned that practical work enabled them to retain what they had learnt in science compared to other learning approaches. A similar finding was also recorded by Murphy and Beggs (2003, p.113) in which learners stated that experiments help them to remember new things and enable them to understand in more detail compared to notes copying.

4.7 Discussion of the findings

4.7.1. Question 1: What are the classroom practices of TTC Science and Technology lecturers?

Question 1 of the study centred on the Science and Technology lecturers' classroom practices. So this study aimed at exploring TTC lecturers' LCT classroom practices and compare them with Bybee's, et al., (2006) 5Es learning model in order to determine whether the lecturers understood and followed the learner-centred teaching (LCT) philosophy or not in their lesson deliveries. Lessons observations data reveal that there were relatively similar approaches to the lecturers' classroom practices across the 29 lessons observed (see appendix 10 and 11, p. 488 and 766 respectively).

From the classroom observations, all the 5Es (and hence, LCT classroom practices) were evident in many of the lecturers' lessons (see table 7, p. 183; appendices 10 and 11, p. 488 and 766 respectively). This could be because all the lecturers were oriented in LCT methods (see table 6, p. 149). In other words, the lecturers were exposed to and trained in learner-centred teaching (LCT) methods. Besides, the TTC Science and Technology curriculum demands full implementation of LCT methods in the classrooms (MIE, 2017). Consequently all the lecturers ensured that whatever they did in the classroom must be in line with the learner-centred teaching (LCT) philosophy as well as the demands of the curriculum.

Bybee's, et al., (2006) engagement, explanation and evaluation (3Es) learning cycles were never missed in all the lessons observed. The other 2Es, exploration and elaboration were

not shown either in one or two of the lecturers' lessons except for lecturers 1 and 5 who had shown all the 5Es in all their lessons (see table 7, p.183; appendix 10, p. 488). This could be due to the nature of the lessons and the lecturers rushing against time to cover the syllabus, the lecturers not being creative enough or failure to understand the LCT procedures to include them (exploration and elaboration) in the lessons. Tomlinson and Imbeau (2010) observed that content coverage is the responsibility of the teachers but this does not guarantee that learners will understand what has been covered. The lecturers had shown little creativity to engage the learners in activities which would assist them in scientific inquiries about and application of the concepts or ideas learnt (see appendix 10, p. 488). In the sampled TTC this is what is happening about learner-centred teaching (LCT) in the teaching of Science and Technology based on Bybee's, et al., (2006) 5Es;

(a) Engagement

Having observed 29 Science and Technology lessons for 8 lecturers, the study findings reveal that LCT is being implemented in the TTC classrooms although at an elementary (surface) level. This finding is in agreement with the study findings by Chipshiko and Shawa (2014) who indicated that there exists some LCT practices in the classrooms in Malawi. In this study, it was observed that the learners were asked recall questions where they just listed or reproduced what was already said in the classroom (see appendix 10, p.488). This is in agreement with Hill and Flynn (2008) cited in Diaz et.al. (2013) who hinted that many teachers tend to ask questions that require the recall of factual information.

The findings have shown that TTC lecturers are incorporating LCT methods that are congruent with their own understanding. For example, in his lesson 2 lecturer 6 modified a ‘one stays and three astray’ method by giving the same task to all groups instead of a different task to each group (see appendix 10, p. 633). Similarly, in lecturer 4’s lesson 1 a modified ‘bus stop’ method was used. The lecturer did not assign one learner to the groups who could be explaining a group’s work to visitors (see appendix 10, p. 563). The biggest shift in the lecturers’ practices was in moving away from the concept of power distance and adopting a closer relationship with their learners in terms of classroom involvement, discussions, support, and decision-making (see appendices 10 and 11, p. 488 and 766). The lecturers held a strong lecturer -learner relationship through classroom interactions. Similar results have been found in another study conducted in Hong Kong (Bao & Lam, 2008) where teacher- learner relationship was seen to be stronger than the learner- learner relationship.

Establishing close bonds with the learners enabled the lecturers to give the learners some autonomy in the teaching and learning process within the classroom since they have realised that traditional practices like rote memorisation, chalk-talk, and drilling exercises were not successful in acquisition of skills or engagement (see appendix 7, 372). Considering Science and Technology lecturers’ understanding of learner-centred teaching (LCT) philosophy, the findings from the post lesson interviews as well as classroom observations (or classroom practices) indicate that all the respondents in the study understand it (LCT) [see appendices 7, 9, 10 and 11, p. 372, 485, 488 and 766 respectively]. The lecturers’ classroom practices involved encouraging learners to ask

questions to both the lecturers and fellow learners; promoting learner participation and collaboration- learners working in groups, holding discussions and making presentations; promoting use of local materials and diagrams: these are activity driven and process orientations. These classroom practices agree with Weimer (2013) and Bybee's, et al., (2006) 5Es learning model which emphasise that the learner must be actively engaged in the teaching and learning processes. Infact, an increasing wealth of evidence confirms how active learner engagement significantly impacts their learning, understanding and critical thinking (Komarraju & Karau, 2008; Machemer & Crawford, 2007).

The lecturers engaged the learners in process, activity driven, conceptual change, inquiry and discovery orientations: i.e. they guided and allowed the learners to interact and do things on their own; the lessons involved activities, and the learners gave responses to questions. The learners used materials (in some lessons) and asked questions during the teaching and learning processes. They (learners) were involved and engaged in various activities, worked together and conducted experiments, discussed and rectified fellow learners' errors. This was observed in all the 8 lecturers during lesson observations (see appendices 10 and 11, p. 488 and 766). Bonwell & Eison (1991), Brookfield (2006) and Cavanagh (2011) argue that at least every 10- 15 minutes a lesson should be punctuated by a diversity of learning activities to keep learners focussed and engaged, which in turn will help them learn. Accordingly, Ayele, et al., (2007) contend that learner-centred teaching practices require the active participation of both teachers and learners.

Using learner-centred teaching (LCT) strategies, the success of any lesson can be gauged

by what the learners have learnt and how they have been involved in the learning process. In reaching this goal a teacher has to decide how to go about the business of teaching and create an environment in which learners have the opportunity to learn. Doyle (2011, p.1) hints that *Neuroscience, Biology, and Cognitive Science research makes it clear that the one who does the work does the learning*. Therefore, the teaching of Science and Technology should illustrate investigation, making creative connections and discovering more than one answer to scientific problems (Brookfield, 2006). The lecturers created a learning environment where all the learners benefited from a variety of learning techniques including individual, pair and small group work (see appendices 10 and 11, p. 488 and 766). The respondents' practices in the classroom involved brainstorming, discussions, demonstrations and use of teaching materials. This concurs with activity driven and conceptual change orientation from Magnusson et al.'s (1999) model of Science and Technology teaching orientation, which is classified as learner-centred. The learning environment facilitated learner engagement in various activities to some extent. This was observed as the lecturers just administered tasks to learners rarely accompanied by further/probing questions which would engage the learners in deep thinking about what was being taught (see appendix 10, p. 488). Enquiry was initiated at the engagement phase. In this phase, the lecturers probed prior knowledge and conceptions (and misconceptions) of learners and raised questions to be discussed or investigated.

All in all learners' engagement and participation in classroom activities is critical for the success of the lecturer and the class as a whole but is not complete in itself. It must be complemented by assessment and evaluation. Learners' active involvement and

participation in the teaching and learning process is a key part of the teaching and learning process (Nanney, 2004; Harden and Crosby, 2000, p. 335; Lea, et.al., 2003). When learners actively participate in their learning instead of just observing passively, they grasp concepts with greater clarity.

(b) Exploration

The categories in the data analysis that relate to the concept of learner-centred teaching (LCT) are the lecturers' use of resources, groupwork, a variety of tasks/activities and questions; their understanding of and engagement with learners' ideas; and their development of new knowledge in the learners (see appendix 10, p. 488). This classroom behaviour shown by the lecturers agrees with Schuitema, et al. (2018) who have posited that opportunities should be created for learners to express their views and create meanings in their learning. The TTC Science and Technology curriculum emphasises the use of a range of resources in order to enable learning (MIE, 2017). These include existing resources such as the chalkboard and textbooks, as well as ideas for new resources such as posters, learners' work, easily collectable objects, etc. Given the under-resourced contexts that most lecturers work in, the Science and Technology lecturers dealt with the development of cheap but appropriate resources for teaching. For example, in her lesson 5 lecturer 8 asked the learners to make an ear using clay soil, an eye with wires and human brain with hard papers (see appendix 10, p. 488)

The classroom practices data show that the activities and efforts done by the lecturers belonged to LCT category. Some facts supporting this assertion are; in the classrooms the

lecturers were not conveyors of information. It is the learners who did the hard messy work of learning (Weimer, 2013). They were not passive recipients of knowledge. Prince (2004) adds that the core elements of learner-centred teaching are learner activity and engagement in the learning process. The lecturers provided a variety of activities and teaching and learning resources (see appendix 10, p. 488). Labaree (2005) holds that activities make learners interact with one another and in this way they develop social qualities of community, cooperation, justice, democratic equality and tolerance for different points of view. Such qualities are necessary in preparing learners to operate in a democratic society.

The lecturers' classroom practices in this study made it evident that the lecturers relied on plenty of minds-on with very few hands-on activities and some interesting games for learning. For example, lecturers 2, 3 and 5 used ball games in their lessons (see appendix 10, p. 512, 538 and 596). The lecturers used the learners' cultural mindsets of not frequently asking questions to their lecturers; so the lecturers encouraged the learners to question everything. They used questioning as a tool to develop critical thinking skills among the learners. These observations overlap with how Science and Technology can be taught. LCT is one of the characteristics of the 2017 Science and Technology curriculum as stated in the Malawi Government National Education Sector Plan (ESIP, 2007-2017, p.49; MIE, 2017).

The lecturers use LCT classroom practices mainly at elementary level. This observation has been made because the learners were just made to memorise facts with little learning. Besides, all the lecturers asked the learners to reproduce what they had learnt or knew about

through question and answer activities (see appendix 10, p. 488). The learners are made just to list facts, review ideas of past lessons and there is little re-construction of knowledge. The lecturers don't encourage learners to come up with their own ideas. There are isolated cases where the learners are asked probing questions or do investigations. If an experiment or an enquiry is done, learners just list or confirm what they learnt about or what is already known or said. So LCT is surface and not deep. In other words, in the TTCs, LCT is at elementary level; the learners discuss tasks with no or very little new knowledge gained (see appendix 10, p. 488). This finding agrees with Mtika's and Gates' (2010) research findings. They carried out a study with teacher trainees in Malawi and the study revealed that the teacher trainees tended to apply LCT but only at surface level such as using group work activities where learners sit in groups but work individually.

This is against what is expected for teaching Science and Technology . Prince (2004, p.223) hints that there is broad but uneven support for the core elements of active, collaborative, co-operative and problem-based learning. This support is not just for learner involvement in activities per se but substantiates that the various kinds of learner engagement explored should result in better learning – i.e. longer retention of content, greater facility in applying what has been learned, deep understanding of the content, plus many more. Fosnot (2005) observes that teachers must challenge the learners' thinking, allow them to ask questions, make hypotheses and test their validity.

The lecturers controlled classes by allocating time for doing an activity, brought in teaching and learning materials, told learners what to learn and not how to learn. This observation

is similar with Kasakula's (2017) study findings that teachers dominate in class activities with little learner participation, except in question and answer discourse and during demonstration of experiments. Using lecturer 8's first lesson as an example (see appendix 10, p. 703), only 3 minutes were allocated for learners to think of, discuss about teaching methods and prepare teaching resources that could be used to teach a chosen topic/lesson. Similarly, in his lesson 4, lecturer 7 allocated 3 minutes only to investigate refraction of light (appendix 10, p. 682). This means the learners worked within impossible time limits in which case they rushed through the activities. This implies that the emphasis was on the lesson and not on learners' learning. This classroom behaviour is categorised as teacher centred (Weimer, 2013).

For the classroom practices used during the teaching and learning processes, the researcher wanted to know how the following were used; question-answer strategy, types of questions being asked to the learners, small group discussions, what learners discussed about and how they conducted experiments. On this, the findings show that in reality learners are not much encouraged to think critically (see appendix 10, p. 488). For this reason, they have to be involved and engaged so that they can construct their knowledge as suggested by learner-centred teaching proponents including Jean Piaget and Lev Vygotsky. These scholars and experts, in their theory of constructivism, say that learners should be more involved for a meaningful learning rather than being passive.

The lecturers emphasise on the lessons and the forms of learner-centred teaching practices (e.g. group work, questioning, bus stop, etc) and not on learners' learning (the substance). This was observed through the following classroom behaviours by the lecturers; telling

learners to stop discussing/performing a learning task even if nobody had finished their work or task, strict control of time and other resources, informal and no systematic evaluation being carried out in the classes with no records available for the learners' learning abilities. All the lecturers did not follow up learners as individuals. These observed factors would hinder proper follow up of individual learners' progress. In most cases no new knowledge was constructed but verification of the theories or concepts (see appendix 10, p. 488).

The lecturers take up learner-centred teaching (LCT) practices in different ways. Majority of the lecturers take up and emphasise on the form and with little substance of LCT but few managed to be substantively learner-centred. In analysing the lecturers' classroom practices the researcher came to describe the ways in which the lecturers were taking up classroom practices as an interaction between forms and substance. In most lessons the lecturers were taking up what the researcher called the forms of LCT without the substance, in few other lessons were taking up both forms and substance. The most dominant was form of LCT. Thus, the researcher's findings point to a predominance of forms of LCT classroom practices. The respondents are taking up forms of LCT which are rarely accompanied by the substance. Form refers to techniques such as giving tasks, activities, questioning, group work, gallery walk, jigsaw plus many more; while substance is about the knowledge that is generated through the LCT processes, i.e. ways lecturers elicit, construct and develop understanding in learners; ways learners ask questions and how lecturers respond to help them develop their thinking.

The lecturers allowed their learners to work in small groups while placing emphasis on individual work as well (see appendix 10, p. 488). This implies that the Science and Technology lecturers allowed their learners to work in groups. This finding agrees with the findings of Mpofu (2002) and Van Graan (1998) who reported that teachers usually allow learners to work in groups during the teaching and learning process which foster interaction and cooperation amongst the learners. Small group discussions challenge learner assumptions and improve problem-solving skills by requiring learners to interact with one another and course material (Millis, 2012). Pairs and other small group discussions have been shown to be powerful learning tools (Ambrose, 2010; Cavanagh, 2011; Doyle, 2011; Millis, 2010, 2012). Hamann, et al., (2012) emphasise that participation in small group discussions enhance learner learning. Additionally, when teachers use discussions, learners get to know each other better, raise questions on course materials. Science and Technology subject being an interactive and practical subject requires a lot of interactions between the learner and lesson contents hence, the need for learners to be allowed to work in groups in order to interact, socialise and learn from each other.

Group work enables learners to discuss, support each other, share and exchange their ideas and experiences and thus learn from each other more than from the teacher. This concurs with Brandes' and Ginnis' (1994) LCT principles and Magnusson et al.'s (1999) learner-centred orientations such as activity driven, inquiry, process and conceptual change. These observations also correspond with Darby's (2005) findings in which learners indicated that they were able to interact with their peers and were able to share their ideas or knowledge

during class discussions. Involving learners in group work and encouraging them to participate in discussions will increase their level of engagement in class activities. Group work is pinpointed by Brandes and Ginnis (1994, p. 33) as a key element of an LCT environment where learners sit in circular groups and are able to speak freely, express their opinions and share their feelings. Such classroom discussions encourage learners' inputs in an ongoing discourse (Martens & Jason, 2013).

The findings seem to suggest that group work method helps learners to take responsibility for their own learning. These findings are consistent with Schmuck and Slavin (1995), Njabili (1995), Kagan (1995), and Brandes & Ginnis (1996), assertions that responsibilities get shared among members of a group and as such learners became accountable for their own learning and for each others' learning. They noted that the working together of learners is a valuable asset in teaching, as it promotes co-operative work habits, a sense of competence and elevated self-esteem among learners.

Learners learn Science and Technology when the lesson is activity based (Panko et al., 2007). Activity based lessons include practical work and group activities that the learners engage in without necessarily doing an experiment. As the learners discussed tasks or worked in pairs/ groups, the lecturers moved around to check on the work progress, to ensure the proper distribution of materials had occurred and that groups had necessary materials and were proceeding as expected. However, the lecturers rarely asked probing questions regarding the tasks to engage the learners with content and make them think

critically. Thus, the respondents understood learner-centred teaching (LCT) as giving learners enough work/activities to do as individuals or in pairs or groups, using learners' previous knowledge in order to teach new information/knowledge and giving of assignments to learners to assess learning. Accordingly, Ayele, et al. (2007) contend that learner-centred approaches require the active participation of both teachers and learners.

Classroom discussion can help learners acquire better communication skills, as they learn to present ideas clearly and briefly; it also provides opportunities to practice listening to, and following what others are saying (Cashin, 2011; Kosko, 2012).

(c) Explanation

The lecturers gave explanations to guide learners thinking so that the concepts of the lessons were constructed cooperatively, not merely given by the lecturers. The common exchanges initiated by the lecturers illustrated a common pattern in classroom discourse, in which the lecturer asked a question, the learners responded and the lecturer made an evaluative comment, then asked another question and the pattern of 'question-response-evaluation' was repeated. This discourse involved plenty of interactions between the lecturers and the learners but in it the authority of the lecturers was unmistakable. In Science and Technology the teacher encourages deeper thinking, use of evidence and clarity of meaning, but by sharing in the exchanges rather than dominating them. The teacher does not evaluate the learners' responses but prompts them to express and explain them (MIE, 2017).

The lecturers called on the learners, added details to the learners' answers, offered examples, organised content, did the preview and the review of previous lessons (see appendix 10, p. 488). Such ways of implementing LCT were also observed during the pilot study carried out by the researcher in another TTC. The lecturers told the learners answers, introduced new ideas and explained a lot to learners (see appendices 10, p. 488). This observation shows that some elements of teacher centred teaching were displayed in the lecturers' classroom practices. In her studies in primary school education, Stuart (2002) found that teachers in Malawi paid lip service to learner-centered teaching (LCT) as well as participatory and active learning, but in reality they used the transmission style of teaching. A teacher centred (traditional) classroom allows for almost complete teacher authority such as teachers deciding on the content of learning, choosing instructional activities, setting the pace of learning, determining the conditions for learning and deciding on what and how to assess learning (Bunce, 2009).

The learners asked and answered questions, listened to the lecturers and each other and gave out ideas in their own words. Freedom of expression in class is an element of LCT (Brandes, and Ginnis, 1994). The view about asking questions as a preferred way to learn Science and Technology implies that freedom of expression in learner-centred classrooms is paramount. This meant that the lecturers believed that practicing effective interaction in the class also helps in the learners' learning. These findings agree with Weimer's' (2013) observations that successful teaching and learning is not *teaching that endlessly tells learners what they should do and what they should know*. Bybee, et al. (2006) encourages use of questions for a deeper understanding of concepts/ideas. Questions assist teachers to

identify gaps in learners about a concept/lesson. Learners in an LCT environment are free to ask and answer questions in the classroom without any fear (Weimer, 2013). At times the lecturers went from superficial questioning to deeper interrogation of the concepts under study. For example, in his lesson 5 lecturer 7's question '*why is it important to teach about mixtures to primary school learners?*' promoted critical thinking in the learners and was part of a deep interrogation (see appendix 10, p. 690).

There were group presentations after the activities (i.e. from pair or group discussions, doing tasks or experiments, e.t.c.) through which the learners were able to compare and contrast their findings. This gave the groups the opportunity to compare their ideas and /or results which created a discussion on how they differed from each other. The results were discussed, and summaries of these were written on chart papers and then pasted on the classroom walls or blackboard by members from each group. Thus the lecturers' knowledge of instructional strategy relates to their orientations towards the teaching of Science and Technology which are activity-driven and guided or discovery and inquiry, thus pointing to Magnusson et al.'s (1999) learner-centred teaching orientation which encourages the learners' active engagement in the classroom.

Elicitation of the learners' ideas which encouraged them to clarify their thinking was done to a certain extent (see appendices 10 and 11, p. 488 and 766 respectively). Alexander (2006) identifies a role for the teacher in verbal interactions, in the form of dialogic teaching. He describes this as a distinct pedagogical approach, which harnesses the power of talk to stimulate and extend learners' thinking, and to advance their learning and

understanding. It also enables the teacher more precisely to diagnose and assess learners. It is through dialogic teaching that teachers can steer classroom talk with specific goals in mind. In relation to Science and Technology this steer focuses on the use of evidence and may lead to what can be described as argumentation. This is different from an argument in daily life. In Science and Technology, goals of argumentation are to promote as much understanding of a situation as possible and to persuade colleagues of the validity of a specific idea (Alexander, 2006). Rather than trying to win an argument, as people often do in non-science contexts, a scientific argumentation is ideally about sharing, processing and learning about ideas. Following a scientific argumentation style, the lecturers asked the learners to conduct a discussion of the reported results/responses of the groups.

All the lecturers encouraged the learners to explain concepts and ideas in their own words. Alexander (2006) advocates for exploratory thinking and dialogue which should be encouraged in a classroom climate in which teachers expect learners to explain things, value their learners' ideas even if these are unformed and highly conjectural, avoid giving an impression that only the right answer is acceptable and that learners should be making a guess at it, judge when to intervene or when it is better to leave discussion among learners to proceed without interruption. The lecturers encouraged the learners to use their common experiences and data from both the engagement and exploration stages to develop explanations. This was evident through reporting of responses to class by group representatives. In some cases the lecturers asked questions that helped the learners express understanding and explanations. They requested justification (evidence) for the learners' explanations (see appendix 10, p. 488).

(d) Elaboration

The learners interacted with teaching and learning resources such as the internet, text books, the natural environment as well as science laboratory apparatus (Bybee, et al., 2006). This was evident as all the 8 lecturers encouraged the learners to use cell phones and text books to search for information during class time (see lecturer 1, lesson 1- appendix 10, p. 488). The lecturers developed and used their own locally developed resources / materials for teaching. For example, the lecturers used paper-made card boards and tins for learners to investigate the properties of light (see lecturer 7's lesson 4 in appendix 10, p. 682). They engaged the learners in using manipulative materials displayed in the classrooms to support all learning styles. The lecturers' practices are in line with Schuh (2004) who suggest that LCT requires a variety of instructional materials, more learner participation and that learners can work individually or in small groups.

Ainsworth (2006) observes that absence of teaching and learning materials may hinder the implementation of active learning approaches. Instructional material enable learners to use more than one sense and to facilitate active learning, relate theory to practice, encourage creative thinking and effective learner skill development hence make learning more meaningful (Ainsworth, 2006). Similarly, Sunzuma et al. (2012) highlight that effective teaching and learning is highly dependent on availability of teaching and learning resources because they give confidence to teachers by serving as a secure base from which content, teaching strategies and techniques are drawn. Shortage of these resources has negative implications for adoption of learner-centred methods (Ainsworth, 2006). Interaction with teaching and learning resources assists learners to comprehend text. Teaching and learning

resources prove to be a formidable supplement for teachers when the reinforcement of a skill or concept is necessary. Not only do they allow learners more time to practice, but they also present the information in a way which offers learners a different way to engage with the material.

Just as the interview data revealed, the data from classroom observations also showed that teachers did not advance much on activities that foster critical thinking and problem solving skills in learners during classroom instruction. This is because activities such as group work, discussions, think-pair-share, e.t.c. were not well monitored by the lecturers (see appendix 10, p. 488). Further, classroom observations showed that learners (individual or small groups) were given tasks that were not challenging to provoke thought in the learners. In other words tasks that were given in groups were not as complex as those that learners would likely meet in their real lives (see appendix 10, p. 488). In utilising strategies such as think-pair-share, walk around talk around, work station, gallery walk, e.t.c. it was observed that the lecturer did not provide space for learners to think individually first before pairing them with colleagues to share their thoughts.

All in all most activities by the lecturers rarely stimulated/provoked thought. Edwards and Mercer (1987) point to the pervasive initiation-response-feedback discourse pattern and argue that it reflects attempts by teachers to enable learner participation and activity, within the constraints of the classroom. As teachers respond to learner-centred policies, they find themselves in a dilemma, which Edwards and Mercer (1987, p. 126) call the *teacher's dilemma*, where teachers have to “*inculcate knowledge while apparently eliciting it. Thus,*

they ask questions, to which they usually know the answers, in order to encourage pupils to participate and to monitor their understanding. They do not engage with or follow up on pupils' meanings, but rather cue them to produce the correct answers which then form part of the teachers' developing narrative of the knowledge to be learned. In agreement with Edwards and Mercer (1987), Scrivener, (2012) hints that teachers tend to ask display questions that they already know the answer to. Thus the TTC lecturers' dilemma is produced by the constraints of having to teach a specified curriculum in a specified time while at the same time trying to be learner-centred.

In Science and Technology the following skills must be encouraged: observing, classifying, measuring, questioning, hypothesising, planning, predicting, and data interpretation. However, all the 8 lecturers emphasised on the following skills only; observing, classifying and data interpretation (see appendix 10, p. 488). One reason for not emphasising on the other skills could be lack of creativity and inadequate preparedness by the lecturers. Gellon, et.al (2005) observed that inquiry based science instruction is extremely challenging for teachers who have had no prior experience with inquiry based learning themselves, or have not participated in inquiry based lessons as learners, since it requires considerable conceptual changes regarding scientific knowledge and how it is constructed, and forces teachers to set up new learner participation paradigms in the classroom.

The findings of this study indicate a broad spectrum of interactions within classroom settings such as learner- lecturer, learner-learner, learner-instructional material and learner-

teaching resources interactions. Through the interactions the learners shared ideas and learned from each other. Rousseau (2004, p. 120) suggests that interaction has an important role to play in learning. Indeed, he has the same idea in mind as Vygotsky (1978) when he recommends that teachers increase the difficulty of the task in proportion to the learner's skill. The TTC lecturers used any number of formats to promote meaningful classroom interactions, such as cooperative learning (Johnson and Johnson, 2009) and peer questioning (King, 2002). In some cases the lecturers asked probing questions to help the learners make sense of their experiences. They provided time (though not adequate) for learners to work on activities and problems and before asking for responses. The lecturers acted as consultants for the learners (see appendix 10, p. 488).

The lecturers allowed the learners to teach one another through mini-lessons and presentations, e.g, lecturer 5 (see appendix 10, p. 596). It could be concluded from these findings that the Science and Technology lecturers at times allowed the learners to teach one other. These findings are in agreement with what Chipeta (1997) and McComb and Whistler (1997) said about learners teaching one another. They noted that the working together of learners is a valuable asset in teaching, as it promoted co-operative working habits, a sense of competence and elevated self-esteem among learners. Often, the case for learners learning from and with each other is a hard sell in heavily content-oriented disciplines, but the evidence from research on learner learning conducted by some researchers verifies more generic findings. For example, McCreary, et al. (2006) found that learners in laboratories led by fellow learners learned more than learners in laboratories taught by teachers. Similarly, Lewis and Lewis (2005) found that when one chemistry lecture per week was replaced by a guided discussion facilitated by

peers, learners in the discussion sections did not learn less (as measured by final exam scores), causing the researchers to conclude: *Fears that learners who had less exposure to lecture would learn less proved to be groundless* (p.139).

(e) Evaluation

Through asking questions the lecturers assessed and determined the learners' current understanding about concepts/ideas on topics under study and solicited ideas from the learners throughout the lessons. This enabled the lecturers to assess what the learners did or did not understand about the stated outcomes of the lessons (Bybee, et al., 2006). The lecturers assigned tasks to the learners for discussions through which the learners compared their ideas with those of others. Through answering questions and small group discussions, the learners expressed what they thought about concepts and ideas.

The lecturers provided time (though not adequate) for the learners to compare their ideas with those of others and perhaps to revise their thinking through pair or group discussions, presentations and gallery walks. Comments from both the lecturers and class members helped the learners to identify what they did well and what they needed to work on. This action helped the learners to; (a) direct their learning and drive knowledge construction; (b) foster discussion and debate, thereby enhancing the quality of discourse and classroom talk; (c) self-evaluate and monitor their understanding; and (d) increase their motivation and interest in a topic by arousing their epistemic curiosity (Alexander, 2006).

The lecturers created opportunities for the learners to participate in the evaluation/formative assessment processes through asking questions to fellow learners, reading and commenting on other learners' work. One way to reintegrate interaction in the context of Science and Technology is through formative assessment. The basis for this assertion is partly practical: in classroom environments, formative assessment represents an effective instructional strategy (Black & Wiliam, 1998; Fuchs & Fuchs, 1986). However, the theoretical basis for this suggestion derives from Dewey's (1997, p.7) idea that reflection uses a certain kind of raw material, described as the firm basis of reasons for the cognitions that a learner possesses. Possibly, this firm basis of reasons is constructed from the social interactions that a learner experiences.

Formative assessment has two qualities that seem to set it apart. First, it involves a learner and a competent peer or adult who guides the learner beyond their present capabilities. Second, it creates the potential for meaningful feedback and researchers have shown that feedback is a variable that promotes reflection (Ruiz-Primo & Furtak, 2004; Spalding & Wilson, 2002). Thus, for the internal assessments the respondents used varied modalities such as observations during small group discussions/activities, listening to learner presentations and informal questioning to assess/evaluate the learners' learning. The lecturers relied on verbal/oral questioning during in class evaluations. Assessment is part of the process of learning. As Knight (2002) has indicated, timely feedback and sound formative assessment practices are likely to enhance learning more than almost any educational innovation.

Other assessment methods were lecturers giving homework and sometimes asking the learners to talk, share, and present. It can thus be seen that these lecturers' understanding of evaluation and assessment is to prepare an activity to correct the learners' wrong answers (not concepts) from the activity. Through class reports and gallery walks the lecturers encouraged the learners to assess their own (the learners') learning/progress and group process skills. The gallery walk, walk-around talk around and author's chair activities entailed learning evaluation processes in which both the learners and the lecturers had to determine how much learning and understanding had taken place. This observation is in line with Papinczak et al.'s (2012) claim that learners following a learner-centred curriculum should be actively involved in the assessment process because this contributes to their learning. The learners would benefit from peer assessment which reflects learner-centred teaching (Gielen, et al., 2011). They contend that peer assessment is an arrangement in which individuals consider the amount, level, value, worthy, quality and success of the products of learning of peers of similar status. Zweck (2006) hints that the way the peer assessment is enacted and how learners are prepared for such practices can lead to very effective results. This entails that it is central that the TTC lecturers be oriented to learner-centred teaching strategies so that they employ varied ways to assess their learners effectively. At times, the lecturers looked for the evidence that the learners had changed their thinking or behaviours through asking probing questions and observation of classroom activities (see appendix 10, p. 488).

The lecturers gave feedback and work to support and enhance the learners' skills to do experiments and learning. They also welcomed the learners' questions and made efforts

to redirect to the class so that the other learners answer questions rather than the lecturers themselves. Hattie and Temperley (2007) argue about feedback to be among the most critical influences on learners' learning, but this impact can be either positive or negative. Feedback is even more effective when it is combined with remediation, as shown by a study conducted by James and Folorunso (2012), in which they investigated the effect of feedback and remediation on learner achievement in junior secondary school mathematics. The results showed that learners who were provided with feedback and remediation performed better than those who were provided with feedback without remediation.

Randall and Zundel (2012) observe that oral and written formative feedback are effective on learners' learning. Mayer (2008) adds that feedback is very important in the teaching and learning process since it serves to strengthen or weaken responses. Therefore, it is important for learners to get feedback from their teachers so that they know their strengths and weaknesses. Reflective learning as noted in literature by MoEST/InWent (2009) calls for continuous assessment to give the teacher feedback which can be used to develop remedial or enrichment activities.

McGuigan and Russell (2005) suggest that aspects of evaluation should include: teachers' use of a variety of ways of finding out and probing learners' ideas, the valuing of learners' expression of ideas, and the use of learners' ideas as the basis of formative assessment to be used in subsequent teaching. Application tasks for formative assessment might include further experimental work, discussion work, plus many more. Similarly, Chickering & Gamson (1987) observe that *learning is not a spectator sport*. This implies that learners

do not learn much just sitting in classes listening to teachers, memorising pre-packaged assignments, and spitting out answers. They must talk about what they are learning about, write reflectively about it, relate it to past experiences, and apply it to their daily lives. Millis, (2012) hints that as learners read, write, discuss and problem solve, they learn more. They must make what they learn part of themselves.

All the 8 lecturers' classroom practices focused on defining the learners' role in the classroom. In Science and Technology, learners' roles should be investigative, attentive and be involved in the lessons (Friedrichsen et al.'s, 2011). The role of learners as investigative could involve practical work/experiments such as discovery and inquiry, project based, guided inquiry. These methods encourage learners to be investigative as pointed by Magnusson et al.'s (1999) science teaching orientations and are learner-centred. The lecturers always created conditions and opportunities that encouraged or required learners to play important roles in the classroom. For example, they engaged the learners in evaluating peers and questioning others (though at a small scale) to develop self-confidence and leadership qualities. The lecturers let the learners discuss or do a task to find their own answers. Using classroom practices like group work, pair work, gallery walk, authors' chair, letter to the author, walk around talk around and one stays three astray, the lecturers let the learners evaluate each other and present to class (see appendices 10 and 11, p. 488 and 766).

Through these classroom practices the learners were able to discuss, support each other, share and exchange their ideas and experiences. This concurs with Brandes' and Ginnis'

(1994) LCT principles which hint that in learner- centred teaching learners support each other, share and exchange their ideas and experiences. These classroom activities are also in line with Weimer's (2013) observations that teachers should start identifying those teaching practices that tend to make learners dependent and those practices that develop autonomous learners.

The researcher faced the following challenges in using Bybee's, et al., (2006) BSCS 5Es learning cycle as an analytical tool for this study;

Context: the 5Es did not take into consideration the context under which they have to be implemented. For example, in Malawi, teaching and learning resources are inadequate or not available at all, the curriculum is examination oriented, large classes and inadequate training on the use of learner-centred teaching methods. These make it very hard to apply and implement the 5Es effectively.

Scope of application: the 5Es do not specify the extent of application of each stage of the 5Es.

For example, under the phase of explanation, its not clear to what extent should the teacher explain concepts or ideas.

4.7.2 Question 2: Why do they choose those classroom practices?

Question 2 focused on the reasons for the lecturers' choices of their classroom practices.

Engagement and exploration

All the 8 respondents hinted that classroom practices such as walk around talk around, mix-

freeze-pair, group work, experiments, etc. enabled learners to contribute, exchange and share ideas during the teaching and learning processes. Blumberg (2008) observes that in LCT, teachers do not employ a single teaching method but use different types of methods that shift the role of the instructors from givers of information to facilitators of learners' learning.

It should be noted that the major reasons given by the lecturers (in table 8, p. 215) for the use of LCT methods of teaching suggest that the respondents valued participation of their learners in the learning process. Respondents' reasons (given in table 8, p. 215) such as *'to stimulate the thinking skills of learners, to motivate learners to participate, to get learners more involved in the teaching/learning process, and to give feedback to teachers about what the learners know and do not know'* are consistent with the practices of the learner-centred approach to teaching. Diamond (2008) hints that active learner involvement is much more effective than passively listening to lectures and offers several insightful assessments.

Based on the post lesson interviews data, the lecturers (respondents) utilise multiple teaching techniques appropriate for learners' learning goals such as small group discussions, question and answer, review content, walk around talk around, jig saw, plus many more. Various teaching methods are expected to be implemented in learner-centred teaching in order to accommodate various learners' characteristics and needs including their learning styles. Besides, the use of a variety of teaching methods in accordance with the learning materials make learners have a deeper understanding of the material. They

(learners) are not only as memorisers, but most likely are able to apply their knowledge to real life situations. Through it the learners can have a more meaningful learning experience.

The post lesson interviews were conducted in order for the lecturers to clarify some of the classroom practices observed during lesson deliveries. During the interviews (both pre- and post lesson), the respondents responded positively that learner-centred teaching (LCT) prepares learners for lifelong learning. This is in line with an observation by Bogdan (2011) that LCT encourages learners to become independent and ultimately to be in charge of their own learning. Lifelong learning is a continuous supportive process which stimulates and empowers individuals to acquire all the knowledge, values, skills and understanding they will require throughout their lifetime and to apply them with confidence, creativity; enjoyment in all roles, circumstances, and environments (Collins, 2012). These can only be acquired through teaching strategies that are learner-centred (Tengku Kasim, 2010). In a learner-centred environment learners feel that the learning process is more interesting and are able to remember what they had learnt (Carlisle & Ibbotson, 2005; Azer, 2009; Segers et al., 2003).

All the 8 lecturers stated during both the pre and post lesson interviews that they were expected to implement LCT as strictly as possible. What the respondents said about their classroom practices during the interviews matched their classroom practices. LCT activities were evident during the observed lessons. The study findings suggest that the TTC Science and Technology lecturers know about learner-centred teaching (LCT) methods as evidenced through their classroom practices as well as their responses to post

lesson interviews. The challenge is to effectively put the LCT philosophy/concept into practice. Learners are not being fully engaged as demanded by the 5Es. The lecturers' pedagogical decision-making and practices were limited by their understanding of LCT methods, the curriculum demands and lack of or inadequate teaching and learning resources, less creativity and unpreparedness. This is supported by the literature which suggests that teachers' thinking and beliefs influence their teaching practices (Wilhelm & Li, 2008). Despite the lecturers' varied interpretation of knowledge construction in LCT environment, their classroom practices focused at achieving instructional objectives as per Science and Technology syllabus guidelines and demands.

The lecturers perceived their pedagogical decision-making to be directed by the Science and Technology syllabus which not only instructed them of what and when to teach, but also suggested how they should teach the content. This could mean that, the curriculum documents also influenced the lecturers' teaching practices. Therefore, the lecturers' varied conception of LCT and how knowledge construction occurs suggest the need for a common understanding of LCT among the Science and Technology lecturers. The lecturers' acquisition of a common understanding of LCT might consequently influence its effective implementation. According to Richardson, et al. (2017) a change in a teacher's beliefs precede a change in their classroom practices.

Elaboration

During the pre-lesson observation interviews, lecturers 1 and 7 said they gave assignments to their learners in order to increase their understanding of concepts (see p.

376 and 421). These findings seem to point to the fact that the Science and Technology lecturers have made significant strides towards the use of learner-centred methods of teaching in their classrooms.

Evaluation

Regarding assessment, the respondents believe that assessment techniques measuring higher order thinking skills were used so that the learners are not only able to know, understand and implement, but also to analyse and evaluate. When asked why they engaged the learners in classroom activities such as bus stop, jig saw, question and answer, peer marking, a letter to the author, etc. the lecturers said these classroom activities promote evaluation and assessment spirit in both learners and the teachers. The lecturers said that peer assessment was promoted through such classroom activities and that learning was made enjoyable, motivating and interesting. Evaluation also helped the lecturers to put in corrective measures for learning to take place.

Lecturers assess and give feedback to help learners improve on their (learners') understanding of concepts or ideas and skills improvement. Feedback can be obtained from learners through observations and listening to learners' small group discussions as the teacher moves around the classroom, both learner and teacher asking oral questions in the course of the lesson. From the post lesson interview discussions it was evident that the lecturers tried to integrate formative assessment (evaluation) within the learning processes as much as possible. By doing this under-prepared and non-traditional learners benefited from continual feedback and encouragement. Feedback plays a very important role on

learners' learning. Through this feedback, a learner can know the extent to which the material the teacher has taught has been mastered. With the feedback, learners can also cope with their own ability, or in other words as a corrective means of learner learning progress. As a result learners would listen, contribute to the small group or class discussions and consequently learn from each other (Bybee, et al., 2006).

The research results show that, in particular, the TTC lecturers appreciate especially the following classroom practices: the importance of engaging learners in the learning process, that the class is a place for discussions, learners are encouraged to be autonomous and that there was some form of shift in power relationships from the lecturers to the learners. The lecturers used content to capture the learners' curiosity and increase motivation. They considered themselves more as facilitators: they gave the learners high responsibility in classroom activities, and provided instant feedback.

4.7.3 Question 3: How do such classroom practices show the learner-centredness of the lessons?

This section will highlight some key ideas to show the learner-centredness of the lecturers' classroom practices including the aspects showing that the TTC lecturers' classroom practices belonged to surface learner-centred teaching (LCT). Using Bybee's (2006) 5Es learning cycle as a lens for analysing the lecturers' classroom practices, the researcher now presents the elements of the classroom practices that show the learner-centredness of the observed lessons.

Engagement

Based on the data from the observed and audio/video-recorded lessons, the findings of this study show that the LCT understanding of the TTC Science and Technology lecturers is limited mainly to oral question and answer, asking learners to do activities/tasks in class and pair/small group discussions methods as well as some experimentation (see appendix 10, p. 488). It is widely accepted that learners understand science concepts better when they conduct practical work (experimentation) and observe real events (Millar & Abrahams, 2009). Mji & Makgatho (2006) found that conducting experiments enhanced learner performance in science. Therefore, practical skill should be an important element in science teacher-development programmes. Burton (2011) found that the avoidance of practical work is caused by a lack of apparatus, while Muwanga-Zake (2000) found that it is related to a lack of teacher knowledge. The findings from these two studies indicate that, although lacking resources may sometimes be used as an excuse, the reasons for not conducting experiments may be multifaceted, including inadequate training of science teachers.

However, the observed classroom practices did not equip the learners with satisfactory knowledge and skills since the lecturers made the learners to reproduce what was already known (see appendix 10). These observations are similar to Stigler and Hiebert's (1999) findings who hinted that the limited number of LCT methods applied in Science and Technology teaching and learning were observed among American teachers.

The researcher mostly observed an ineffective questioning style characterised by simple questions in which the learners were asked to give, to state, to list et cetera with few “what, how and why” types of questions (see appendix 10) that have proved to promote high order thinking capacity (Ikeda & Matsubara, 2017). Omari (2018) expresses that asking questions can be a way to check learners’ progress from their informative feedback during classroom teaching and learning process. Inadequate use of oral question and answer method found in Malawi TTCs has also been found in Zambia and Rwanda where teachers were asking teacher – led responses and learners were almost forced to give the reply that the teacher expects without being given time to think scientifically on the question (Ikeda and Matsubara, 2017).

Classroom practices observation data showed more lecturer-learner interactions than learner-learner interactions. All the 8 lecturers initiated dialogue through asking questions in each and every lesson (see appendices 10 and 11, p. 488 and 766). Just as Croft (2002) and O’Sullivan (2004) observed that in some African countries LCT was shaped by contexts and centred much more on learning than on learners. The TTC lecturers were challenged with asking the learners to develop authentic questions from the learners’ own experiences with the world around them for investigation. In the classroom practices, all the lecturers did not provide enough guidance to the learners in formulating questions that could be investigated scientifically (See appendix 10). This was the case in 28 out of the 29 lessons observed. Learners learn from teachers how to ask good questions (National Research Council, 1996).

In 28 out of the 29 (96.6%) lessons observed it was the lecturer only who guided the lesson by raising questions for discussions by the learners (see appendix 10, p. 488). Only in lecturer 4's lesson 4 did the learners formulate questions meant to investigate plants for further classifications and as a guide to the day's lesson (see p. 592). Learners' questions play an important role in meaningful learning and scientific inquiry. They are a potential resource for both teaching and learning science. Developing deliberative skills seem to be key to promoting democratic citizenship in learners (Enslin, et al., 2001). As Dewey (1985) and (Ginsburg 2010) note, democracy gets practiced by learners in the classroom when they learn to share ideas, respect each others' views and develop ways of sustaining and elaborating their arguments.

Generally, the learners were given pre-planned tasks from their modules or on chart papers. Thus the lecturers' understanding of the LCT methods is not complete: the notion of meaningful learning through learners constructing their own learning seems not to have been well understood by the Science and Technology lecturers. This observation agrees with researches and monitoring done on teachers' and teacher educators' perceptions and practice of learner-centred teaching (LCT) by Sibuku (1997), Van Graan (1998), Shinyemba (1999), and Pomuti (2000), which reveal that although many teachers are familiar with the term LCT, only a few of them have a deeper understanding of the concept and its implications.

The lecturers administered various classroom activities to the learners. However, the activities did not fully engage the learners. The lecturers were challenged with creating an

environment for the learners to use their previous knowledge for learning. They rarely engaged the learners with the content. The learners were given obvious tasks not really challenging to make them think deeply. Engagement was observed when the learners were asked about their prior knowledge. The learners were not involved much beyond what they already knew about. The lecturers were limited to few things only but other issues about engagement were not coming out. For example, in all the 29 lessons observed, the lecturers always took charge/control of all classroom activities and controlled classes by assigning tasks to the learners to do, gave directions and instructions, allocated the time for doing activities, brought to class teaching and learning materials, decided for learners what to learn and what not to learn (see appendix 10, p.488). This explanation shows evidences that there was surface learner engagement in the classrooms.

Exploration

The lecturers engaged the learners in pair and/or small group activities or discussions, presentations, e.t.c. Doyle (2011) hints that learners working with others get exposed to different ways of thinking, have improved intellectual ability, learn to express feelings. The learner-centred teaching (LCT) principle which emphasises learning by doing (Hackthorn, et al., 2011) was followed by the lecturers (see appendices 7, 8, 9, 10 and 11). This principle follows that learning should be interesting and that learners must be active (Nanney, 2004; Harden & Crosby, 2000, p. 335; Lea, et.al. 2003). In agreement with this view, Gallagher (2003) observes that the individual learner must be an actor rather than a spectator. The pre- lesson observation interviews during both pilot and main study, the post- lesson discussion with respondents (appendices 7, 8 and 9, p. 372, 456 and 485) and

the lesson observations (appendices 10 and 11, p. 488 and 766 respectively) have shown that all the 8 lecturers understood the LCT principle that learners must be actively engaged (in doing activities or discussions) for learning to take place. However, classroom observation had also shown that in some cases the learners were treated as spectators. The lecturers were seen dominating the lessons by controlling time, group discussions, resources, giving lengthier explanations than the learners, e.t.c. as shown in appendix 10, p. 488.

The learners did experiments in 20.7% (6 out of 29) only of the lessons. However, it has been further observed that experimentation methods used in the science lessons were seen not to give chance to the learners to develop their thinking capacity through either prediction or presentation of their findings. The same challenge of not permitting learners to develop their mind was also found when they were requested to answer questions in the classroom. For Science and Technology teachers, it is much imperative to use other methods such as close and open ended questions for helping learners to develop their thinking capacity so that they can deal with today's daily challenges.

From the identified classroom practices, the researcher is asking himself how the TTC lecturers with limited practical skills and knowledge of learner-centred teaching (LCT) methods effectively implement a competence - based curriculum currently adopted in Malawi. The possible way to deal with the aforementioned challenges is through capacitating prospective lecturers and in-service lecturers. Thus the capacity to innovate (Rogan & Grayson, 2003) is critical to the effective implementation of the TTC Science

and Technology curriculum. Therefore, a zone of feasible innovation has to be created where individual lecturers at first identify their strengths and weaknesses and then after consider them for building on what they are able to do. After that, they will be exposed to various methods of learner-centred education.

Some lecturers did not even know the names of some LCT methods and left them in suspense without being completed. This was evident during lesson observations and confirmed during post lesson discussions when lecturer 8 confessed that she did not know the names of the learner-centred teaching methods she was using leading to classroom activities (appendix 7, p. 441). It seems that these lecturers do not have an in-depth understanding of the LCT concept. The limited theoretical understanding in TTC lecturers is justified with the insufficient pedagogical knowledge on other methods of LCT such as problem solving, problem tree, concept map, backward teaching, teacher directed, discovery, project based, resource based, and KWL (know, want and learn) chart as the respondents reported not being aware of or hardly used these methods. Such an unsatisfactory pedagogic knowledge in implementing LCT prevents the TTC lecturers from teaching effectively since effective teaching is a function of pedagogic knowledge (Shulman, 1987) and institutionalised system for gradual, incremental improvements over time (Stigler and Hiebert, 1999). It also hampers the construction of knowledge as argued that knowledge is constructed through social interaction and is shared rather than an individual experience (Gergen, 1995; Vygotsky, 1978).

An example is lecturer 4. In his lesson 2 he used a K-W-L teaching method but not in the

way it is supposed to be done. As required, the K-W-L procedures demand that at the end of the topic/lesson, the teacher must record anything under L column but lecturer 4 (in his lesson 2) did not although he asked the learners what they had learnt in the lesson. Similarly, in the conclusion, he didn't find out from the learners using the W column what had been covered and not covered during the lesson. The lecturer did not ask or encourage the learners to research on the work not covered during the lesson, but he indicated to the learners that he would research for answers by himself to the unanswered questions about the lesson (see appendix 10, p. 576).

The lecturers rushed for time and this behaviour negatively affected the learners' learning. This observation concurs with Seng's (2014); Mtika and Gates's (2010); Aswegen and Dreyer's (2004) study findings which indicate lack of time as an impediment to learner-centred teaching (LCT) practices. Learners take a bit of time to get organised into groups and more time is needed for the group discussion. Yilmaz (2008) observes that LCT practices such as group work require enough time for learner- learner and learner - materials interaction. Class activities were allocated between 5 and 10 minutes which was not enough for meaningful learning (see appendix 10, p. 488).

After the allocated time to an activity had elapsed the lecturers told the learners to stop the activity regardless of whether the learners had finished the task or not. In this case the learners had less opportunity to mess around with the materials and ideas. They also had limited opportunity to try different ways to work on a task/ or problem. This was a contradiction with the exploration phase (Bybee, et al, 2006) in which learners must be

allowed ample time for their activities. The lecturers heavily controlled time such that the learners could not proceed with an activity as they wished (see appendix 10, p. 488). This disadvantaged slow learners. Diamond (2008) stresses that learners' efforts and involvement, such as hours spent studying, determine how much they learn; learners learn more through positive reinforcement and interactions with other learners and lecturers.

The classroom activities tended to follow input by the lecturers instead of developing from the learners' ideas. The activities were, therefore, seen as a means of illustrating the new concepts and acted as a confirmation. As Weimer (2002) observes, it is the learners' learning that must be the subject of the teachers' most energetic care and attention—not their lesson plans, nor their schemes of work, nor their rich and stimulating provision—but the learning that results from everything they do (and do not do) in the classrooms.

The lecturers used pair or small group work/ discussions, think-pair-share, class discussions, question and answer activities, etc, in a traditional way. Some groups were adhoc, no group leaders were appointed, and the lecturers asked the learners to do discussions with little guidance. Most activities were directed and instructional and there was little evidence to show that the learners might construct their learning using their own ideas. The evidence was that all the activities were tightly controlled and planned by the lecturers (see appendix 10, p. 488). Komarraju & Karau, (2008) hint that different instructional techniques should be used to most effectively reach all learners. In some lessons or activities, the lecturers initiated the answering of questions. It took the form of exchanges within a sequence regulated by the lecturers. The lecturers chose the learners' answers selectively in order to arrive at the answer that was wanted. In a learner-centred

environment, if a learner lacked knowledge, the lecturer was supposed to ask the other learners to explain/give the correct answer. A common feature in cognitivist LCT is the tight control lecturers had of all activities. Vavrus (2009) hints that teachers find it more practical to control learning when classes are overcrowded, a reality in the sampled TTC.

The lecturers made the learners work in small groups of 4 to 6 members although at times groups could be unnecessarily very big with 10 members. Cooperative learning leads to deeper learning and increased critical thinking (Millis, 2010). Cavanagh (2011) adds that cooperative activities help learners understand content better because they are more actively engaged. However, the researcher observed that few group members who were considered knowledgeable in the groups made contributions or did the experiments and all group members agreed to the given answers/solutions/findings. This was due to the lecturers not encouraging all the learners to take part in performing the tasks, some learners not being sure of themselves to do things correctly, the learners being in large groups and inadequate available teaching and learning resources. The researcher's argument is in line with Galton (2007) who observed that weaker members in a group become submissive partners.

A situation where the learners worked in big groups of up to 10 members had negative impact on the learners' learning as some learners could not access the required information/instructional material on time. In a good number of lessons, the learners did not have access to teaching and learning resources which could have helped them discover

new concepts (appendix 10, p. 488). For instance, in lecturer 5's lesson 1 the learners were observed discussing a concept using a text book only. Figure 10 confirms this assertion.

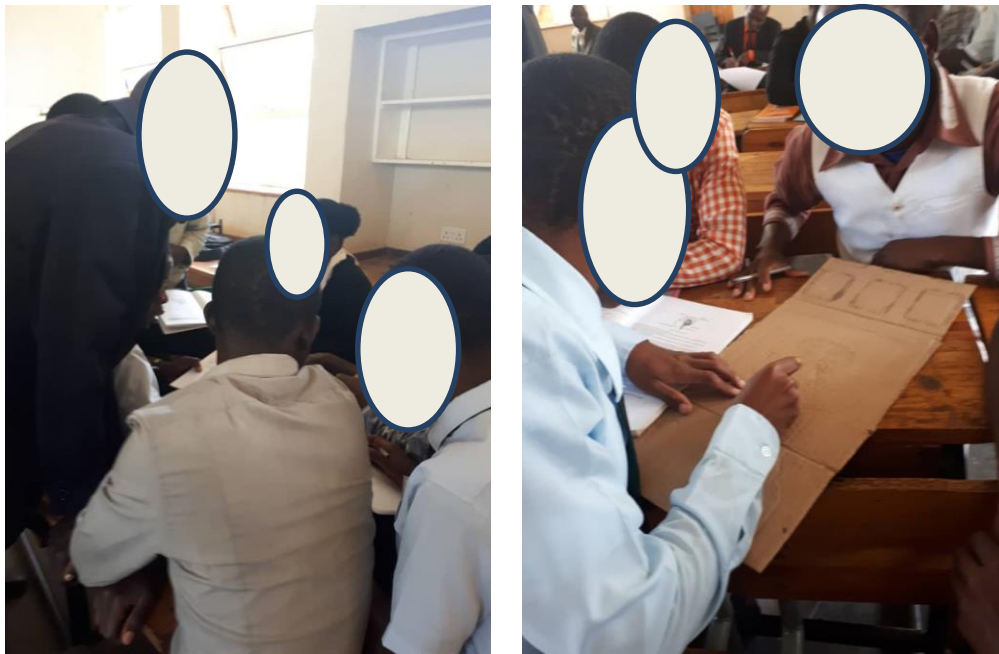


Figure 5: Learners discussing about the concept of photosynthesis using text books only

In figure 10, the learners should have been given a variety of leaves for them to understand the concept of photosynthesis better. Working without the necessary teaching and learning resources posed a challenge because the resources would have aided the learners in the construction of knowledge which is one of the principles of LCT. In the same vein, Ward and Lee (2002) note that lack of teaching and learning materials for classroom instruction create barriers to the implementation of LCT. Vavrus et al. (2011) assert that the implementation of LCT requires the teacher to create the conditions for learners to discover and construct knowledge, it was, therefore, difficult for these learners to construct their own knowledge in the absence of the said teaching and learning resources.

This observation agrees with some literature which hint that teachers in Sub-Saharan African countries continue to teach in undesirable ways of chalk and talk regardless of the introduction of, and different interventions on the LCT approaches in their education systems (UNESCO, 2012). Even though Brown (2003) has found that teachers hold constructivist beliefs about scientific problem solving, more importance is given to learners' answers rather than problem solving solutions (Brosnan & Erickson, 1996) cited in Mwelese (2014) [See appendix 10, lesson 3 by lecturer 5- p.608].

Explanation

The researcher observed that the lecturers did not refrain from lecturing or too much telling even the information that the learners could have attained on their own (appendix 10, p. 488). Similarly, the lecturers repeated or re-explained the learners' responses even those which were correct. This observation had been proved through the lecturers' own confessions during the post lesson individual interviews and their actions during lesson presentations (See appendix 10, p. 488). This implies that the lecturers believed that the learners could not go alone without their (lecturers') input. This is a pure contradiction to and defeats the essence of the LCT philosophy. The researcher acknowledges Tsang's (2004) hint that repeating learners' answers/ ideas leads to the learners' own repair; is considered to be more beneficial and effective for the learners' learning and increases their critical thinking ability. However, the repetition observed in this study was not necessary because LCT aims to develop learner autonomy and independence (Lea, et.al. 2003; Jones, 2007) by putting the responsibility for the learning path in the hands of the learners (Rogers, 1983; Pedersen & Liu, 2003). Teaching and learning should focus on deep learning as

opposed to surface learning (Lea et al. 2003, p. 322; Weimer, 2013, p.31-33). Similarly, Weimer (2013) hints that successful teaching and learning is not teaching that endlessly tells learners what they should do and what they should know. In other words, in an LCT environment the teacher should not demonstrate pedagogical showmanship but facilitates the learning (Weimer, 2013). In agreement with Weimer (2013), the Concordia University (2016) and Lea, et al.'s (2003) observe that in learner-centred instruction, learners and instructors share the focus. Instead of listening to the teacher exclusively, learners and teachers interact equally.

These findings are not surprising given the fact that the lecturers believe that they are the only source of information. However, Brooks and Brooks (1993) hint that a teacher cannot pour information into a learner's brain and expect them to process it and apply it correctly later. The lecturers should have used this phase to help the learners form conceptual explanations for the lessons' exploratory questions through intellectual engagement. Figure 11 shows learners seated in rows listening to their lecturer explaining/ lecturing during a lesson.



Figure 11: learners are seated in rows listening to their lecturer talking

Based on figure 11, the lecturers never wanted to leave the classroom to be democratic but to conform to their dictatorial powers in class. This was compounded by the lack of or inadequacy of teaching and learning resources for teaching and learning activities (as evidenced in figure 10, p. 283). In some group discussions or tasks, no resources at all were used. The lecturers did not have enough material resources for them to develop alternative LCT practices. Most of the lessons were spent by the lecturers' subject content to the learners and giving various examples. Recitations were prevalent; the learners sometimes answered their lecturers' questions in chorus (see appendix 10: lecturer 3, lesson 1- p. 538).

The lecturers tightly controlled the talk and the activities the learners were engaged in to serve the purpose of putting across certain ideas or concepts to be learned. They explained

about some concepts in details for clarity sake. This behaviour contradict the essence of learner-centredness. In LCT teachers should reduce telling learners (Weimer, 2013) what the correct answer is rather they should pose questions which should guide learners to the correct answer. An interpretation to this observation might be that the lecturers are in favour of LCT concept but since they have not developed the needed craft knowledge for LCT practices they exhibit some traditional classroom practices.

The findings of this research show that the lecturers retain expertise on subject knowledge and the control of knowledge transmission (see appendix 10). These findings resonate well with pre existing literature, which report that teachers' dominance in instructional practice is often sustained in the face of LCT recommendations in developing countries (Croft, 2002; Sikoyo, 2010). This implies that the LCT recommendations in the Science and Technology syllabus are not followed with precision during lessons. The lecturers engaged the learners in question-pause-name (QPN) activities during which they mostly asked volunteers to answer questions. This behaviour militated against development of communication skills of some learners who did not have the courage to speak in public. This also promoted laziness in some learners. It was observed that one or two or three learners only responded to the questions and the lecturer proceeded. This behaviour was observed in all the 8 lecturers.

At times there was no opportunity for the learners to raise questions and no time was allocated for listening and talking to the learners thus the lecturers could not identify the learners' ideas. Instead the lecturers monitored the learners to complete the tasks given to

them so that at the end of the activity they would be able to present the results or the discussions in plenary. In this case the lecturers' interest was to see the activity done not necessarily learning of the learners. This is not the type of engagement envisaged in learner-centred teaching (LCT).

The identified classroom practices are not limited to Malawi only since the research conducted in Ghana to find out whether the Mathematics teaching is perceived by teachers and learners to be learner-centred or teacher-centred (LCT) revealed that learners described the teaching to be dominated by teachers. On this, they reported that they listen while the teacher explains, follow instructions, memorise rules and procedures but also work in groups (Ampadu, 2012). Again, the investigation of science teaching practices in Rivers State secondary schools in Nigeria revealed a highly dominated transmission- oriented pedagogical practices comparing to the constructivist ones (Ovute et al., 2015). The findings also agree with the study of Nsengimana, et al (2014) who showed that science teachers in Rwanda were still dominating in their lessons than learners.

Research data also show that if the learners asked a question, the lecturers were challenged to respond with a question that would guide the learners in their exploratory activities. Learners should be let to make observations, discuss what they observe, and have a chance to make predictions and/ or inferences from their observations. This was not the case with the Science and Technology lecturers. The lecturers rushed to tell the answers or give explanations. This is in contrast with the essences of both learner-centred teaching (LCT) as well as Science and Technology teaching. It appears the lecturers were cautious about syllabus coverage to meet the examination demands within the confines of LCT.

It was also noted that in cases where the learners were given chances to ask questions during the teaching and learning processes, only few could do it and none could show disagreement with their lecturers' decisions and /or ideas. They took their lecturers' word: they accepted whether the lecturer said yes or no except for in one isolated case where a learner boldly corrected the lecturer's answer to a question (i.e. during lecturer 5's lesson 3- see p. 608). The lecturers rarely encouraged the learners to disagree where they (learners) felt the information given was not correct.

Most of the activities did not allow the learners to demonstrate their creativity. The activities given by the lecturers were so structured that there was little opportunity for the learners to raise questions. This would actually help the learners to clarify what they already thought and knew and what they wanted to find more about. Hence, the activities provided by these lecturers did not encourage the learners to raise questions but instead invited them to answer questions given by the lecturers. Questions are instruments to scrutinise new ideas, facts, information, knowledge and experiences. They play a great part in communication (Chaudron, 1988). Questions and responses are inevitable in exchanging ideas and negotiating meanings. Therefore, they are one of the important tools to enhance learners' learning in general and teaching in particular (Nuru, 1992 cited in Azerefegn, 2008). What was seen was the lecturers explaining verbally the ideas or concepts that the learners should gain from the activities.

The learners were told what they were supposed to learn from the activities. There was

little effort from the lecturers to make the learners think deeply about what they identified or discussed about in class. In other words, when there came an opportunity for the lecturers to engage the learners with content (what is covered in the syllabus), it didn't come out clearly (see appendix 10, p. 488).

Elaboration

The learners were asked to read text books and list some ideas which the lecturers wanted them to find from the text books. At times the lecturers could provide teaching and learning resources to the learners. The learners could be asked to study the specimens in order for them to come up with specified observations with no follow up or probing questions that could make the learners think beyond what they already knew about. For this reason, the learners had to be involved and engaged so that they could construct their knowledge as suggested by LCT thinkers including Piaget (1980) and Vygotsky (1978). These scholars and experts, in their theory of constructivism, say that learners should be more involved for a meaningful learning rather than being passive. However, critical thinking was rarely promoted by the lecturers since in most of the classroom activities the learners just produced what they already knew about (see appendix 10, p. 488).

In the lessons, the activities were used mostly to produce an outcome from a particular lesson. Most of the activities did not give the learners the opportunity to solve any problems in order to see if they could apply and transfer acquired knowledge and skills into new situations (see appendix 10, p. 488). In the elaboration phase of the 5Es (Bybee, et al., 2006), learners are supposed to be given the opportunity to use their developing ideas in a variety of situations, both familiar and novel. Thus new concepts may be consolidated

and reinforced by extending the context within which they are seen to be useful. The lecturers rarely suggested questions and activities that could allow the learners to apply what they had learnt to new and novel situations. Similarly the lecturers rarely encouraged learners to extend their learning with readings, internet research or other individualised reinforcement of concepts and principles being learnt.

The classroom observations had shown the lecturers' inability to come up with activities which would demand extension or application of the learners' previous knowledge to new situations and nature of the topic under study in which the learners were not directed how to apply or use the knowledge and skills learnt in the lesson or previous lessons (see appendix 10. P. 488). For example, demonstrations on the application of scientific knowledge and concepts was not done in some lessons. The reason could be that the Science and Technology curriculum is not explicit enough on this aspect and the lecturers could be less creative. Teachers can maintain the spirit of enquiry by focussing on questions that can be answered by collecting observational data, using available knowledge of science, and applying processes of reasoning.

In some topics like pressure, there is adequate coverage on how the concept of pressure can be applied to new situations and real life situations. Westbrook, et al. (2013) hint that a teacher is supposed to connect learning to everyday life and make it relevant to learners such that the learners' background experience should be the prerequisite to learning. The majority of the topics in the 2017 Science and Technology syllabus do not have this aspect (MIE, 2017). The other reason is that the lecturers were not creative enough accompanied

by little preparedness to come up with activities which would demand the learners to apply what they had learnt to new situations. There has not been adequate or scope of coverage in the curriculum on how the scientific concepts or ideas are applied to new situations (MIE, 2017). Furthermore, many success criteria in the curriculum do not require the topics to address how certain scientific concepts can be applied in new situations (MIE, 2017). This poses a lot of challenges for the Science and Technology lecturers as well as the learners.

Evaluation

All the lecturers conducted assessment for learning. Assessments were actively used to improve learning (i.e. noting where errors were made for further instruction) and the learners were involved in feedback and discussions. For all the 8 lecturers' 29 lessons observed, the lesson conclusions involved the lecturers asking questions about the lessons and inviting learners to make small presentations using short activities such as a letter to the author or author's chair or question and answer (see appendix 10). This helped the learners to explain ideas/concepts in their own words and to do a self reflection on each of the lessons. Hodson (1998) points out that reflecting on their own learning helps learners to appreciate that conceptual change is involved in learning. In reviewing change in ideas Scott (1987) invite learners to reflect on how their ideas have changed by drawing comparisons between their thinking now and at the start of the lesson/chapter.

The learners were given timely feedback about the quality of their work and how their learning compared with expectations. Scott (2014) hints that feedback should be timely,

and as specific as possible. The lecturers were challenged with interviewing the learners as a means of assessing their developing understanding. The lecturers' feedback did not give much information: it focused on the person not the task, did not encourage the learners to think critically about the work but about how good they are, did not indicate what to do next and did not give ideas about how to do it. This observation contradicts Orsmond, et al.'s (2005) hint that learners prefer feedback comments about the task not themselves. The lecturers emphasised on feedback that was judgemental: this is expressed in terms of how well the learner has done (which includes praise as well as criticism) rather than how well the work has been done, gives a judgement that encourages learners to label themselves, provides a grade or mark that learners use to compare themselves with each other. This contradicts Lizzo & Wilson's (2008) observation that learners like comments that discuss strengths and weaknesses; explain mistakes and give advice on how to improve. The lecturers used good, very good, hand clapping and other bodily signs as feedback.

From the preceding arguments or observed LCT implementation gaps it appears it is hard to sweep away the traditional practices and implant fully fledged LCT methods in their place. TTC lecturers are only concerned about imposing cooperative learning practices on learners and expecting them to change their way of learning accordingly rather than providing them with the experiences that will help them to change. A large volume of literature on educational change has demonstrated that such approaches to learning should not be imposed because this situation easily causes rejections (Elmore, 1996).

To make group work effective, teachers should plan tasks which are challenging to make learners think critically. Tasks have to be done either in pairs or in small groups of 4 to 5 members where each and every learner is actively involved and later on, different groups have to share their work with the whole class. The outcomes from individual or group activities can also be shared at first in pairs, where one of the participants presents to his or her colleague and later on each of them is given the time for reflecting to what his or her colleague presented about and then by doing so, learners will construct and develop different knowledge, skills, and values through constructivist approach as emphasised by Jean Piaget. Group discussions are useful in learners' learning through a social interaction among learners as emphasised by Lev Semyonovich Vygotsky (1978). Therefore, teachers are advised to use them for a kind of synergic strategy in learning.

4.8 Chapter summary

The study provides evidence that TTC Science and Technology lecturers expose learners to learner-centred teaching (LCT) classroom practices. It has established that the lecturers' understanding of LCT is limited to a change of instructional methods from teacher-centred to learner-centred methods. The lecturers showed little evidence of understanding how learners' mental cognition functions and the kind of instructional competence learners needed to acquire during the teaching processes. This was reflected during their classroom practices where the lecturers dominated most of their instructional practices. Effective guidance and facilitation of the learners' group activities was notably absent when the lecturers assigned the learners into small group activities. Many times the lecturers initiated

questions to the learners contrary to the constructivist learning beliefs. The learners were also given limited time to reflect on the scientific aspects of their discussions.

Both the lesson observations and post lesson interviews results reveal that the respondents understood LCT as teaching and learning practices where learners are actively involved and engaged in all classroom processes. The respondents used LCT methods mostly those which seemed not to require teaching and learning materials even though the lessons/topics themselves demanded use of resources. To sum up the major findings of the study were that:

1. Science and Technology lecturers used few of the learner-centred teaching (LCT) methods that motivated, stimulated and promoted active participation of the learners in the teaching and learning processes. These methods included the question and answer method, small group work and discussion method.

Nevertheless, the Science and Technology lecturers preferred to use the LCT methods that gave them the opportunity to have control over the teaching and learning processes.

2. The Science and Technology lecturers gave the learners the opportunities to ask questions, provided the learners with the opportunities to respond to other learners' contributions, encouraged all the learners to participate in the teaching and learning processes, allowed the learners to teach one another through discussions and presentations at various points in their teaching and they allowed the learners

to work individually mostly through classroom tasks.

3. The Science and Technology lecturers have knowledge about the learner-centred teaching methods, they used a variety of teaching methods at various stages in their teaching, preferred the teaching methods that gave them control of the teaching and learning processes and they held positive attitudes towards the use of the LCT. The lecturers involved the learners in the evaluation of their own work.

CHAPTER 5

CONCLUSIONS AND IMPLICATIONS

5.1 Chapter overview

This chapter concludes the study and presents its contribution to the existing body of knowledge about LCT classroom practices. Using three research questions the study investigated TTC Science and Technology lecturers' classroom practices in order to determine their understanding of the LCT concept and how they interpret it. The chapter constitutes two major sections: the conclusions and implications.

5.2 Conclusions

Findings of the study reveal that regarding the classroom practices, the lecturers show consistencies in their implementation of learner-centred teaching (LCT) methods. The findings based on the observational data show that TTC Science and Technology lecturers' classroom practices depict LCT at an elementary or surface level. However, the classroom observation as well as the post lesson interviews data reveal that the lecturers demonstrated understanding of LCT.

5.2.1 Research question 1: What are the classroom practices of TTC Science and Technology lecturers?

Question 1 of the study centred on the Science and Technology lecturers' classroom practices. The research findings reveal that the lecturers' classroom practices included

providing appropriate and relevant activities and some teaching and learning resources; offering a variety of activities or tasks; encouraging the learners to ask questions; promoting learners' participation and collaboration and the lecturers showing mastery of the subject matter by giving appropriate and relevant examples. They (lecturers) showcased this in their classroom practices by asking numerous questions.

From the data gathered, the Science and Technology lecturers' classroom practices also included the use of some experiments (not frequent), linking topics taught to the learners' daily life, taking into account the learners' pre-requisite knowledge and skills, and use of appropriate methodology. The learners were engaged in classroom activities or learning strategies such as; gallery walk, walk-around- talk- around, author's chair, ball game, question and answer, K-W-L, brainstorming, individual/pair work, class presentations or reports, e.t.c.

Another key finding is that the lecturers allowed the learners freedom to ask and answer questions during the lessons. This was evident in the lesson observations and was also mentioned by all the 8 lecturers during the post lesson interviews. However, based on lessons observation data, most of the classroom activities did not allow the learners to demonstrate their creativity. The classroom activities given by the lecturers were so structured that there was little opportunity for the learners to raise questions but instead invited them (the learners) to answer questions given by the lecturers. What was seen was the lecturers explaining verbally the ideas or concepts that the learners should gain from the activities. The learners were told what they were supposed to learn from the activities. There was little effort from the lecturers to make the learners think deeply about what they

identified or discussed about in class. In other words, when there came an opportunity for the lecturers to engage the learners with content (what is covered in the syllabus), it didn't come out clearly. Generally, the learners were given pre-planned tasks from their modules or on chart papers. Thus the lecturers' understanding of the LCT methods is not complete: the notion of meaningful learning through learners constructing their own learning seems not to have been understood by the Science and Technology lecturers. The classroom activities did not fully engage the learners. There was little learner engagement with the content by the lecturers. The learners were given obvious tasks not really challenging to make them think deeply. The learners were not involved much beyond what they already knew about. This is evidence enough that there was surface learner engagement in the classrooms. Thus, the lecturers were limited to few things only but other issues about engagement were not coming out.

The lecturers' feedback did not give information: it focused on the person not the task, did not encourage the learners to think about the work but about how good they are, did not indicate what to do next and did not give ideas about how to do it. The lecturers emphasised on feedback that was judgemental. Hence, the conclusion that the lecturers' classroom practices depicted LCT at an elementary or surface level.

5.2.2 Research question 2: Why do they choose those classroom practices?

Question 2 focused on the reasons for the lecturers' choices of their classroom practices such as bus-stop, think-pair-share, asking questions in class, etc. During the post lesson interviews, several reasons were given for the varied classroom practices. Following are

some examples; lecturer 5 said he used bus stop teaching method for the learners to assess each other. The lecturers said the varied classroom practices such as asking questions, group work or walk around talk around, etc, allowed and promoted the learners' participation and assessment in class activities thereby promoting learning.

According to the lecturers, some classroom practices made the learners reflect on their learning through guiding them (learners); giving them (learners) tasks to do; engaging them in question and answer, author's chair and letter to the author activities. The lecturers indicated that the aims of the classroom practices, for example; class presentations, work stations, etc. were to enhance learning and give autonomy to the learners and to promote listening, communication and critical thinking skills in the learners.

According to the respondents the said classroom practices encourage and promote team working spirit in the learners, learners and their lecturers moved and constructed knowledge together, learners owned and used the constructed knowledge and did not lose it easily. According to the respondents, learners discovered knowledge on their own because of these classroom practices.

5.2.3 Research question 3: How do such classroom practices show the learner-centredness of the lessons?

Question 3 focused on the learner-centredness of the classroom practices. The constant use of a variety of classroom practices by the lecturers accompanied by learner engagement in various classroom activities and provision of some teaching and learning

resources proved that the lessons were learner-centred. However, the lecturers used the classroom practices such as small group work, think-pair-share, class discussions, question and answer activities, etc, in a traditional way. Most activities were directed and instructional and there was little evidence to show that the learners might construct their learning using their own ideas. The evidence was that all the activities were tightly controlled and planned by the lecturers. In some lessons or activities, the lecturers initiated the answering of questions but did not comment or suggest ideas. It took the form of exchanges within a sequence regulated by the lecturers.

Teacher centred classroom practices were also observed and are still being implemented in the TTC classrooms. However, the findings based on the lesson observation data showed that LCT classroom practice was more frequent and dominant than the teacher centred practice. This study, therefore, concludes that there is a blend of learner-centred teaching as well as teacher centred teaching practices in the classrooms. This is not surprising as other researchers found similar results.

From the researcher's findings and point of view there is a distinction between the strong conceptual version of what is involved in LCT as envisaged by the proponents of LCT and the weak version of LCT in practice which the TTC lecturers implement in the classrooms. It may be that the lecturers have misunderstood what the LCT proponents are saying and that any modification to their classroom practices is based on a misinterpretation of the LCT principles. The researcher's belief is that the model of LCT generally put forward is one which is based largely on methods which work for

researchers rather than methods which work for teachers in typical classrooms. The discrepancy between the version put forward by researchers and the version applied in the classroom may, therefore, be indicative of a realistic response by teachers, who may be committed to LCT approaches in principle but have to find ways of making this manageable in practice.

To sum up, the research findings are in line with prior researchers and it has been clearly shown that a good number of learner-centred teaching (LCT) methods are not being used in the teaching and learning process because the lecturers are facing challenges to understand them. So it can be concluded that unless the stated constraints are addressed LCT will ever remain in the archives. Finally, it can be concluded that although the Science and Technology lecturers understood what the learner-centred methods of teaching were all about they were yet to fully embrace the various LCT methods in their classrooms and were yet to incorporate all the learner-centred teaching (LCT) methods into their everyday teaching.

5.3 Contribution of this study to the existing literature

The study illuminates learner-centred teaching (LCT) gaps from the perspective of Science and Technology lecturers in TTCs;

(a) Learner engagement and formative assessment are still rather weak points of LCT and although a number of theoretical findings recommend what to do, there is still no ideal practical solution. Learners do not seem to spend much time learning as evidenced by the classroom behaviours where they are stopped doing an activity/task once the allocated

time is over. The researcher concludes that learner engagement and formative assessment in LCT are not yet fully developed, i.e. assessment within the LCT framework should be more flexible, integrative, contextualised, criteria referenced, informing the learners about the results, giving advice on how to improve knowledge, and be fair. Feedback should contain an explanation, the language should be non-evaluative, given frequently, and it should help learners to plan further studies.

(b) The findings of this study have strengthened the existing literature by indicating that (i) the TTC lecturers' classroom practices in Malawi depict surface level learner-centred teaching. Due to the context and level of the lecturers' understanding of the LCT philosophy in which the lecturers are operating, they are not practicing the strong LCT which is being advocated for by the proponents and authors of LCT. (ii) One hundred percent LCT has not been achieved in the TTC classrooms.

5.4 Implications of this study

There is a growing concern that teachers should change their approaches towards the LCT concept. This study is not a panacea but may contribute towards improving the state of LCT classroom practices in teacher education. The findings of this study add to the literature on LCT classroom practices by providing a new direction for: (i) TTC lecturers, (ii) researcher, (iii) curriculum developers and (iv) policymakers how to view classroom practices in TTCs.

(i) TTC lecturers

Without sufficient professional development opportunities to learn how to make expected changes in the classroom, TTC Science and Technology lecturers will continue to rely on more familiar and functional approaches and methods. Teachers in Malawi are under immense pressure to simultaneously improve the learning outcomes of learners, cover a crowded curriculum, and prepare learners for national exams that emphasise rote learning. Until TTC programs, curricula, and examinations are coherently re-organised, it is unlikely that TTC lecturers will fully embrace LCT. The shift towards LCT may take considerable time for TTC lecturers because they may not understand the rationale for it or how it fundamentally alters the view of learners from receivers of information to co-creators of knowledge. Moreover, some TTC lecturers in particular, may not have a clear sense of how to change their classroom practices, having gone through teacher training colleges during a different era. Providing high-quality in-service programs and ongoing classroom-based mentoring for the TTC lecturers may be one of the best ways to evoke change in the direction of LCT.

(ii) The researcher

The study findings helped the researcher as a teacher trainer, to get a better understanding of how TTC lecturers teach Science and Technology. These findings have implications for teacher education in Malawi and that teacher trainers may change their conception of classroom practices by creating teaching and learning experiences that will incorporate these findings. This study has identified several gaps (see section 4.7.3, p. 273) to the implementation of LCT despite requirements for its full use in the classrooms. The overall picture the researcher sees is of TTC Science and Technology lecturers not fully

understanding LCT principles and using it to some extent because of its limited integration into the curriculum and the national exams. The researcher also finds the TTC lecturers seeking ways to adapt LCT to mesh with the contexts in which they teach, namely, in classrooms with limited or no access to teaching and learning resources; and with little training in how to utilise LCT methods to enhance classroom practices and learners' learning.

(iii) TTC curriculum developers

The results also have implications for TTC curriculum developers who must understand that LCT methods could be incorporated in teaching and learning processes when aligned with the classroom context.

(iv) Policy makers

The Science and Technology syllabus proposes instructional methods and approaches lecturers should use in the classroom. Thus the lecturers' classroom practices were reflected in the nature and guidelines of the curriculum materials. This means that the lecturers' flexibility in their pedagogical decision-making and practices was limited thus constraining effective implementation of the LCT methods.

Completion of the syllabus and learners' achievement in the instructional objectives and not their engagement and ability to use their life experiences to make conception of the topics determined the lecturers' evaluation of teaching and learning processes. The lecturers used evaluation results to assess their achievement in the delivery of the instructional objectives and not to assess the learners' engagement in the evaluation process. Therefore, there is a need to address the curriculum compatibility and package to influence its implementation in LCT contexts. The TTC lecturers need continual training regarding LCT methods and its application in different classroom contexts.

5.5 Suggested Areas for Further Research

This study has highlighted observable gaps in the TTC lecturers' implementation of LCT in the classrooms (section 4.7.3, p. 273). While general good classroom practices were observed, it appears that the TTC lecturers learned these skills outside of the subject context. Therefore, a further study needs to be carried out to investigate how TTC lecturers are using LCT in their instruction and what support they perceive to need to use such strategies in order to fill the observed LCT implementation gaps. The study will map notable real-world classroom practices of LCT – namely, those classroom practices with proven potential to contribute to the quality and inclusiveness of teaching and learning processes. This mapping will identify a catalogue of best-practice examples of LCT, the most interesting of which will be presented as case studies in the study. In order for LCT to empower the TTC lecturers they will require a clear understanding of what LCT is, what it “looks” like in practice and what the benefits are. Presenting the TTC lecturers with successful case studies and empirical evidence would be beneficial in encouraging them to improve classroom practices and, hence, fully implement LCT and would also act as a guide to troubleshooting as they move away from their traditional teaching methods.

The study will put into context the LCT practices that have been mapped, by reviewing recent, top-level academic research on LCT. Insights gained from this research will allow the researchers to explain how and why certain practices work or do not work, what benefits they provide, as well as to identify any negative side-effects they may give rise to. Furthermore, these insights will deepen the lecturers' understanding of the conditions

necessary for LCT to succeed, and the potential bottlenecks in practice that can prevent the successful implementation of LCT as a learning and teaching approach.

The researcher also suggests that the same study be conducted on a wider scale to explore the LCT classroom practices in Malawi. The researcher also suggests that a longitudinal follow-up study could be built on this research study in order to see whether the TTC Science and Technology lecturers have maintained or extended the use of the LCT methods in the classrooms to enhance teaching/ learning of Science and Technology . The longitudinal studies could be carried out with the 8 Science and Technology lecturers that were involved in this study plus other TTC lecturers from across Malawi. Furthermore, there is need to investigate which LCT classroom practices can work well in Malawian context and identify dominant teacher beliefs that may conflict with the assumptions of the LCT.

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APPENDICES

APPENDIX 1: Semi - structured questions for pre lesson observation individual interviews

Describe your experience of learner-centred teaching (LCT) approaches.

Can you describe to me about your current LCT classroom practices?

Describe the reasons for your current LCT classroom practices.

APPENDIX 2: Post lesson observation discussion guide

What did learners learn from the lesson? How do you know that learners learned?

I noticed that you involved/didn't involve learners in the lesson; was my observation correct? What made you do that?

What LCT practices did you use in the lesson? Why did you use them?

Which LCT practice (s) do you need most to improve on? Why?

How did you help learners construct new knowledge?

How did you help learners apply and/or extend their understanding of new concepts? Why?

How did you provide support to learners' learning? Why did you do that in the lesson?

How did you evaluate the learners' learning during the lesson? Why?

How did you provide feedback to learners during the lesson? Why did you do it that way?

In your opinion did the learners construct new knowledge during the class activities? If yes give an example.

You defined the following concept.....why didn't you bring an example or drawing of the.....?

I observed that you used the following teaching practices in your lesson
..... Can you explain why you did that?

In this classroom, I saw teaching and learning resources relevant to your lesson but
you never used them, why?

During the lesson, a learner mentioned that because
..... You didn't give your comment on the assertion, why?

I saw you moving around the classroom during group discussions yet you didn't
assist the learners, why?

The topic was taught with/without any teaching and learning
resources, can you explain that?

APPENDIX 3: Consent form

Dear sir/madam,

My name is Stanley Kwerengwe, a doctoral student in the Department of Curriculum and Teaching Studies- Chancellor College, University of Malawi. I am working on the following research project: **Learner-centred teaching practices of Science and Technology lecturers: a case of one Teacher Training College in Malawi** and am inviting you to participate in the study.

I am specifically interested in how TTC lecturers understand the concept of learner-centred teaching and how they interpret it in their classroom practices. The aim of this study is to inform TTC lecturers and management of learner-centred teaching practices in Malawi with a view of tailoring professional development for teacher expertise in this field.

The study will cover a period of two months, from 7th January, 2019 to 1st March, 2019.

In the first phase of the project, Science and Technology participants (lecturers) will be asked to answer questions on learner-centred teaching practices. In the second phase I will seek your permission to observe your lessons. This will help me understand classroom interactions and other LCT practices.

I am responsible for the project and should you have any question, I can be contacted at 0888523131 or 0992328031.

Before we start the project I would like to emphasize that

Your participation is entirely voluntary

You are free to refuse a lesson observation or to answer any question.

You are free to withdraw from the project at any time.

All information collected for the research will be kept strictly confidential. Excerpts from interviews / results may be part of the final research report and in such cases your permission will be sought before your 'words' are used. However under no circumstances will your name or any identifying characteristics be included in the report.

I do hope you will agree to participate. If you do, please sign this form to indicate that you are willing to be part of the project. (**Stanley Kwerengwe**)

Name.....

Signature Date

APPENDIX 4: Interview guide used in selection of respondents (lecturers)

Name _____ of _____ participant:

Dear respondent,

The purpose of this interview guide is to collect information about you as a Science and Technology lecturer. Your participation in completing this interview guide is extremely useful and sincerely appreciated. The information gathered will be used for selection of participants purpose only. Therefore, you will be required to write your name on this interview guide.

You are requested to respond to questions truthfully by writing your answer in the spaces provided.

For how long have you been teaching Science and Technology ? _____

Is Science and Technology your major subject? _____ if not, which subject

(s) did you major in at college/university? _____

How did you learn Science and Technology in school and at college/university? -

a. How did you get to know about learner-centred teaching approaches?

Have you ever had training or an orientation in learner-centred teaching (LCT)? If yes, when? -----

How do you use the knowledge gained from the LCT orientation/training? -----

APPENDIX 5: Lesson plans/notes and schemes of work

TEACHER TRAINING COLLEGE LESSON NOTES

IPTE: 14

DATE 23/01/19

CLASS: N, K, P

TIME: 8:30 - 9:30 am

LEARNING AREA: Science and Technology

TOPIC: Plants and their environment.

SUCCESS CRITERIA: Students must be able to:

- Classify plants
 - Use appropriate teaching and learning methodologies to teach about plants and their environment (classification plants)
- TEACHING AND LEARNING RESOURCES:
- plants of different types

INTRODUCTION:

- Ask learners to state some misconceptions learners might have about plants eg plants are not living things.
- Explain the characteristics that make plants be living things.

ACTIVITIES: eg growth etc.

Step 1 - Student teachers observe and collect some plants outside the classroom.

Step 2. Ask students to classify the plants collected according to different characteristics in their groups eg shape of the leaves, etc.

Step 3. Let them classify the plants using mind mapping method.

Step 4. Consolidate the activity.

CONCLUSION:

Ask them to summarise the main points of the lesson.

LESSON EVALUATION:

The lessons went on quite well, they participated actively in the activities - only that some had problems in identifying shapes of some leaves during classification and were assisted.

TEACHER TRAINING COLLEGE LESSON NOTES

IPTE: LP

DATE 20/02/19

CLASS: N.I.L.F

TIME: 8:30-9:30, 10:00-11:00,

LEARNING AREA: Science and Technology 2:30-3:30.

TOPIC: The teaching of coordination

SUCCESS CRITERIA: Students must be able to:

- identify the challenges in learning about coordination
- explain the rationale for teaching and learning the topic coordination in the primary school
- describe the internal structure of an eye.

TEACHING AND LEARNING RESOURCES:

- models of the eye, mirror, student teachers, food stuffs etc

INTRODUCTION:

- Ask students to do different ^{hands on} activities to introduce the topic 'coordination' eg listening to sounds,

ACTIVITIES: eating particular foods brought to class etc.

- Discuss the meaning of coordination is the linking together of body systems and processes.
- Let students think, pair and share the challenges that learners may face when learning coordination eg lack of adequate knowledge about the topic by the teacher etc.
- Brainstorm how the challenges can be addressed eg modelling, can be good for mastery of the content and ideas etc.
- Using ball bearing, students discuss the functions of parts of the internal structure of an eye.

CONCLUSION:

Ask students questions on the work covered.

Assign them to suggest the resources which they can use to teach other senses organs like ears, skin etc

LESSON EVALUATION:

It was a good lesson, the hands on activities used in introduction motivated the students and captured their interest & attention, but the problem was that copies for tasks to use for ball bearing were inadequate, so next time will have adequate resources.

WEEK AND DATES	SUCCESS CRITERIA	PLANNED ACTIVITIES	TEACHING, LEARNING AND ASSESSMENT METHODS	TEACHING, LEARNING AND ASSESSMENT RESOURCES	REFERENCE
8 25/2/19 To 01/3/19	Student teachers must be able to: - Design experiments which would enable learners to investigate ways of combining substance and separating component in a mixture - Analyzing challenges that learners face in understanding how to separate a solution from solvent - Apply appropriate methodologies when teaching methods of combining and separating component parts of a mixture - Assess learners knowledge and skills associated with the mixture	CORE ELEMENT: Basic scientific knowledge, skills and attitudes TOPIC 10: The teaching of mixture - Designing investigations for separating mixtures - Identifying challenged in learning about mixture - Exploring ways of separating components of a mixtures - Analyzing various appropriate strategies for teaching mixtures - Conducting a microteaching session on mixtures	Group work ICT Gallery Think-in-pair-share Card collection and clustering Brainstorming Author's chair Debate Paired reading Research	Magnets Filter paper Filter funnels Masking tape Distillate apparatus Ink mixture Centrifuge machine Glass tubing Soluble materials Beakers	Malawi institute of Education(MIE) IPTE Science and technology Syllabus Domasi MIE Page 8 Malawi institute of Education (MIE) IPTE Science and technology Module 1 MIE Page 65-72

APPENDIX 6: Lesson Observation Guide

Observable item	Observed
Lecturer's Knowledge of Curriculum	
1. Relates content to learners' experiences.	
2. Linking prior knowledge to new knowledge	
3. Activities set up meet the learning objective(s)	
Lecturer's Knowledge of Instructional strategies	
1. Encouraging learners to ask questions	
2. Promoting learners' participation and collaboration	
3. Making a variety of activities	
4. Providing appropriate and relevant activities and teaching /learning resources	
5. Summarising the main important points of the lessons	
6. How does lecturer use teaching, learning and assessment resources?	
7. How does lecturer provide opportunities for learners to connect their previous experiences with current learning and to make	

conceptual sense of the main ideas of the lesson?

Lecturer's Knowledge of learners' understanding of Science and Technology

1. Addressing learners' misconceptions
2. Helping learners with difficulties
3. Meeting the needs of learners by providing adequate teaching/ learning resources
4. Give a brief revision of the previous lesson
5. Taking into account learners' prerequisite skills and knowledge
6. How does lecturer encourage application or extension of learners' knowledge and skills?
7. Do the learners play the role of explorer, teacher and producer of knowledge? How?

Lecturer's knowledge of assessment

1. Do learners apply or extend previously introduced concepts and experiences to new situations?
2. How assessment/evaluation of learning is done: is it ongoing and generative?
3. How does lecturer evaluate learners' understanding of concepts and ideas?

4. Questions asked not only based on knowledge or recall.
5. Allows learners thinking time

Learner Involvement

1. Are learners engaged actively in lesson activities? How?
2. Are learners encouraged to give/demonstrate their prior experiences / knowledge /skills
3. Are learners given the opportunity to carry out practical activities/discussion tasks/calculations
4. Are learners given the opportunity to interact in pairs work, small groups
5. How does lecturer promote exploration of concepts or ideas in the lesson
6. How does lecturer play the roles of a facilitator, guide and co-learner?
7. How lecturer gives feedback to learners' responses.

APPENDIX 7: Post lesson discussion data with respondents

Researcher: I observed that you introduced your lesson by asking questions, why did you do that?

Lecturer 1: During lesson deliveries I assess learners' prior knowledge by asking questions basing on the previous lesson related to the new lesson because there is need to know what they know. By asking questions that will check for their prior knowledge it helps me to know what they know on the topic to be covered. By teaching from known to unknown, by relating the content to real life experiences I assist learners link new experiences with existing knowledge.

Researcher: The learner-centred teaching philosophy states that learners must be at the centre of the teaching and learning process, how did you ensure this in your lesson?

Lecturer 1: As I teach I expect learners to listen to the explanations, do group work, make some presentations, discuss activities, writing, etc, because this makes learners to be engaged throughout the teaching process. I also give them reflective tasks because this helps them to check their own understanding. I give them assignment tasks for learners to focus on what has been covered. I give my learners clear instructions because these are the only way of making them follow the learning process.

During the lesson learners are given tasks to do so that they obtain knowledge through interaction. I give them clues on how to tackle specific tasks in order to get answers easily.

Then learners are asked to present their findings for class discussion. Those who do not understand certain concepts may seek clarification from group members and even the teacher may come in to elaborate on the said concepts.

Lesson 1

Researcher: Tell me how you prepared your lesson before you came here.

Lecturer 2: First of all I have to look at my work for that day from the book that is the teachers book and starting to study the topic that is about the instruction and there after I come with the activities that should be like, i have to plan the work according to one hour.

Researcher: According to one hour?

Lecturer 2:Yes,

Researcher: What are the activities in the planning?

Lecturer 2: The activities in the planning ? Mmmmh, we started with learners where-----
-----, in the planning? The activities ?

Researcher: Yes, in the planning you say that you did yourself as you were planning.

Lecturer 2:I had to look at, I wanted learners to analyse

Researcher: i wanted you to look at the book when you were planning for the class, what did you do? For example reading books?

Lecturer 2: I had to read books about animals and the plants and there after i have to find the resources which will be needed while i will be teaching the lesson and again i look at methodology, what methods am i going to use when teaching the lesson ?

Researcher: in your lesson what activities did you use to engage learners?

Lecturer 2: I used explanation and group work, it was there, i also use think-ink-pair-share; it was also there i also used move around and talk around i also used group discussion, presentations

Researcher: I saw you taking learners outside. That was the third time to take learners outside. why didn't you just bring the animals in class?

Lecturer 2: I wanted the learners to observe the animals in the environment, its either they should know whether they can find the animals because they should say-----
---- because others are scarce because of some dangers.

Researcher: Does it make any difference seeing the animals in the classroom and seeing the animal outside?

Lecturer 2: Yes there is a difference, because most of the times when they see the animal in the classroom it means the animal is dead or sometimes it is just a model but actually seeing the animal in the environment they will know how they live, they can know their habit and that is ----- if they stay in th tree they can know about it and also their behaviour in the environment it's easy to observe the behaviour of the animals in the environment rather than getting them in a classroom.

Researcher: Ok , i saw that you brought some resources in class, can you name them and who prepared the resources?

Lecturer 2: I came with preserved animals the ones from the laboratory,

Researcher: what are the examples of the animals? Snake?

Lecturer 2: Snake, grasshopper, camellion and also bones from the cattle.

Researcher: So these are the animals you got from the lab? From the laboratory, you bought them along time ago?

Lecturer 2: They were not bought but they were preserved.

Researcher: Who preserved them?

Lecturer 2: The lab assistant.

Researcher: during the lesson I observed that you asked learners to work in small groups, in pairs and at times you asked them to walk around and then talk around. Why did you do that?

Lecturer 2: (laughs) you see, during teaching and learning process the learners must be fully engaged in the lesson. All learners must be allowed to participate in the lesson. So I used the techniques you saw in order for learners to participate in the lesson. If learners participate in the lesson, they learn to listen to one another, they contribute and share ideas during group discussions. They also learn from their peers.

Researcher: are you sure learners participate during group work and the other methods I talked about?

Lecturer 2: of course you can still see a small number of learners who stay idle without making any contributions.

Researcher: One last question, in the primary schools we don't have such animals or we don't have animals preserved, what is your advise or what would be your advice to the learners?

Lecturer 2: I can advise them to use the models or sometime they should model like snakes but to animals like fish, grasshoppers i can advice them to use salt or dry them.

Researcher: One simple question, do you think learning took place and what do you think makes you believe that the learners learnt?

Lecturer 2: Yes I believe that the learning, teaching took place because the learners are allowed to do the activities

Lecturer 2: post lesson Interview 2

Researcher: One question , we have learner-centred teaching and teacher centred methods, which we call transmissive method; what has been your experience in teaching using learner-centred method?

Lecturer 2:Learner-centred, using learner-centred method you look at learners, they will be participating in the lesson and you involve them in the activities. Sometimes you can come up with an activity or way of teaching and most of them will participate.The second thing is that it helps one to observe the learners as you know that some learners are reserved

then in learner-centred teaching method they will be free to interact and sometimes come up with ideas which are new to you.

Researcher: Now as a lecturer have you had time on learners who could come up with something as you say they bring ideas which are new?

Lecturer 2: Like in mathematics, the learners could come up with new ways of solving the mathematics problems in class, they can come up with a method which is new to you.

Researcher: What about in Science and Technology ?

Lecturer 2: At times some ideas, there are other things which you as a lecturer you have no knowledge of that so some learners may be having that knowledge. They may have got the information through research as demanded by the new curriculum. So through such knowledge we cooperate and interact in the lesson which is good unlike in the past were we used just to give give the content.

Researcher: Right , okay in learner-centred teaching , it is so said because it is a theory which assumes that learners can contribute knowledge and talks of learners being active in the lesson. From your experience do you think when learners are talking to each other they are actively involved and creatively constructing knowledge?

Lecturer 2: Yes, and that knowledge which they construct they will not easily forget it and they will use it for example in mathematics

Researcher: Yes, I am asking this question, I will give an example of a lesson I observed: the lecturer wanted learners to look at primary school Science and Technology text books and TTC Science and Technology books then he said; can you check topics which are taught in primary schools and they are also taught in TTCs? The learners were busy comparing the two sets of books and finally discovered that really there are topics which are taught at primary school and are also taught in TTCs. Now, my question is; in this scenario, was there construction of knowledge in that situation?

Lecturer 2: No construction

Researcher: No construction, yet it was group work?

Lecturer 2: When we are talking of constructing, I am thinking of a situation like this at this school, when there is an outbreak of something for example opening bowls, we can ask them the cause or we can just assume that it is due to cold food so we can ask learners to say what we can do and they will come with ideas like eating hot food or healthy food.

Researcher: who assembled and prepared the teaching and learning resources before lessons?

Lecturer 2: laboratory assistants largely did that

Researcher: now, let us go to the syllabus, you have given a good example of opening bowls now give me one topic where learners can construct knowledge. Where can they construct knowledge in the curriculum?

Lecturer 2: Eeeeh in eco-system, where they can observe animals and how they live in the environment and how they relate and their dependence on each other.

Researcher: Are those done continuously with your learners?

Lecturer 2: Not continuous but at times

Researcher: Okay, finally, finally, I just want to learn what happens on the grounds when using learner-centred method, how do you feel as a lecturer?

Lecturer 2: Eeeem, I feel relieved because we learn as a class and we construct knowledge as a class and that knowledge they construct they own it and do not lose it

Researcher: Now one question, when you teach using learner-centred approach how do you feel as a lecturer?

Lecturer 2: I feel we are moving together and doing the thing together, as they are engaged in research and everyone does the work so we work together.

Researcher: Now, I thought I have finished but another question has cropped up. In our teaching, in your teaching eeeeh do you emphasize on skills development or on cognitive development or both?

Lecturer 2: Both

Researcher: Give an example of both skills what is it that you do in skills development give an example and in cognitive development give an example, what is it that you do?

Lecturer 2: When learners are doing the experiment the first thing they need is knowledge of what they are to do first then they will do the experiment that means they are developing the skills

Researcher: Where is the cognitive skills?

Lecturer 2: They are related, when they are doing an experiment they acquire both

Researcher: I have observed several lessons where a teacher was saying, 'I will give an example of about 3-4 lecturers who were saying can you give an example or find out the requirements of photosynthesis in a plant in groups to discuss. Unfortunately there were no leaves or plants learners were just discussing. The topic was photosynthesis, no plant, no leaves, the learners were in the classroom, after ten minutes the learners stopped their discussion, so what skills were being developed? What skills was the lecturer emphasizing on?

Lecturer 2: Eeeeh, kkkkkkk maybe it was just recalling the knowledge which they had as they were just discussing, there was no skill development.

Researcher: Maybe communication skills because there is no cognitive development.

Lecturer 2: Yes, it's not there.

Researcher: Thank you very much madam

Post lesson interview with lecturer 3

Researcher: welcome to this post lesson session. I just want to seek some clarifications from you for the classroom behaviours that I observed from you during the lesson delivery.

To begin with, I observed that you used group work in most of the class activities. Why did you do that?

Lecturer 3: it's like you want to get feedback from the learners. Group work also allows for a lot of content to be covered within a short time. If a lecturer has a lot of work to be done within a short time then group work is the best strategy. However, ensure that the group work is properly done.

Researcher: mmmm are you serious in group work a lot of work can be covered within a short time? How can that be? In some lessons I have observed lecturers giving the same task/activity to all groups in the class. So how can this enable a teacher to cover more work within a short time?

Lecturer 3: mmmm that is not alright because the lecturer just dwells on one activity/task only. But what I mean is that each group must be given a different task from their friends. Effective group work requires that different groups must have different tasks/activities. Maybe a teacher can assign the same task to two groups only but not all groups having/doing the same task. In this case should one group not do well the other group may produce good work. However, it is important to give the groups different work/activities. When you give learners in their groups different work, then you are going to cover a lot of work. Group work assists learners to speak freely to each other. Some learners fail to speak freely in class but during small group discussions you find them making contributions. By allowing them to speak or share their ideas during small group

discussions, the learners do more learning. Some learners don't like raising up their hands during class discussions. However, in small group discussions they will make an important point to the extent that their colleagues accept it. In so doing such learners feel encouraged and motivated to make contributions again in other lessons.

During small group activities, learners help each other. Group work encourages and promotes team spirit in learners. They learn to do things together and depend on each other. During group discussions, a lecturer can get new ideas which he/she didn't have. A teacher can get some new information from learners.

Researcher: what do you call group work where each group is assigned a different task/activity from the other?

Lecturer 3: Jig saw.

Researcher: ohhh Jig saw!!!

Lecturer 3: Jig saw is a good strategy because each learner becomes an expert. He/she tries as much as possible to learn something because the fear is that if he/she does not learn it means there will be nothing to share with his/her colleague. Each learner tries to own the content so that they have something to present before members of their group. This makes them to become attentive and participate fully in the lesson. They become very much involved in the learning process.

Researcher: I also observed that you gave the learners a walk around talk around activity. Why did you do that?

Lecturer 3: learners will get different information from others. They will learn from each other. For example, if its pair work it means I will talk with one person only but if its walk around talk around, it means I will talk with this one then I will leave, pair with another one talk with him/her then I leave again so on and so forth.... So I can get different views. if its pair work it means I will talk with one person only. In walk around talk around an individual gets paired with several learners one at a time, this means this learner will interact with many learners and in the process he/she will get different views from different learners

Researcher: In the lesson you used teaching and learning resources; any reasons for doing that?

Lecturer 3:we use teaching and learning resources to cater for diverse learning in learners. Learners have different learning styles. Using teaching and learning resources enables learners to learn through hearing as well as sight. Some learners can use both sight and hearing in the learning process while others will use either of the two. They can also use the sense of touch in order to learn. It should be remembered that that we can have learners with visual or hearing impairments. These groups of learners can use either touching or sight to learn about a concept if there is a representation.

Use of teaching and learning resources help me in easy explanation of concepts, I don't struggle to convince my learners. I don't need to explain much. If a teaching and learning

resource is well labeled even those learners with hearing impairment will make sense out of it thereby making their learning of a concept easy. In this case I as a teacher don't need much to explain. Some learning resources make the work easy. They make the meaning of a concept to be easily understood. For example, I want to teach about parts of an eye, I just have to bring a well labeled eye or a model of it. In this case the learners will see for themselves rather than me struggling to explain the teaching and learning resources will be self explanatory. The learners will see for themselves and the meaning comes very easily. Understanding by the learner also becomes very easy because I have used concrete objects and he/she is learning in a real life situation.

Researcher: I observed that during the teaching and learning process you asked questions to the learners and at certain points you also asked learners to ask questions. One, why did you ask questions to the learners? Two, why did you ask learners to ask questions?

Lecturer 3: teachers ask questions to learners to find out if the learners understand what is being taught. Are learners learning? Are we moving together? I asked questions to get feedback from the learners.

Researcher: some questions come from topics which have not been taught yet.

Lecturer 3: yes, its true. Such questions are asked in order to determine the learners' prior knowledge. This is to find out how much the learners already know about a concept. So I ask questions to find out if they know anything about what I am going to teach

As to why I ask learners to ask questions, I allow them to do that so that they can seek for clarification of a concept or idea should need be. If they did not understand and they want the teacher to clarify so they ask questions. Sometimes learners may have different answers/ideas from what the teachers has given. In this scenario they will ask questions for clarification. For example, a learner may ask about the behaviour of something and would want an explanation about it. At times I ask learners to ask fellow learners questions because I am not the only source of knowledge. I ask the learners, have you heard the question?' if they say yes, I ask them to answer the question. Most of the times, learners answer each other's questions. I as a teacher am not the only person who knows the answer. Some learners may have some answers to questions. I always encourage learners to answer each other's questions although some learners have always asked me to answer questions direct and instantly. I usually encourage them to answer the questions first before me. I only come in if I feel all learners have failed to give a correct answer. It is important to give a chance to fellow learners to answer a question first before the teacher comes in.

Researcher: is it correct to say that the aural questions asked to learners during the teaching and learning process are part of assessment of learning?

Lecturer 3: mmmmmm yes, the questions are part of assessment of learning because I check how much the learners have understood what has already been taught. I check if we are moving together in the lesson. So yes the questions are part of assessment of learning. There are two types of assessment; there is continuous and summative assessments.

Researcher: I observed that as the lesson progressed most learners gave correct answers to your questions as well as fellow learners'. However, you repeated all answers despite the fact that the answers were correct. Why did you do that? Why wouldn't you just tell the learners that all answers/ideas given by their colleagues were correct?

Lecturer 3: you are right. Some learners trust the teacher very much. When a fellow learner gives an answer or idea they don't take seriously unless they hear the same from their teacher. So there is a need for me to consolidate, I call it consolidation. You gave them the task/activity then you need to consolidate. When the teacher repeats the learners responses, other learners certainly understand and take the points as correct.

Researcher: Yes, I understand you but I am talking about obvious situations where everybody knows that the answers/ideas given are correct. Why should you repeat the ideas/answers? Isn't it a waste of time?

Lecturer 3: sometimes it's a habit. Teachers do that because they are used to it. We feel we are the only ones with the information/knowledge. We feel that once we say something learners automatically understand. However, the best practice should have been that once learners give the correct answer/idea the teacher should simply say that's correct, that is a good idea,..... then I proceed with the lesson. Finally I have to emphasise that some learners believe and expect the teacher to say something about the answers/ideas given by fellow learners.

Researcher: do you have evidence that some learners want you to repeat their colleagues' answers/ideas? Do they tell you to do it?

Lecturer 3: of course not in class but when we meet outside the class they will comment to say that they were not happy when they didn't hear my voice/input on what other learners had said. What I am saying is true, learners really complain about the lecturer's missing voice.

Researcher: I observed that you moved around during the lesson more especially when learners were doing pair/group work. Why did you do that?

Lecturer 3: to supervise, to give help to learners. Some learners may fail to understand the task/activity. So I need to go there to help. Some learners will just stand idle, no contributions at all. So when you see such things the lecturer needs to go for help. If I see that something is going wrong but learners don't ask for help, I need to ask probing questions just to put them on the right track. For example you can tell them that you seem to be doing the right thing, can you explain how you did this? How did you arrive at that? How about if you did it this way?.... so moving around the classroom is necessary to help the learners. They need to be guided on how to do things. Don't tell learners, 'this is wrong'.

Just for information sir, when some learners see you approaching their group they will stop working in anticipation of help from the teacher. This can mean they don't know what they are doing so they wait for the teacher's help. Some learners even fail to ask questions about how the task/activity can be done.

Some learners chat during pair/group work. So they need to be supervised to see to it that everybody is working not leaving the work to a few individuals. so moving around will make them work. They become serious with whatever they are doing. If you don't move around, the work that you want done may not come as expected. If you go around and see how they are progressing you may end up with quality work. Moving around makes the learners to be serious.

Moving around also enables the teacher to ensure that learners are doing the right things in the right way- assessment.

Researcher: why did you move around as you were explaining issues to learners?

Lecturer 3: moving around makes learners to be attentive. Some learners play during the lesson.

Researcher: how did you engage learners during your lesson?

Lecturer 3: I asked questions to ensure that every learner was involved in the lesson. I also gave them pair/group work either to discuss or work on. I also give them something to investigate on. Give them a situation or scenario for them to work on. Let them come up with ideas. Don't give them the answers. I also give them activities for example constructing a teaching and learning resource. This makes each and every learner become engaged.

Researcher: did I see you subjecting your learners to formative assessment during your lesson?

Lecturer 3: is summative to do with continuous assessment?

Researcher: no, but formative assessment does.

Lecturer 3: oooh yes I remember.

Researcher: do you do formative assessment in your class?

Lecturer 3: yes, I do. I ask questions when teaching the learners. I ask my learners aural questions whose answers are given immediately, I give them class exercises, quizzes. Learners give immediate answers to aural questions asked during the lesson. I cannot teach the whole lesson without giving my learners an exercise. I also mark learners' work in order to assess how they have understood certain concepts. I ask my learners to model a teaching and learning resources which they can present to class. I do formative assessment to ensure that learners are able to achieve lesson objectives.

Researcher: suppose they make a snake as a model? How do you assess it?

Lecturer 3: in this situation, my interest would be to see to it that they have modeled a snake and it should be similar to the real snake.

Researcher: in teaching we are supposed to encourage learner-learner assessment and self assessment. Did I observe you doing that in your lesson? If yes why did you do that?

Lecturer 3: first of all I want to say that I encourage learner to learner assessment, for example learners exchange notebooks in order to make each other's work. At times we ask

learners to read out what their friends have written in their notebooks. As for learner self assessment, its there but mmmmmm I don't have typical examples to give as of now.

Researcher: I observed that you engaged learners in a letter to the author activity. Why did you do that?

Lecturer 3: In a letter to the author all learners get engaged. For example, when I ask them to write a letter to the author telling him/her what they have learnt. Each learner becomes very busy writing in his/her notebook because they don't know who will be chosen to make a presentation. So everybody will be busy writing. Each learner does the writing on his/her own. Each learner as an individual comes up with ideas. This is learner engagement. At the end of the tasks, each learner is chosen at random to present.

Post lesson interview with lecturer 4

Researcher: Thanks for the lesson, just 2 or 3 questions madam.

Lecturer 4: okay

Researcher: What is it that the learners have learnt today?

Lecturer 4: Today they have learnt the topics that they are going to teach in primary schools

Researcher: Eeeeh, at one time as you were introducing the lesson, I heard you talk of the resources and the nature table, asking them what they have learnt previously about resources. Is this the nature table or scientific corner? Can you look around; I didn't see a nature table.

Lecturer 4: That is a nature table. We have not finished constructing it. We are in the process of constructing and improvising the resources

Researcher: Is it a nature table or a science corner

Lecturer 4: This is a science corner but when we have finished we are going to put it in place

Researcher: Just from your own opinion, what should come first the learning of nature table and its construction?

Lecturer 4: The learning

Researcher: The learning should come first. Okay on the nature table who is supposed to put the resources, the learners or the lecturer?

Lecturer 4: **Learners** themselves, and maybe I should say that last week I did not come, so today when I came, I heard that my friend had already started on plants so I had to continue but we will find time to finish the nature table because we have not yet finished and it's when they are to construct the nature table.

Researcher: Thus teaching of plants?

Lecturer 4: We agreed that we are going to find our own time to finish the nature table

Researcher: In this lesson which I have observed today what were your roles and the learners' roles?

Lecturer 4: My role was just guiding them to identify topics, scientific knowledge and skills, attitudes and values which are taught in primary schools. Learners' role was analyzing the topics taught and what they are going to teach in primary schools.

Researcher: Can we say, in your opinion, that the lesson was learner-centred? if so what makes you to believe that?

Lecturer 4: They are the ones who discovered, identified those things on their own.

Researcher: one of the characteristics of learner-centred approach is that during the process of teaching and learning, there should be that element of classroom assessment. Did you do that?

Lecturer 4: I asked them about questions, first in the introduction, I asked to know, if they remembered what they have learnt and in the next step I asked them what are plants, to know if they know about plants and the third step is on scientific knowledge I asked them questions to find out if they know them

Researcher: Suppose you found out that nobody or the majority had no knowledge or answers what would you have done?

Lecturer 4: Then the lesson would be difficult, but I would now teach them about plants and I have plants here I could have shown them. Thus why I asked them questions so that I could help them if they are stuck or find more other questions.

Researcher: I guess before you came to teach you had time to prepare, if so can you share with me how you prepared for your lesson?

Lecturer 4: I sat down and thought what should I do first the next, thus why I came with what should I do first, the introduction, in the introduction what am I going to do, then what is the next step. From there, what next. Maybe on this one you cannot see the ideas because they were coming as I was teaching.

Researcher: So the first thing was to write the lesson notes, am assuming that you were reading

Lecturer 4: First it was reading, then writing short notes and then collected the resources

Researcher: And these resources are from the environment, how did you get them? Did you do it on your own?

Lecturer 4: I did it on my own

Researcher: Madam, you are rich you have many learners, why couldn't you ask each learner to bring the resources?

Lecturer 4: There wasn't much on plants but in the next lesson, they are going out to do things for themselves.

Researcher: So you are saying in the next lesson they will go out to see for themselves?

Lecturer 4: Right! To see, observe, classify and write for themselves and then come here to tell me about it

Researcher: Right, thank you Madam for giving me this opportunity to observe your lesson. We have really enjoyed it. What is your name?

Lecturer 4: Pillow, Ms Pillow, nee Pillow, Mrs. Sasa (pseudo names).

Researcher: Alright, I hope next time we need to observe your lesson again you will allow us especially myself being a science lecturer to do so. You were reminding me some of the things we did with IPTE 6, so I was saying yaaah this topic is still there. Thank you Madam

Lecturer 5 – Post Lesson Interview

Researcher: Mr Lecturer 5, Sir!

Lecturer 5: Sir

Researcher: How are you once again?

Lecturer 5: Very fine and you?

Researcher: Very fine

Lecturer 5: Yah

Researcher: Just a few questions

Lecturer 5: Oh. Ah, Tikhale pena pake eti (let's sit somewhere)

Researcher: Aaaa

Lecturer 5: Pompa? (Here?) Chabwino (It's okay).

Researcher: Ah, Inu ndi anyamata (you are still young). We can just stand. You cannot read from me but i can

Lecturer 5: Chabwino (it's okay)

Researcher: Yah, thanks for the lesson and that you allowed us to observe it.

Lecturer 5: thank you very much.

Researcher: my research focus is about lecturers' practices as they use ah learner-centred teaching in the classroom

Lecturer 5: yes

Researcher: so am always very interested with this question: was your lesson learner-centred? If yes, why? If not, why?

Lecturer 5: aa, i will answer it as yes, it was learner-centred.

Researcher: umhu

Lecturer 5: Aaa, why? Because I would indicate that the methods that were used allow learners to engage aaa to get engaged. For example in the introduction, they had to write the things from the environment. So right away, they were involved in trying to reflect on what are the things that are found in the environment. And then after that I said, okay you have written them then can you share that with a friend, and they did and I said okay, can you isolate which of the things which you have indicated are plants? Then they did, so it was, they were just mentioning trees, plants and then, I aa. Okay today, then we went outside where they had to collect different types of plants there. And after the collection then they actually had to be classified. And in this way, they were interacting ah with the materials, with, inferring with their friends, conferring and doing all those and then they also had to record, to design a small table and report their findings and from there we also had to look at this is the topic, it's one of the topics in the primary. How can you teach?

So can you see that, there are two approaches, two methods you can teach this one. So right away from the introduction to the end ah the learners were engaged at a different stages of the lesson, so it was learner-centred and the methods ah deployed they were a mixture of learner-centred methods and the traditional one (laughter) because there is no way, an old broom sometimes sweep clean (laughter) so there was question and answer ndithu (indeed) spiced ayiyayi ndithu (indeed). I wasn't saying but this is author's chair can you come ah can you do this? So, yes I would say the methods also promoted that the lesson be learner-centred.

Researcher: Umhu

Lecturer 5: That is what I can say and then to answer why aaa, the if as you can see as you may have observed ah why were the lesson learner-centred? I would answer it in two ways. On of the ways is that the way the learners interacted with each other, with the materials and there was an indication that they were engaged in the whole ah teaching process aam, you would also understand that this is a familiar aa topic to to those. They have learnt it in secondary school about classification of plants. Aah, but to to make it sure, you will notice that there was a debate about star grass, either eh non-flowering plant for not being or being a flowering plant. Ah because they found it I think with no flowers. So the thinking is (laughter) the, this that one ah, so that type of engagement will give you an idea the ah methods allowed learners to express themselves, to be very free not afraid of giving wrong answers but allow it to be a platform for discussion and I think if we are coming back tomorrow and if they go outside and see star grass, they would say aah no it is not these

are the reasons because they have gone. They will be looking for an answer and a definite one to say, okay this is what it is.

Ndithu ndiye (that's it, so) when you have points like these in a lesson, where kodi ndi chiti? Kodi ndi chiti? (which is which?) Content ndiyiti? Content ndiyiti? (which one is the content?) And then you suspend it or at least it was easy to tell them that this is not a non-flowering, it was very easy, but now they will find it themselves and then when they are coming it will be they will never forget it, I think for the rest of their life. But that is the answer the question why were the lesson learner-centred methods. What do they ah have such ah impact? That is an example of an impact. But you also noted that some of these methods take long, they take long.

Researcher: And you don't want to use them?

Lecturer 5: Aaaah but modify them. I don't know whether you observed, we were looking for the bus stop. Ah, normally, the approach for bus stop is that you have different concepts done in different spots but if you recall, it was the same thing there the table about the groups, the table about the two main groups. And then that methods was adopted to say can you go and see what your friends have done, if you feel there is there isn't anything that has been done can you add so when they got back to the station, they were now perfecting their work (laughter)

Researcher: Umhu

Lecturer 5: But that is a form of a bus stop. Adapting it or adopting it and adapting it. So where the methods are ah a bit longer, one can always have the opportunity to adopt it to modify it so that it suits and it also enriched what the other groups had had done. That is the advantage sometimes of modifying their statements. So with those that are long that is why I say when you choose a method, think about how best you will use it. Now but don't think in terms of because ah it is too long. That is not said. We normally tell them but think of the practicability or the practical implications of the methods and then ah is it going to work ah ah yes. Is it going to be suitable in this context? For example in this book ah of course they are critical thinking methods but there are basically those methods that ah are for Science and Technology, but I think all the methods fit in according to context in which you want to use them. So why the why the aspect we will when you when the lesson you indeed your lesson you have spots where you have learners ah engaged in a very ah powerful discussion ah that is a very good example on how these methods will promote ah thinking in learners. They will promote learners to be very free to express and I think they even forgot that you were in the classroom (laughter).

Researcher: Alright, ah from the explanation, I have come up with two other questions.

Lecturer 5: Okay

Researcher: In learner-centred teaching as you rightly talked about learners' engagement but there are also other aspects of learner-centred teaching in that the ah the learners must construct knowledge because learner-centred teaching is derived from constructivism.

Lecturer 5: Yes

Researcher: Fine, alright ah according to today's activities, do you think learners constructed some new knowledge? And the other part attached to that is that learner-centred teaching ah learners must be allowed to assess each other and even the teacher has to also assess the learners. Did these two activities take place? The teacher assessing the learners, the learners assessing each other?

Lecturer 5: Yah, on the teacher assessing, I would say but let me begin with the learners assessing each other. I think as they were going round

Researcher: Using the bus stop

Lecturer 5: Using the bus stop method, they were either you observed they were putting question marks on their colleagues work. I would go back to the star grass. Is this so? That was part of the assessment, to say but this cannot be a non-flowering plant but at the same time even as they were going round ah I saw one group actually wrote what, flowering and non-flowering plants to the other group which the other group had actually skipped. So that allowed aa assessment of learners aaa themselves. And even during the presentations right away, from the beginning ah we did say that ah can you ah there was there was there was one who used author's chair to to make a presentation and then I did say if you discover that something has not been indi has been indicated don't say it again, then someone said, no. they yah, so there was, I would say so and on my part I would also say that

Researcher: Umhu

Lecturer 5: Yes, as I was not necessarily writing

Researcher: Umhu

Lecturer 5: Ah but I did ask some questions as I was interacting with the groups what do you think according to this? Ah flowering plants? So they were able to say okay these are the plants that produce flowers. What about non-flowering? Okay, what are the groups that you have managed to come up with? So that that was there even the construction of knowledge. Ah this question can plants be put into groups? You know all those activities were leading to them saying, “I think we have two groups of plants, flowering and non-flowering” so in that context I think that was the evident but on my part it was in the groups that I was asking questions but questions leading them to find out that plants can be put into groups. I would say so.

Researcher: Alright, Lecturer 5

Lecturer 5: Yes

Researcher: Ah, what is your experience about learner-centred teaching?

Lecturer 5: Thank you very much, my experience is that learner-centred methods are the methods that promote learner engagement if they are chosen ah appropriately. Chosen and used timely

Researcher: Umhu

Lecturer 5: because sometimes they may be they may appear as eh seekers as just like I would compare to dancing aimlessly in a classroom but if they are used ah in the right context, they are chosen, you choose the right methods, use them in the right situations, they promote ah learner engagement and insight in this respect insight then you will be

more less like a facilitator. Ah and then learners will be ah in the driving seat, asking for clarification and asking for this. So learner-centred methods. That's my view but my experience is that ah before all these learner-centred methods I think we had difficulties ah in trying to make learners understand various concepts. So they enjoy ah the teaching and learning process. To say so, the engagement ah is there in the classroom is what surpasses many things.

Researcher: Umhu

Lecturer 5: to say this leads to what makes teaching to be very enjoyable activity because you also and sometimes you even discover new things ah because learners are free to express ah learners are heard, ah learners here will appear to demonstrate ah yes I think my point was understood (laughter) that is very necessary in the process of teaching and learning.

Researcher: Umhu. Did you have a situation where you feel ah learner-centred teaching approaches shouldn't be used anymore in Science and Technology from your experiences?

Lecturer 5: Ah, honestly no. honestly no, but what I would say is that we have certain methods that are very long.

Researcher: For example?

Lecturer 5: There are very long methods and whose procedure requires care free (laughter). Yes, I will, I will give you an example. You have methods like ah ah but there are things

like directly reading and thinking actively ah but sometimes you call it “DART” eh direct ah dart is Directed Activity Related to Text. Then what it means is you need to prepare a text eh you need to prepare a text, probably with blanks in between related to say, you say in this case ah plants with their environment and specifically classification. Very long and then as you know the ability of our learners to read and then may be in primary schools, and then you have large classes, some may not be ah not I wouldn’t say appropriate but may not be applicable in certain context.

Researcher: Okay, fine

Lecturer 5: So you have the impression that ah I think I would have used this but now look at this, that is that is what happens and then also the expertise for example when observing our learners you also say is using one stays and three stray ehe three stay in the end you find all of them have gone astray. (Laughter)

Researcher: Yah on that one, I also noticed a lesson, even with lecturers where in my understanding; I don’t know may be I stand to be corrected. When we say one astray, I mean one remain three stray

Lecturer 5: Ah one stay

Researcher: To my understanding ah one stay, three astray, to my understanding then in that group there must be?

Lecturer 5: Four

Researcher: Is that correct?

Lecturer 5: Very correct

Researcher: But you find in a group there are six

Lecturer 5: Has six, yes

Researcher: And then there is one remaining. The ones astray you say are these three?

(Laughter)

Lecturer 5: That is always the confusion

Researcher: You see?

Lecturer 5: Eee that is always that is always the confusion and.....

Researcher: Okay, fine. You have to rush to another class. Let me ask you three more questions. So as we are going home, which methods should I say were used in the lesson in your lesson?

Lecturer 5: Okay I used quick write, bus stop, ah paired brainstorming, ah is mind mapping, where I had where I had ah paired brainstorming, ah Socratic questioning

Researcher: Umhu

Lecturer 5: Ah which is ah we went outside, excursion

Researcher: Excursion

Lecturer 5: Enhe, yah. I think those are the ones that I used. Ah author's chair. I also used it.

Researcher: Okay, on the excursion ah am just thinking.

Lecturer 5: Yes

Researcher: These, these things that we see there, came from outside. Why wouldn't you just end your lesson outside bearing in mind the plants are there?

Lecturer 5: Ah, very good. Ah, what we wanted to do was that if we had a class classification board here we it's, once they have collected they need to I should say that's related to a procedure ah in the teaching of Science and Technology . Yah, once they have collected, they should come, look, examine the specimen more thorough, more closely.

Researcher: Can't that be done in the field?

Lecturer 5: Yah, now (laughter) I was looking at this, because they came here without these resources, so I thought now engaging the learners, collect the resources themselves to be used in this room (laughter)

Researcher: Yah, but it would also be possible to say; okay the resources I want us to use are outside. Let us go and learn from outside the class.

Lecturer 5: Yah that can be that is also possible to go outside and start the lesson and finish it there. That is possible. It can be planned in that way. It would go by the plan. That will now depend on the plan but my lesson plan indicated that I should I say ah let us collect them. There so many out there but they will select. Let us come here and do it

Researcher: Per station

Lecturer 5: So it was a question of ah the planner's choice (laughter)

Researcher: Ah as we are going out as we are going out ah when planning the lesson

Lecturer 5: Yes

Researcher: How much or how far did you involve the learners as you were planning not as you came to class?

Lecturer 5: Honestly, I did not involve them

Researcher: Did you have any time?

Lecturer 5: No, I must admit I did not involve the learners. This was my lesson plan. That was I did not actually ah involve them. I must admit.

Researcher: Alright

Lecturer 5: But it was basically to look at ah yah ah that has been our tradition. (Laughter)

Researcher: Alright but we enjoyed your lesson

Researcher: why did you use small group work, walk around talk around, gallery walk activities in your lesson?

Lecturer 5: to promote learners' participation in the lesson

Researcher: can you clarify what you mean by learners' participation?

Lecturer 5: it means giving the learner an opportunity to take part in the lesson. Through participation learners share ideas, listen and learn from others.

Researcher: Does that work in an ideal classroom?

Lecturer 5: Yes it works but it all depends on the facilitator who is the lecturer. Whatever he/she does in the classroom matters because he/she is the guider. For example, group work does not work if the activity is being dominated by those learners who are more knowledgeable than others. So the lecturer must organise the activities in such a way that every learner gets engaged in the activity.

Researcher: so you are saying that all learner-centred teaching methods promote learners' participation?

Lecturer 5: Yes, the methods simple promotes sharing of ideas and learning from one another. In fact they are not critical thinking methods but the way how they are used can allow learners share ideas, ask each other questions. In the process learners may develop critical thinking. But the method itself is not critical thinking. The methods just promote critical thinking in learners.its possible to use the methods but learners do not become critical thinkers. All this methods allow learners to participate actively.

Researcher: I observed that you kept asking questions from one stage to another throughout the lesson. As learner-centred teaching is concerned, does the teacher need to do that all the time?

Lecturer 5: no its not always required in learner-centred teaching. It is important to vary the activities in order to cater for all learners because different learners have differwnt learning styles.

Researcher: I observed that you started your lesson by asking questions, why did you do that?

Lecturer 5: I introduce my lessons by asking learners to share their experiences or knowledge acquired from previous lessons which are related to the day's lesson. This is done because introduction should always be interesting to learners and provide continuity at the same time. By asking them to answer questions or to explain or to describe their prior knowledge on particular scientific concept I try to assess how much they know about previous knowledge. This can also happen through observing how they do tasks. In this case I am able to notice challenges or misconceptions learners have about particular concept or topic. If I find out that their previous knowledge is falling short I make some explanations or giving relevant examples and also using illustrations and resources".

Lecturer 6: post lesson interview, lesson 1

Researcher: The main issue in my study is that I am interested in the learner-centred classroom practices which I have already observed. On the other part ndimafuna kwambiri ma experience (I am very much interested in the experiences) you have had in using learner teaching methods. What have been your experiences with learner-centred teaching approaches, sir? In this case am trying to say kuti (that) ammm during the course of your teaching not ma lesson amene ndinaonera kale koma pomwe munayambira (not only the lessons which I observed but since you started teaching) using learner-centred teaching approaches. Aaam mwachitsanzo (as an example) learner-centred teaching, what is it? What is it? I also want to know what has been the reaction of the learners as you were teaching. Did they welcome you or did you have instances when you felt learner-centred

teaching approaches did not work? Have you ever been disappointed for using learner-centred teaching approaches? Or else, you haven't been successful with the approaches because of ABCD, or since you started using these methods, everything has been working out nicely for you. These are the things I am looking for. So, in short what have been your teaching experiences in using learner-centred methods? What experiences have you gone through since you started using these learner-centred teaching approaches?

Lecturer 6: Ah my experience has been that with learner-centred teaching methods, mostly they save time. That is most of the methods. If you put learners in groups using group work, the improved one, we cover a lot of work for example with the method bus stop. You give them different tasks. At the end of that group work or that method it means you have covered a lot of work. However with my experience, I have observed that when using some of these methods, they require some resources, books or you need to have some content somewhere that you need to give your learners, that you should give learners to discuss in groups which is a challenge. Again we can say maybe we can say if learners don't have the books, nowadays we are talking of ICT where we can allow learners to use their phones. So the disadvantage is that learners do not have phones. In a classroom you may discover that maybe only two who can if you give them such instructions to search for information. They just sit, two may be searching from their phones but others say they don't have phones. Others will say, we have them but maybe they have no bundle. So that is a disadvantage. The main disadvantage, of lacking resources, but mostly they are good. I like them.

Researcher: So learners (not with this group only) but for the groups you have been teaching; what has been their reaction? Should we assume that they have welcomed the learner-centred methods bearing in mind our learners come from different backgrounds? It's possible they were using different methods, but when they came here they found you using learner-centred teaching methods?

Lecturer 6: Yes

Researcher: discuss this

Lecturer 6: Ah, my experience has been that it is the way you present, you as a lecturer or teacher. The way you present to learners. If you give them tasks using the learner-centred methods to do on their own and report and just stop there, yes you will notice that the learners feel unsatisfied, yes, they show that sign. I think may be as you have said kuti anazolowera kuti mphunzitsi amaima kutsogolo, nkumafotokoza amakhulupirira kuti even though akakambirana mmagulu amayembekezera kuti iwenso udutse monse muja. Umalize. Koma the way you present the issue to them and may be after the report you may give some comments. I think they felt satisfied or I feel the in my experience they get satisfied and they like the curriculum. That is in the majority however I have already pointed out that others want someone to stand in front and explain everything.

Researcher: Okay, suppose you have a new lecturer in campus and this lecturer says sir, I want to be doing what you normally do or I want to follow your teaching practices in the classroom the learner-centred one amm what would you recommend kuti are the best learner-centred teaching practices. Munthu akufuna azipanga zomwe inu mmapanga so

whatever you tell this person azipanga zimenezozo inunso mukupanga. What can you say are the aah your best teaching practices that you normally do when you go to classes?

Lecturer 6: Like my best methods? You say?

Researcher: Not necessarily methods. A practice is anything that you do in the classroom in the course of teaching, for example, ah asking questions, and moving around the classroom, etc, just giving examples eti? May be marking, these are practices. Komanso when you are doing them you say apapa what am doing am inline with learner-centred teaching methods. Just giving examples kuti mwina asking questions kuti mwina mupanga zakuti. When you go there, make sure at the beginning you ask questions. The reason for asking questions ABCD. Now when the reason is in progress may be put them in groups. Those are yes we have methods inside the practices. So anything that you do in the classroom, teachers marking in the classroom kaya asking learners to be in pairs nde inuyo what would you say about the best practices zimene mukuzidziwa kuti with learner-centred teaching zili inline, ngati motivation.

Lecturer 6: Ah I would rather recommend that a teacher should at first introduce the lesson well and then

Researcher: what do you mean by well?

Lecturer 6: (laughter) ee purpose of introduction is to make learners to capture interest in learners in such a way you make the learners to have interest in the lesson so as you will be coming in with the learner-centred methods even though the methods they are like boring one but since you have introduced the lesson interestingly and the learners have that

motivation they accept it and they do it. As I said earlier on indeed some of these teaching practices are not good ones, they have some disadvantages but if the learners already have the interest to learn if you give them such methods to use, they do accept and they do them interestingly. Yah, I can also advise the teacher to include some questions because that is part of finding out if the learners are following the lesson. That should not be missed, that is on questioning, finding how the lesson is progressing but you also need to put in some element of assessing the learners. So with that I cannot emphasise to my fellow teacher because I normally don't do it because of time.

Researcher: Time, time yi imakusokonezani?

Lecturer 6: Eee One hour imachepa

Researcher: Mwatero?

Lecturer 6: Eee

Researcher: Ndiyeno, follow up question ah using learner-centred teaching experiences, ah why do you think it is necessary to have a lecturer in the classroom? Am asking this question poona kuti from your explanation koyambirira kuja, ana aja ali in groups like that eti? Ndikutha kuona kuti in college like TTC where learners can read on their own you can remote control them. Ndili mu office kungouza kuti open page one just follow the instructions. Apanga apanga okha mapresentation kungobwera basi paja munatipatsa paja, tamaliza. So why do we need a teacher in the classroom? Because learner-centred teaching says learners must do more than the teacher. Now you have done, you have put so many

groups in the classroom. Why do you need the teacher in the classroom? Ngati inuyo ntchito yanu ndi chani?

Lecturer 6: Aa may be I can say the teacher is there is there to facilitate or tell learners what to do ndiyeno munthu ukakhala mkalasi muja, mphunzitsi ukaapatsa ntchito ija, they are forced to do it. Chomwe ndinaona ineyo.

Researcher: Komatu mmapanga zoti zili m'buku?

Lecturer 6: Sometimes zimakhala kuti zili m'bukhu, sometimes zimakhala kuti aganize ndiye ndimaona kuti ukakhala uli momwemo, amazipanga seriously, koma ukakhala kuti mulibe (laughed) zimaoneka kuperewera kwina kwake. Zimakhoza kunena kuti as you are saying kuti mwina tsiku limenelo uli busy nde wangoapatsa ntchito yoti takambiranani mmagulu, podzapita kuti umveno feedback kuti mwakambirana chani mmagulu muja, umapeza kuti ndiochepa omwe amakuuza zoyenerera. Ena aja amangoziganiza mwina nthawi yomweyo kusonyeza kuti nthawi yomwe unaatuma ija unaauza kuti apange zija iwe mulibe anasiya, mwina amapanga zina, they lost maybe concentration on the activity. Koma ukakhala momwemo, ah they are forced

Researcher: Are you trying to say, the learners not all of course, some learners do serious work when they see that the teacher is around?

Lecturer 6: Yes

Researcher: When this teacher is not around then it is not important to do whatever?

Lecturer 6: Eee, they just feel like you have given them work to make them busy, so they feel they have something more busy than what you have given them (kkkkk) kaya mwandimvetsa pamenepo?

Researcher: Yah, I understand that in fact, I have to be honest. I never thought about that. It is a new point worth noting (laughed)

Lecturer 6: Iwo amaona ngati aa iwo aja angotipatsa izi cholinga choti ife tikhale busy koma ife tili ndi zina zotipatsa busy apart from this. Nde zimaoneka kuti they switch on to what they know can keep them more busy than the work you have given them. Zimenezotimaziona even tikapita, apapa ndimasiya ntchito ku class G ndili ndi period yanga ndi ya Mr Lecturer X nde ndawafunsa kaye, Mr Lecturer X anakusiirani ntchito ? akuti ee. Mukugwirabe ntchitoyo? Nde akuti timagwira nthawi ina ali yonse, musadere nkhwawa, inu mubwere basi. (laughed). Musadere nkhwawa, inu bwerani. Timagwira nthawi ili yonse. Timazipanga pa nthawi yathu komabe lesson for that lerolo pa timetable ya masamu ilipo. Ntchito awasiira , koma ayankha kuti ife timazipanga pa nthawi yathu ina yapadera osati pa nthawi ya mkalasi. Nde I think kugwirizana ndi kuyankha kwanga ndi mmene ndimaonera ndi mmakalasi mwanga mwinamu ndimaonera ndikaasiyira ntchito, pobwera ndimapeza kuti ayiyayi koma timapanga zoti amazipezera iwowo okha zochita zinz zimene zingawapatse busy more than what you have left for them. Nde sizimagwira kwenikweni kuti ungowapatsa ntchitoyo iwe ukhale uli kunja.

Researcher: Finally, mwaphunzitsa kwa nthawi yaitali tsopano, using learner-centred teaching practices, do you think there is any gap in learner-centred teaching that needs to be filled? Icho icho ndikanachidziwa , zimenezo zilipo?

Lecturer 6: Eya zilipo

Researcher: Aaa

Lecturer 6:Pali ma teaching practices ena ineyo ndimalephera kuwagwiritsa ntchito chifukwa chakuti: one enawo am not used to them mwina chifukwa sinnawamvetse mmene tinkaphunzira. Pamene ena ndinawamvetsa koma mwina ndi nature of my learning area, nde amenewonso sindimaagwiritsa ntchito.

Researcher:Then why, nde amene mukuti munawamvetsa koma sakugwira ku learning area yanu, do you have an example in mind?

Lecturer 6: Eee

Researcher: Monga?

Lecturer 6:Pali pali teaching practice ina amaitchula kuti make a stand. Of course alipo koma yomwe ndikuikumbukira panopa ndi make a stand mmene mumapereka funso kuti ena ayankhe “yes”ena ayankhe “no” ena apezeke alibe yankho. So amu “yes” aja akuyenera kukhala ndi “yes” ndi zifukwa zake. A mu “no ” aja akuyenera kukhala ndi “no”ndi zifukwa zake. Amene alibe choice aja amakhala attracted ndi zimene anzawo aja akufotokoza then at the end, mmapezeka kuti muli ndi magulu awiri. Apopo nde kuti ndi topic imene imafunika kuti mubwere ndi advantages ndi madisadvantages a chinthucho.

Nde in my learning mulibe ma topic amene amafunika kuti mukambe zamaadvantages ndi madisadvantages za chinthu chimodzi mostly of course alipo koma ndiowerengeka. Nde ndimaona kuti aa, sizimagwira kwenikweni.

Researcher: The question require some to agree others to say “no” ena ah chete. So awa a “no” wa they should defend their “no”. aa ife mmene tikuonera dzuwa komano now I understand you. I have deviated a lot, I mean a little komano zinazo anawa akuzidziwa kale even if we say, inu muoneke osadziwa (laughing).

Lecturer 6: Nde umatha kuti nditayeserako, nthawi ina anapezeka kuti onse apita pa “yes” kusonyeza kuti they are agreeing palibe amene anali pa “no”. ndinangodziwa kuti apapayangayi ndiyosagwira chifukwa iwowa zinazi akuzidziwa nde they cannot create the negative side of that thing.

Researcher: Okay, funso lomaliza. Sindifunsanso lina. Do you know the learner-centred teaching philosophy?

Lecturer 6: Ah mmm

Researcher: Simukudziwa? The learner-centred teaching philosophy, ah you already said that. Says ah teacher must be a facilitator. Ah, the teacher or the facilitator must emphasise on learning of the learners and chani and the focus must be on learners not on the teacher. What they are trying to say is when you say focusing on the learner and not the teacher tikunena kuti as you said when you go into the classroom you give them work so that they should be interacting, constructing knowledge so on and so forth. So in short in learner-centred teaching philosophy tinene kuti the teacher so the emphasis must be on learning

and not on teaching and must be on the learner and not on the teacher or not on the instruction. Sometimes teachers were emphasising on instruction to cover the content, eti?

Lecturer 6: Ee

Researcher: If you attended MIE workshops mwina amenewo amayankhula kuti don't cover the content but you should uncover it. Ankakonda ena ake ku MIE. What he was trying to say ndikungonena kuti make sure the learners understand what they are learning basically, that is it. Komano munaipanga mention as you already mentioned kuti ndikapita ku kalasi, ana ndimaika mmagulu. Ndimatani, ndimatani. That is the learner-centred philosophy emphasise on learning and facilitation not on teaching.

Lecturer 6: Okay

Researcher: Right, mwina ndidzakufunaninso kamodzi, thank you very much for your time.

Lecturer 6: Okay

Researcher: Likabwera funso lina ndidzakufunsaninso. As of now thank you for the answers you gave me unless you have a question.

Lecturer 6: post lesson interview, lesson 2

Researcher: Sir, you already know our reasons why we bother you, using your classes. The issue is not to evaluate you but to see and observe the lessons. Ok, so thank you for the good lesson, we enjoyed it. In fact you reminded me about light when I was teaching

so I said within myself, this lesson is still there! So after the lesson observation I have some questions. Right, the first question is the usual one, my interest is on learner-centred teaching, so I just want to know before we make any conclusions. Was your lesson learner-centred? If yes, how do you know?

Lecturer 6: It was learner-centred because of the practicals

Researcher: What else apart from the practical's?

Lecturer 6: Apart from the practicals I think that the first one I made them to interact themselves, in groups or? Yes, or going outside? No, that sure the practical part but are I think they form in a circle and then after the first activity was speaking in chains which you just found us at the end of it I made them to be in pairs.

Researcher: Speaking chains?

Lecturer 6: Yes, the first one where I asked someone close to me a question and he answered and that someone close to him too, it was going like that. That is what I mean by speaking in chains, but as you were arriving the activity that was going on was pairwork while they are still in the groups I asked them questions on the properties and I asked them to think and there after I made them to be in pairs and share after they exchanged partners

Researcher: That's good, ok fine that's very interesting. Did I hear you saying speaking in chains? Do you ask one learner a question?

Lecturer 6: Yes, that is what is supposed to be

Researcher: So you started with the one who is close to you?

Lecturer 6: Of course the question was like, ‘what are the sources of light?’ So this one is close to me, will give his views and after giving his views will ask the same question to the other.

Researcher: What about if I have the same answers to what he has said do you still allow that?

Lecturer 6: I insisted to them not to repeat what others had said.

Researcher: In today’s lesson you know as a teacher you had your own activities and you wanted learners to learn something, what would you say the learners learned? And how do you know they have learned?

Lecturer 6: I asked the learners to learn the properties and how they can investigate some of the properties of which I have hope that they have learned, because you saw them investigating?

Researcher: Yes. Now I was thinking about this as a researcher, you asked the learners to do the group activity which everybody saw, we saw that happening we found them outside discussing some points of course you mentioned the approach that you used. You said one stays three astray, when they come back I didn’t hear you ask them to report what they learnt in groups is it deliberate? shaaaaa

Lecturer 6: No it was not deliberately done but I can say it is the way I feel it is supposed to be, right. Because even in the groups----- one can remain so ----- and then at the end I feel like all the groups have----- groups, except for this one person. What I did with those remaining ones?

Researcher: Yes, that my interest now,

Lecturer 6: I thought this real methods were supposed to be explained by their colleagues for example the ones after going through all the groups they are the ones to report to the one remaining behind what they have learnt from this other group that is how it is supposed to be, but in my case I did not do it in that way instead we have two groups in the classroom and four outside I really told them to take that one who was staying in group one to join group two this one to go to group one and in that case I was-----
----- but I was depending on that group because -----
----- and from explanation there was no need for people to report back.-----

--

Researcher: Who prepared the resources? For recording purposes, what are the names of your resources so that we do not record something which we don't know?

Lecturer 6: Am the one who prepared the resources but I get them from the Lab

Researcher: From the lab assistant?

Lecturer 6: Yes.

Researcher: There was no learner when you were preparing the resources?

Lecturer 6: No.

Researcher: They just saw them in the class?

Lecturer 6: Yes

Researcher: The resources they look very local-----

why didn't you say to them make this and bring them to class? -----

-- what was the first question? The name of the resources.

Lecturer 6: First of all the stage one, you say all ones be here ----- that left part, left

column there was a wood and a cut boards we just mentioned it the way I did , I don't know

if they have the real names as the way they look as an -----the parts

and the ----- . One beaker with salty water, another one with pure water, mirror-

-----.

Researcher: I am interested with the group which was given pure water and salty water,

why did you do that?-----

----- as the

lesson was progressing did you assist your learners?

Lecturer 6: In that group I think yes

Researcher: How did you do it?

Lecturer 6: First of all I was moving around the groups and ask if there was need for help, however they were saying they were not in need of that help.

Researcher: Because I saw you moving around and I thought you were just interested and I did not know that it was one way of the assisting them -----

-----.

Lecturer 7: interview, lesson 1

Researcher: Mmm I hope tipanga pick. Right. Ah, ma questions athu they are centred only on understanding of and experiences about learner-centred teaching practices. Okay. There are general questions and how learner-centred is implemented in Science and Technology and finally your perception about learner-centred teaching. So first question is what do you understand by learner-centred teaching?

Lecturer 7: Okay, to me, I think learners' teaching approaches are focused mainly in engaging learners actively ah eh participating what they are going to learn in terms of content. As leading to our system as Teacher trainers, we have been expecting on the skills which are to be acquired and the methodology teaching that method even problem solving
Researcher: Umhu

Lecturer 7: That is how I understand.

Researcher: Okay, ndiye I heard you saying engaging or making learners learn ah actively, so what would you say are the roles of the learner in class as you are applying learner-centred teaching?

Lecturer 7: In most of the cases according to our curriculum the instructions are prescribed, however they are put in such a way that the instructions tell the learner what to do and how it must be done.

Researcher: What do you say are the roles of the lecturers?

Lecturer 7: The role of the lecturer is just to guide the learner on the standards of how that task is required to be done and even monitoring or supporting them where they have problems.

Researcher: Some people say the learner-centred teaching, sorry, some people say the learner-centred teaching can only be possible where there are enough resources, teaching, and learning resources. What do you think on that?

Lecturer 7: To some extent, that may not be true because there are some approaches which do not need the availability of resources for example, role play. You can role play even if some of the resources are not there.

Researcher: Alright. Umhu. How ah you how how do you prepare sorry, how do your lessons, sorry again. How do your lesson preparations reflect learner-centredness? How do you make sure that as you are preparing for your lessons it must be learner-centred?

Lecturer 7: Ah, in most cases when I am preparing, I go through all the instructions. In times, the curriculum developers may overlook some ah activities which can actively involve the learners. So I modify them ah in a way that I think how best can I engage the learners when suggesting the type of task that is best for them eve even the method that must be applied.

Researcher: Ah do you involve learners in lesson preparation, say you want to teach tomorrow a lesson, do you call learners so that they can be involved in the preparation?

Lecturer 7: In Malawian context ah lesson preparation does not involve learners' input.

Researcher: How do you ah how do you prepare learners to learn?

Lecturer 7: Ah, sometimes we give them assignments in advance so that they can, we give them a picture of what will be taught in the next lesson and as we meet we will listen on the tasks on which they were engaged on and then we develop the new work that is required to be learnt or to be practiced.

Researcher: Ah in the academic circles people talk about use of learners' prior knowledge in a lesson.

Lecturer 7: Umhu

Researcher: So my interest is to know how do you assess learners' prior knowledge and why?

Lecturer 7: Ah, prior knowledge can be assessed sometimes by asking oral questions in the introduction ah in fact when you are asking such questions you can judge whether they have any other experience as related to what you are asking. Then this assist the teacher or

helps the teacher to organise instructions so that they ah facilitate facilitated or presented to the learners.

Researcher: Ah then how do you assist learners link new experiences with the existing knowledge? What I am trying to say is you have a pot of knowledge which you want to give to learners. So how do you make them link the new knowledge with the previous one?

Lecturer 7: Sometimes you just you just ask them to reflect on the previous knowledge. They are able to make connections on their own when you give them task to discuss.

Researcher: Right, in teaching, we have the teacher, who is said to be the facilitator and we have the learners who are supposed to learn. And then, there is content ah which is to be taught to the learners. In your opinion what do you think is the use or the role of the content in teaching and learning process?

Lecturer 7: Ah to me content is like a foundation on which ah all other tasks will be based. Ah, without content, then ah we may not have direction of whatever we are going to do for example we want to practice certain skills in how it can be implemented as in pedagogy, it is based on content . We cannot talk about how to do something without content.

Researcher: Umhu. So how should content be presented to learners?

Lecturer 7: In this case, ah we can engage the learners in tasks which will help themselves in generating the content and then will discuss how that content can be presented in terms of how learners can acquire it because here we are dealing with student teachers.

Researcher: Ah, during lesson deliveries what activities do your learners do?

Lecturer 7: Ah lesson delivery ah sometimes, we ask them to reflect on the expected outcomes. To say, what do you expect to be achieved out of this? Sometimes we may ask them ah to suggest the order of tasks ah in which the a certain topic can be structured and we engage them sometimes actively in deciding the strategy in which that topic can be presented. Ah in the preparation of the resources in which I mean the resources have to be prepared to present that topic. So in lesson delivery most cases we engage them actively whether reflecting on the content or else deciding how best the content has been presented, what may be required in order to facilitate delivery of that.

Researcher: Alright and again am interested in the activities that ah the lecturer does during lesson deliveries. What does the lecturer do as ah sorry during the learning process? Is it just talking to them the learners or there are other things that the learner ah the teacher or lecturer has to do as the lesson is progressing?

Lecturer 7: In most cases we get to note that in the introduction ah once the introduction has been made where the learners are engaging answering as we go into steps, the teacher can just give instructions, on how it is done. As the learners are working on that task the teacher goes around according to those groups with problems even in evaluating how best it is done in different books or as an individual, how best is each and every learner or student fairing so that you can know shortfalls which are required to be improved before the end of the lesson.

Researcher: Alright, ah am also interested to know ah, teaching talk about reflection, thinking back on how learning has taken place. So in your class how do you let learners reflect on their learning?

Lecturer 7: Sometimes after a lesson as we are starting a new one we give, we give them chance to give areas which they have not understood. So in that way, they have given out a picture of what they have not understood, the teacher may come up with a modification on the task and connecting them with the new work.

Researcher: Alright, ah in learner-centred teaching, we one of the conditions is that learners must be guided and supported during the learning process so again am interested to know how do you guide or support your learners during the learning process?

Lecturer 7: Ah, in most cases we have guidelines that are put in steps. A lesson in most cases is represented using the lesson plan and a lesson plan describes what must be done in step one, how the learners or learners going to do an activity. So and using that, teachers know how and what must be done by the student teachers.

Researcher: Umhu

Lecturer 7: The learners follow those instructions. Sometimes they are put on the board, sometimes they are typed, sometimes we just tell them to say, can you open page so in your Teacher's Guide or learners' handbook, and they take those instructions.

Researcher: Ahaa, do you assess your learners during lessons?

Lecturer 7: Yes

Researcher: Why?

Lecturer 7: We as teachers wish to know if they have mastered what I have presented or what has been practiced in a particular step before we move to another step. So we assess the learners in all or sometimes in a certain step. You write a question, I want to find out if you have understood how this is done. Can you write down what you have captured? And you move. After evaluating, you move to another task to another step. So It helps the teacher to know what elements are challenging and how best learners can be supported on that particular problem.

Researcher: In short if I say what sort of assessment do you give to your learners? What would you say?

Lecturer 7: Ah in sci science context or in maths context?

Researcher: In Science

Lecturer 7: In Science context we give oral questions, written exercises, performance exercises. This is some of the ways we assess the learners to make judgement on how it is done.

Researcher: Umhu, during the assessment, what are your roles? And what are the learners' roles?

Lecturer 7: During the assessment, their role is to pose a question or give instruction which learners must follow in order to do a certain exercise again, the student teachers while they are doing that you go round marking or sometimes if it is an oral, as one is giving out an

answer you analyse the eh the answers which have been given out and make statements ah is the answer correct or wrong so that after the answer is being given you support that one who needs improvement before you go further to start new work.

Researcher: Alright, so you said what are what are the learners ' roles?

Lecturer 7: The learners' role is to do that task you have assigned them to do or which you have asked them to do. Giving input to the question.

Researcher: Ah, if I could ask another question related to the same

Lecturer 7: Umhu

Researcher: Ah, at what level of the assessment should learners be fully involved? Ah, by talking about level am thinking of preparation, then while you are asking the question and then administering and marking and there is that of giving feedback to the learners. so looking at these processes, where should learners be involved and why?

Lecturer 7: To my understanding learners are fully involved mainly in the implementation or in the steps where they are actively involved. Ah very little can be done engaging them to decide ah what to do and how it must be done because it is already prescribed in the teacher's hand books or lecturer's handbooks. So you get engaging them to decide what to do or how it is done but the actual doing as they are answering if it is an oral. You engage them actively to polish up or to correct somebody's answer

Researcher: Alright, do you use learner-centred teaching methods?

Lecturer 7: To some extent, yes.

Researcher: Ah, you are saying to some extent. When do you use learner-centred methods in teaching?

Lecturer 7: Ah, sometimes the nature of the task demands that we should put or organise the learners so that ah they themselves find out information or discuss what type of skills they are required so in this scenario where ah we are required to analyse or to find out the information or discuss how it is to be done. It is where they can actively be involved.

Researcher: So by saying to some extent means that other times you don't use.

Lecturer 7: Sometimes you are forced not to use.

Researcher: What could be some of the reasons?

Lecturer 7: Ah the reason is ranged from ah sometimes the nature of the task as related to science.

Researcher: Umhu

Lecturer 7: It may be that you don't have enough resources. Sometimes you feel that the type of set-up can likely cause an accident so you are forced to just demonstrate how it is done because you can use other precautionary measures. To some extent if you have missed on or two lessons, ah sometimes you plan in such a way that ah it must be to some extent controlled by ah the teacher because sometimes when you give responsibilities, the learners drag in doing exercises. So you feel it is not proper for the lesson to be ah controlled to some extent by the learners.

Researcher: Alright ah from other evidence I have collected from you, you do use learner-centred in class. So if I may ask, what form does it take? Or what is the form of learner-centred, the form of learner-centred teaching that you use in the classroom?

Lecturer 7: Mmmm can you

Researcher: There are so many methods that are associated with learner-centred teaching, for example people go for group work, others will projects or use experiments. Others will use ah ah group work others will use think- pair -share and so on and so forth. So of these, which ones do you use?

Lecturer 7: Ah ku science, mainly the activities involve experiments but the experiments may be done in groups. Ah, some of the experiments require discussion first so you may apply in discussion, participation and then we go to group work. Sometimes we make use of other methods like work stations which is a modification of group work. Ah we may use gallery walk, ball bearing, jigsaw, sometimes we use what we call card collection and clustering. These are some of the forms of methods which ah we are engaging and we should not forget that science also demands field work. Ah we take the learners to the field and carry out some observations. These are the methods of which we apply.

Researcher: Alright, ah are there any challenges you face in the presentation of learner-centred teaching approaches?

Lecturer 7: Ah the challenges are there. The first one is that with learner-centred, it is something that is new and how it has come in ah I think the approach is not being good

enough to make the lecturers conversant with the materials. My thinking is that the learner-centred must right ah start right away appearing in the learners' book. When the teachers are being trained while in college, the type of approaches must be learner-centred. Now if these teachers who are being trained come to institution like TTC and they are using resources, the method that must be in the handbook must also be learner-centred. But you will find that here at college, there was no learner-centred. In the handbooks you find there is no learner-centred. Again learner-centred is just coming ah as a small component which has been put in the system. So to me you will find that there might be some resistance because some people may not take it as very significant because they are taught in a different way and what they find in a Teacher's Guides and in handbooks does not match.

Researcher: Anha, in your opinion of course. You were going around the the class to supervise the activities. What is it that you would like to see so that you would call it learner-centred teaching? Someone is teaching and then you want to check whether learner-centred is being applied. What is it that you are going to see kuti apa pali learner-centred ndithu?

Lecturer 7: Ah lesson must flow in such a way that the the teacher must just have a small autonomy of guiding them and then leave the learners work on their own generate information and at one point the learners must be in a position to facilitate representation of critiquing the information ah when analysing what learner information represented is right or wrong and teacher's role at the end is just to consolidate.

Researcher: Alright from what we have explained from the beginning of this ah discussion, I want to hear from you. Do learner-centred approaches be applied in teaching Science and Technology ? That is in your opinion.

Lecturer 7: Learner-centred should be applied in Science and Technology .

Researcher: Why?

Lecturer 7: The reason being, Science requires much of enquiring and development of the learners, how many can carry out investigation and the like. So when we engage them actively using learner-centred approaches ah are shaping them into future scientists who will be able to carry out science research on their own. So I feel that the learner-centred approach should be applied in Science and Technology .

Lecturer 7: Umhu, some methods require experimenting.

Researcher: Umhu

Lecturer 7: Ah role plays, games, I use work stations.

Researcher: Umhu

Lecturer 7: Brainstorming, I sometimes use ball bearing.

Researcher: Umhu. Are there any learner-centred methods which you know but you never used them? If so why?

Lecturer 7: Mmmm, some learner-centred teachings with, I am to be correct, I may know them but if you go through, you may think it is too involving. Enhe but I have just forgotten the nature of ah the learner-centred methods. It might be too involving in in sense that may

be if you use them you might find that at the end you have no time to reflect on what you have done. So the lesson is concluded in suspense. So such methods are not used.

Researcher: Definitely, what is your perception about implementing learner-centred approaches, in other words what is your opinion about using learner-centred approaches?

Lecturer 7: My perception is that learner-centred is feasible in a situation where the teacher is conversant with how the methods must be used and that ah there must be conducive environment of having enough resources ah that are required to be used by the learners when they are doing their tasks.

Researcher: Umhu, now what motivates you to use learner-centred teaching approaches in your classes?

Lecturer 7: Learner-centred methods ah some of them are very good in that they arouse the interest of the learners. They keep them active throughout the lesson. That is one of the reasons. They motivate the learners.

Researcher: Alright and the last question is what is your experience about learner-centred teaching?

Lecturer 7: My experience of learner-centred teaching is that in most cases what we teach here to the learners to be done or to be practiced is not done when they go out on teaching practice or even when they ah qualify. When we move around to observe lessons, we find that very little or very few are using learner-centred teaching. Ah to me this means a lot of

questions. Ah, why is it that we teach using learner-centred methods but when the learners go out they don't use the learner-centred methods.

Researcher: Thank you very much Mr Lecturer 7 for your answers. Ah your answers will be looked at and if there is any point I didn't understand, I may come back to you for clarification. Thank you for your time.

Lecturer 7: Thank you sir

Lecturer 7: post lesson interview2

Researcher: Eeeeemndifunandipangenanu share your teaching experiences when using learner-centred teaching, khayandi ma successes khaya ndi ma challenges, and how learners respond in the classroom or khaya what other teachers are saying, akutichiyani?

Lecturer 7: Mumenendimaonera, some of the methods are feasible to use them in class within the given time koma pali ena ma methods we fail to fully use them due to time umangoona nthawi yakuthera due to our content umangoona nthawi yatha pomwe ma activities sanathe. Eeeeh to the learners they are highly motivated and engaged in the activities and some of the learners samathakupanga verify some of the methods like card clustering and collection and ball bearing.

Lecturer 7: Ndimachita observe lesson ya a lecturer M, learners were engaged and were able to apply in the method like ball bearing imakhalangati game ana aja amakhala motivated and are engaged and are learning to some extent due to some materials which

we use as they fail to apply them when preparing lesson plan, this is observed even ku field when they are writing lesson plans, they fail to integrate the methods and you hardly find them using them like ball bearing in schools but here we are encouraged to use them.

Researcher Ndiye mmene mukuonera from what you have explained is learner-centred teaching possible in Malawi especially ku TTC kuno?

Lecturer 7: Ku TTC kuno ili 50 -50 because you can find another lecturer using a certain method instead of the other depending on attitude and choice of the one using them, lecturers are free to choose what method to use because of autonomy, so one selects what method to use or not especially the method one is conversant with because this is a borrowed thing maybe.although we do have some orientation but maybe due to time we are failing to fully implement them.

Researcher: I observed that you allowed your learners to ask questions during the lesson. Why did you do that?

Lecturer 7: to give them an opportunity to seek clarification where they did not understand. Sometimes learners may ask questions where they had full understanding of the concepts but have interpret the concept more than it should be. So its in two ways either they did not understand, and therefore, need more information or they understood they concept more than expected. So out of interest they ask questions so that the teacher can explain more. Lack of information may lead learners to ask questions in class.

Researcher: is it possible for a learner to ask a question outside the context?

Lecturer 7: Yes its highly possible but we tell him/her that this is irrelevant

Researcher: why did you keep asking questions to your learners during the lesson?

Lecturer 7: the aim is to find out whether what has been taught has been fully understood by the learners

Researcher: I observed you walking around the classroom during small group discussions. Why did you do that?

Lecturer 7: one, the focus is on learners who don't pay attention to what the other learners are doing. They will sit idle and never make any contributions, no input to what their peers are discussing or doing. Secondly, the aim is to listen to the discussions to determine whether learners are doing the correct thing or not. Sometimes, the lecturer may identify a group which is off track. Learners may be doing the given task different from what is expected of them. Learners may also have problems or face challenges to come up with what is required. In this case the lecturer will decide the type of guidance or support to be offered if he/she discovers that learners have a problem. Thirdly, the lecturer has to check if learners are doing the correct things.

Researcher: can I take it that walking around the classroom by the lecturer is part of assessment?

Lecturer 7: yes it is part of assessment. However, this will depend on whether it was indicated in the lesson plan that individual assessment will be done by moving around.

However, its not always true that walking around while learners are working in small groups is assessment. If its considered assessment then its an informal assessment where there is no record for whatever is observed. In teaching we have formal and informal assessments. In formal assessment the lecturer prepares assessment tools and records are kept.

Researcher: does assessment of learners' learning take place in each and every lesson?

Lecturer 7: Yes, teachers assess their learners in each and every lesson. The aim is to find out if the objectives of the lesson are being achieved or not. This can also make the teacher to put in corrective measures such as repeating the lesson, asking learners to do more research on the topic, teacher doing a rigorous consolidation.

Researcher: Okay, from your experience of visiting cases, you mentioned of a certain lecturer and your own experience what are the commonly learner-centred practices which are being used in class?

Lecturer 7:Very common are gallery walk, think-pair-share, work stations, walk around talk around , some apply case studies like in social studies, also we use projects

Researcher: Okay, using what you are saying in teaching eeeh there are 2 major dimensions , we teach using cognitive domain skill which has to do with mental processes and skills what can I call them okay verbal skills, for example learners should be able to reason on their own, or go and study what should be done by himself or herself even assessment skills much as done by the teacher and a learner must be able to assess himself

as well and most important part of it one should have manipulative skills to which he or she must cope up with the world. Ku Science and Technology , using learner-centred method in your own opinion and experience or visit your own examples, what skills are emphasized, you can say your own examples, kuti as am teaching I emphasise on this?

Lecturer 7: Ngatiku Science and Technology timachita emphasize za problem solving komanso za group work, tikhoza kuti zina ndiza project like in Science and Technology .in mathematics eeeeeeh

Researcher: Nooo am interested in Science and Technology

Lecturer 7: Okay in Science and Technology , we emphasize about inquiry skills, experiments, projects, modified group work in some topics, work stations, when teaching classification we emphasize on card collection , think-pair –share.

Researcher: Kodi lesson yanu imodzi ndinaonera topic yache inali chiyani? Okay classification of plants and animals, if am not mistaken. I know it's something which you have done in the past koma chimene munachiona cha ma skills munaphunzitsa chinali chiyani? Analingati ati?

Lecturer 7:Eeeeeh , ability to identify classes.....

Researcher Ngati skill?

Lecturer 7: Eeeem ability to analyse related plants ,eeeeh ziyenela kukhala zimenezi.

Researcher: Okay, chabwino one last question, in learner-centred teaching and the traditional method of teaching TCT , in TTCs we use learner-centred teaching method,

you have been teaching now for a number of years, when you teach using learner-centred teaching how do you feel, is it fine or not, teaching yanu imakhalabwanji?

Lecturer 7: I feel motivated if am teaching an area or topic am conversant with and feel encouraged because ndimakhala ngati expert ndineyo and learners are motivated and eager to learn. To the learners' side ena amaona ngati sititha kuphunzitsa, if we are to engage them in activities do this and that because amaona kuti chomwe tikuwafutsa ndi icho.

Researcher: And I wanted to ask this question. In learner-centred method some writers ananena kuti learner-centred teaching method cannot be used with large groups and when you don't have adequate resources. What is your opinion as you have been teaching for a long time ?

Lecturer 7: To me some methods can be adapted with large classes

Researcher: For example what?

Lecturer 7: Ma games , you can split it into small groups and then perform the activities provided you have enough space to use. With the resources , some methods can fit using large groups with inadequate resources if well managed but some will not be feasible.

Researcher: Pa learner-centred teaching ena amanena kuti eeeh learners do construct knowledge , do you agree with that?

Lecturer 7: Yes, it's true because when you tell them to be in groups, tell them to find out what happens, then they do the activity and find out what happens , when a metal is heat

so the learners they interact with the materials , hands on and find out the knowledge and say out what really happens so they really construct knowledge.

Researcher: Eeeeh , I want you to be clear on that point, I am not convinced because at , I want to give an example, at some point I observed a lesson it could be here or elsewhere , a certain teacher said, “ The following are the conditions for photosynthesis to take place, one there is need for sunlight, two there is need for carbon dioxide, so for us to prove this let us do the experiment. So after doing the experiment they kept the materials somewhere and on the next lesson they came and said let’s see the results. So in this experiment did learners construct knowledge or it was just verification?

Lecturer 7: To me following your explanation, that approach which he used, was wrong because instead of directing them he could have asked them to say what are the procedures necessary for photosynthesis, so learners could have come out with the results on their own without guide lines or directing the conditions. Learners should have identified the condition necessary for photosynthesis on their own. So here learners were limited.

Researcher: So some teacher practices limit learners to think on their own, so this teacher limited the learners to think on their own, so this limited the learners to construct their own knowledge?

Lecturer 7: Kkkkkkk Sir, some of these questions are tricky. Thank you

Lecturer 8 post lesson interview, lesson 1

Researcher: Was your lesson learner-centred?

Lecturer 8: yes

Researcher: please explain your yes!

Lecturer 8: Because most of the activities were done by learners. For example, I put them in groups.

Researcher: What teaching and learning methods did you use from the beginning to the end of your lesson?

Lecturer 8: The methods, when learners went in their groups and expert groups, it was Jigsaw and when closing the lesson it was a letter to the author. The lecturer then went on to say, 'sir, I don't know if I have followed the steps of this method (meaning Jigsaw)' lecturer confessing that he was not sure of the methods; Implication-doesn't understand some LCT methods fully

Researcher: In your opinion as a lecturer did the learners learn what you planned for them to learn?

Lecturer 8: yes

Researcher: Are there any learner-centred methods which you know about but since you started teaching you have never used them?

Lecturer 8: Yaa,not, not if I say I know then it means I can do them but I simply know them by the names

Researcher: you simply know them by the names?

Lecturer 8: but how to go about them its very I cannot do them

Researcher: so you are saying there are some learner-centred teaching methods which you heard about but you cannot apply them?

Lecturer 8: yes I cannot apply them because I don't know how to go about them for example there is another method known as cinquine I have tried to find out from people to say what is this method? How do we go about this one? So I have never found the best answer for this method, that's why I asked for that manual maybe if I go through the manual/handbook and read maybe I can find that information. There are so many LCT methods that i don't have information not only myself probably most of us here

Researcher: ahaaa, fine on the same there are some LCT methods which are now being used here are you sure people are using them effectively and correctly? The ones that are now in use?

Lecturer 8: If I say they are using them correctly and effectively then I may cheat because it depends how one understood the method and how he/she is going to apply but what I know most of the methods people are aware of them but how to use them in their lessons then it will be difficult for me to say there are using it or not. A good example we made a simple research on this participatory methods and we found that in the same department in the same department some members are using them and in the same department some members are not using them because after coming up with the analysis of the research

results it was found out that the same methods in the same department are being used and the same methods in the same department are not being used. So the research informed us that some members in the Science department are using LCT methods while others are not. But in general people are using the LCT methods.

Researcher: Now people have complained not in this college only but even elsewhere that LCT methods demand a lot of time and our syllabus or our curriculum is examination oriented, how are you marrying the two? You need a lot of time but at the same time examination fever will dictate you to cover the whole syllabus! How do you marry the two?

Lecturer 8: this is very true. That's why to cater for that we are not consistent in using LCT methods when you feel that you are very late in covering that topic then we use our traditional methods there you have to rush and meet the time but it's because of the need of time in this particular methods that you need at least more time to use them in the lesson. And usually if you use so many methods sometimes then you will not complete what you are going to cover. At least you need to use two or three methods in the lesson then you will cover. But however in other instances you have also an advantage because you can cover a lot of work within the same period of time. So in some cases it's good on your side and in some cases its also bad in terms of time

Researcher; In the lesson mmmmmm when you gave group tasks and then you allowed them to present I was listening attentively. Now being a scientist I noted that most if not all of the answers were correct and I justified that thinking because there was nowhere

where you said no that is wrong you just continued explaining and building from what they said, now I was asking myself to say aaa these learners are giving correct answers but why is the lecturer bothering re-explaining

Lecturer 8: the correct answers were coming from individuals and not from everyone so I could not conclude to say everyone is comfortable with these points. You see! So to me it would be false generalisation to say oh because this one has said something that is correct then everyone is competent with that then to me I felt it would not be good on the other students that's why I had to panel beat the answers that were given.

Researcher: oh I see. And finally, learner-centred teaching requires that learners be empowered in whatever they are doing in the classroom so in that lesson how did you empower your learners?

Lecturer 8: Right, I empowered them in researching the information and come up with responses that are expected. A good example is the one you are saying they were giving correct answers. I did not tell them you were there and you saw that they were coming from them. So that is another way of empowering them.

Researcher: during the lesson, why did you allow learners to ask questions?

Lecturer 8: Learners are also encouraged to ask questions where they are not sure so that the teacher can explain or clarify. This promotes autonomy and self learning in learners. The participant also understood the teacher's role to be that of a facilitator.

Lecturer 8: During lessons, I give learners the opportunity to ask or answer questions. The questions would determine whether learners are following or not and help to clear misconceptions arrived at during learning. Learners may assess other group's presentations and facts and come up with correct information. Finally I consolidate the ideas presented by groups".

Researcher: I observed that you engaged learners in a quick write activity, why did you do that?

Lecturer 8: "I ask learners to write what they know relating to a particular concept so that I am guided how to take particular concepts i.e. if learners have enough information I may rush and if learners lack knowledge I take time to analyse given concepts

Researcher: in the introductory part of the lesson, you started by asking questions to the learners. Can you explain why you did that?

Lecturer 8: "I introduce my lessons by asking questions in order to assess learners prior knowledge. When introducing the lesson I can ask them what they already know. In this way learners are motivated to learn by the way I introduce my lesson. This may also assist learners link new experiences with existing knowledge when the new concept is being introduced it is reflected from what they already know.

Researcher: Why did you ask some learners collect teaching and learning resources from you and then share to other learners?

Lecturer: I use group leaders and appropriate illustrations and resources. I always ensure that learners are trained to be responsible for their education. I observe them when doing

tasks, asking them to peer assess colleagues' work and also asking them questions. Assessment is always continuous.

Researcher: ok. Anything?

Lecturer 8: No I don't have anything just your coming has impressed me to use these (LCT) methods and I had to think to vary the methods. If you could remember in my lessons I did not use the same methods (Researcher: No, a variety of methods) so to me I think it was good on my side again.

Researcher: Alright. Thank you very much Mr. Lecturer 8

Lecturer 8: lesson 2

Researcher: Khaya Mwaswera bwanji?

Lecturer 8: Ndaswera, khaya nanu mwasweranso bwanji?

Researcher: Ndaswera. As usual Mr lecturer A,ndikufuna just few questions with you I wouldn't say one because sometimes questions come (lecturer A interrupts: in the discussions) in the discussions

Lecturer 8: yes the way you answer you also invites some questions

Researcher: Yaaa

Lecturer 8: so i think the way I answer wouldn't invite some questions

Researcher: kkkkkkkkkkk there is no answer that cannot invite a question. My interest is 'is there anything that you learnt from the learners in today's lesson?

Lecturer 8: very good I have learnt more

Researcher: for example?

Lecturer 8: For example, aaa worth?? Is said to have brightly coloured or scented roots that one the information that I had I did not have that point. (Researcher: ooh I see that's good) But looking at the way they presented then I said aaa this one again qualifies. That's why when I was trying to go through the displays i also hinted on that one.

Researcher: Alright and based on that response should I assume that the learners in today's lesson constructed some new knowledge?

Lecturer 8: Exactly. Definitely

Researcher: are you sure?

Lecturer 8: Yaaa

Researcher: Ok fine in this lesson which LCT practices did you use?

Lecturer 8: I have used a variety of them. One of them is one stays three astray where they were in 4 groups and then the learners numbered each other from one to four. Then the number 1s stayed in the groups and the three strayed to other groups where they shared

information from those members. The other one was gallery walk where we spread the chart papers in the class. The other one was quick write, the other one was brainstorming, and discussion is the order of the day.

Researcher: Alright, you have been using these teaching practices now for a long time. In your opinion are there any LCT practices which are being used wrongly or inappropriately?

Lecturer 8: Yes, yes because each practice has its guidelines so that possibility is just there. It's possible that maybe you missed a step of how they can go about that one. That one it's there but in the end still the learners know that this is the teaching practice that we wanted. And you even see them the way they re arrange themselves to come with that teaching practice because most of the teaching practice these learners they know.

Researcher: so what do you think could be the reason or the cause for an expert like yourself to miss at some point as you are teaching?

Lecturer 8: even an expert cannot be an expert in everything has some weaknesses in some areas

Researcher: could we call it a misunderstanding of the teaching practice or no it's not the ... it could be well understood but still as you are putting it maybe because of the environment or the class context might have lead someone or might lead someone to miss a method?

Lecturer 8: But with me for the one stay three astray teaching practice that one was not i cannot do as i expected its not because of the environment or what but I simply missed the steps. Yaa in terms of organisation.

Researcher: I saw that you brought to class the teaching and learning resources like the kalongonda, etc where did you get those materials from?

Lecturer 8: from within the local environment

Researcher: Was it yourself or you asked the learners to bring to class.

Lecturer 8: aaaa I used them (learners) and some I brought them because if I had to bring by myself they could not suffice to everyone. So I gave them the chance to bring them because I knew what is supposed to be covered today. So it's just a prior arrangement

Researcher: So generally I can ask this question, 'what has been your experience of learner-centred teaching? Can you share with me?

Lecturer 8: aaaa my experience is that it makes the lesson the lecturer and the students themselves interacting throughout and not only that most of the work is covered by themselves and they also even some information that is already there but they have to

source by themselves and say this is the point this is the point regardless the fact that some of the information is already in the books.

Researcher: At some point you were checking on the learners' work, I am not sure if I got you correctly, but then should I say you asked someone to add some points? Was it like that? Or I got lost?

Lecturer 8: That was when they went into their stray groups I said you are going to find a member who is number 1 in every group will explain to you but those who have also strayed can also share what they have learned in their original groups to this particular person who is the one remaining in the group the stay one the strayed should also give their information so that this one should also learn from them. That was what I said.

Researcher: Now I have remembered my question; my thinking is that when learners moved from station A another group comes in third group comes in to the same work and nobody said ichicho ichi nchosayenera my assumption was all the answers or the points were correct that's my assumption because all the groups visited that station but nobody added or subtracted, so why did you bother to consolidate?

Lecturer 8: Yaa

Researcher: Because the groups were satisfied why couldn't you just say akuluakulu basi zakwana

Lecturer 8: yaa that is true I could not take it for granted because some students are lazy they cannot even contribute even raising up a hand itself some of them it's difficult unless you point them they will raise up a hand. And even if they did something wrong they cannot say it even if they can have a point to add they cannot add so I went through the work for the sake of such people who could not even who could not analyse it the best that I wanted who could not point out to say this is wrong or this is right so that's why I had to go through to make sure that what is in each and every display is what is expected

Researcher: in your lesson one of the methods that you used was one stay three astray. Do we give all learners the same tasks/activities or each group must be given a different task/activities?

Lecturer 8: It is where I am to learn now. The fact is I was trying to ask myself should I give the same or different activities. Then I said let me just give them same activities

Post lesson discussion for lecturer 8: lesson 3

Researcher: Paja dzina lija mumati ndani?

Lecturer 8: mentions her name (Mr Lecturer 8).

Researcher: ooh so you are lecturer 8?

Lecturer 8: eeeeeee

Researcher: Aaaa zikomo lesson inali bwino we have enjoyed it. Komano there is a question, was your lesson learner-centred? What's your opinion?

Lecturer 8: Yes,

Researcher: why?

Lecturer 8: It was learner-centred because I involved the learners in some of the activities.

Researcher: Mhhhhh

Lecturer 8: Yes

Researcher: ok fine. Who wrote these papers? (referring to papers which had names of animals on them and were used as teaching and learning resources)

Lecturer 8: These ones?

Researcher: Yes,

Lecturer8: the learners

Researcher: learners!

Lecturer 8: the learners themselves. I gave them these papers so that they should write any animals that they knew and then paste the names of the animals on the chalk board

Researcher: so my interest is you said they wrote the names?

Lecturer 8: Names of animals,

Researcher: names of animals and they gave the papers to you?

Lecturer 8: No but paste on the chalk board.

Researcher: okay I see

Lecturer 8: not giving me

Researcher: not giving you?

Lecturer 8: Yaaa

Researcher: In your class room I have seen real animals like a bird, a frog... at that corner.

so to me I said aah today's topic matches with these animals that I see

Lecturer 8: that one at the back! Yah

Researcher: yaaa that one at the back because we are talking about vertebrate and invertebrate animals (lecturer comments: invertebrates animals) why didn't you use any of them so as to clarify your point of invertebrates and vertebrates for example this one?

Lecturer 8: Ok.(smiles)

Researcher: Why didn't you do that? I actually saw them,(lecturer interrupts: Yaaa) real animals there at the back

Lecturer 8: smiles, Okay, the...the drawings?

Researcher: No, real animals even a frog at the end there

Lecturer 8: ookay at the end there! Okay it was just an introduction because we have already introduced this lesson, just an introduction and I told the students teachers that one of the methods that you can use when you are teaching classification of animals is using card collecting and plastering, so it was just an introduction just to have a feel of how they can use that, yes.

Researcher: alright.

Lecturer 8: Yes.

Researcher: You said you also told the learners that during teaching they can also assess their learners?

Lecturer 8: yes.

Researcher: In fact you mentioned formative and summative assessments. I heard you saying like that. Now my interest is did you assess your learners in today's lesson? (Lecturer laughs) you mentioned observation (lecturer interrupts: Yaaa) did we see you assessing the learners?

Lecturer 8: Yes I was observing my learners and I was assessing them because my learners were asking me some questions it means that they had knowledge, yaa, and I was assessing them that now they are getting the points,

Researcher: Al right

Lecturer 8: I was observing them my learners I was assessing them because.....

Researcher: ok, the last question; what did the learners learn today?

Lecturer 8: today learners were looking at the challenges that they will face when they go out there, when they will be teaching concepts such as metamorphosis and survival mechanisms because these are some of the concepts that they will have challenges so they have learnt that they need to have knowledge of metamorphosis and also survival mechanisms so that they can deliver these concepts to the learners well.

Researcher: Were they learning or were being reminded? Which is which? According to you, were they being reminded or they were learning? Why am I using reminding? If they already knew something, maybe we could take it as a reminder

Lecturer 8: No, they were learning because they know what metamorphosis is but they don't know the challenges that they will meet when they go out there to teach this concept, (researcher interrupts: alright), so they were being warned on what they should do when they go there so that learners in their classes should not have that challenge.

Researcher: Alright I wanted that explanation so that I can defend my explanation. Thank you madam,

Lecturer 8: you're welcome.

APPENDIX 8: Pre lesson observation data for respondents

Semi - structured questions for individual interviews

Lecturer 2

Researcher: Describe your experience of learner-centred teaching (LCT) and what it involves.

Lecturer 2: It is when the teacher involves learners in different hands on activities through the use of different learner-centred strategies to allow them come up with their own knowledge.

Learner-centred teaching involves the use of a variety of learner-centred methodology. As a teacher my role is to guide the learner on how to go about with the activity.

In learner-centred teaching, the learners are able to build their own knowledge, skills and attitudes hence own what he/she has learnt. It demands on the use of a lot of resources. But then learners will be involved in the collection and use of those resources hence own the learning. If well planned learner-centred teaching will allow every learner to participate on the lesson/activities hence allowing them to have minds on and hands on experiences.

I use learner-centred teaching methods by incorporating them in the activities done by learners during planning. And then learners are engaged on the methods when carrying out the methods. Some of the learner-centred teaching methods I normally use are; gallery walk, jig saw, silent participant, bus stop, think-ink-share, ball bearing, and many more.

One of the challenges of learner-centred teaching is that it needs thorough planning and it is time consuming. In learner-centred teaching, learners do the activities on their own or learners are engaged on hands on and minds on experience and the teacher is a guider.

My experience about LCT is that they are good methods in a lesson but if not thoroughly done can make learners not understand the content.

Researcher:Describe to me your current learner-centred teaching classroom practices

Lecturer 2:I start my lessons by asking questions from previous lessons as a revision, telling stories, games and using the learners' experience. This will make the learners not to forget, have experience and get on board with teacher.

Learners are involved starting from the preparation of resources to be used in the lesson or collection of resources and again on the pre- discussion where the teacher will find out on their prior knowledge concerning the topic.The planned activities on the lesson plan should actually show the involvement of learners especially on the learners' activities thereby allocating more work to be done by the learners and learner-centred methods being depicted on the developmental steps.

I normally assess learners' prior knowledge through asking questions or giving them an activity to do. This enables me to measure how much the learners know. And then base on the learners knowledge to teach.

i assist learners link new experiences with existing knowledge through giving them an activity on a new experience which will enable them to apply the existing knowledge on that activity in order to come up with the required knowledge.

I also give content to learners which act as a scope to guide the extent of teaching and learning. The content is presented to learners by involving a variety of learner-centred methods so as to allow learners to have minds on and hands on experience and then own the knowledge acquired. The roles of the learners during lesson presentations are; listening to the instructor, carrying out the activities using different learner-centred methods, coming up with new knowledge achieved from the activities so as to enable learners own the knowledge gained from the lesson. The learners do the activities by using learner-centred methods.

During lesson deliveries I give clear instructions through explanations, providing enough teaching and learning resources, engaging learners in different learner-centred teaching methods, supervising learners and guiding the teaching and learning activities to make learners own the learning process and acquire their own knowledge.

I help learners to integrate learning into real world situations by allowing them to have hands on and minds on activities/experiences and then relate what they have acquired to everyday life. Learners are also encouraged to apply knowledge to real life situations.

I help learners to reflect on their learning by providing conducive environment for learning, guiding the learning, and supervising the learning activities, consolidating the learners'

work to make sure that the right content is acquired by the learners. To help learners reflect on their learning, I create an environment where learners can apply the scientific knowledge, skills and attitudes in everyday life (technology) i.e. coming up with items. To see or find out if they can use the knowledge gained. I involve them in research, explorations, or any other scientific investigation to measure the scope or how much they know.

I normally engage in thorough preparation of activities, resources and appropriate learner-centred methods. During lesson deliveries I consolidate learners' activities at the end of each activity. I do this to make sure that the success criteria have been achieved.

I assess mylearners during lessons through questions, looking at the end product, observation, written tests, and many more this is done to find out how much the learners know and are able to do. I administer both continuous assessment and formative assessment. During assessments, I facilitate the assessment while learners do the assessment. Learners are involved at all levels. If it is an investigation, learners should start from preparation to enable learners to follow the assessment.

Researcher: Describe the reasons for the choice of your classroom practices

Lecturer 2: Science and Technology is full of practical lessons hence LCT will enable learners to have hands on experiences as required by the subject.

I use the following methods and techniques when teaching; games, card collection, cluster, role play, gallery walk, bus stop, jig saw, ball bearing, **think- ink-share**, KWL, pair work, group work, silent participant, just to mention but a few. The methods are easy to be followed by learners. LCT methods are good and need to be used in teaching and learning. There is need for thorough implementation.

However, there are some LCT methods I know about but have never used them. These are; *analytical teams because I don't understand it*. I have been motivated to use LCT methods in class from workshops and inserts which were carried out at different places with different TTCs, hence learned the skills of how to conduct them during lessons. More activities are done within the lesson hence, more work covered on a lesson.

Lecturer 2: Interview about level of difficulty of interview guide

Researcher: Good afternoon Madam

Lecturer 2: Am good and you

Researcher: I hope you are fine. Am good. Eeeh I gave you an interview guide where I said you should answer something on learner-centred teaching. Apart from the answers you gave me, one way was to find out how difficult or simple or how the clarity of the questions were. So as someone who interacted with the questions, I just want to hear your views, were the questions clear?

Lecturer 2: The questions were clear but other were not clear as somewhere I failed to find out what you need or want.

Researcher: Can I assume that they were confusing or some questions confused you?

Lecturer 2: Some questions were really confusing; I couldn't know what actually you wanted

Researcher: If you look at the number of questions which were clear and which were not clear, eeeeh which ones were many?

Lecturer 2: Most of the questions were clear

Researcher: And eeeeh , finally on the same questions, were they too many or it was a good number of questions in your own opinion?

Lecturer 2: They were many because at least it was a wide range of questions which included the information which you wanted.

Researcher: Thank you, thus the end of the interview.

Lecturer 3: pre lesson observation interviews

Researcher: Describe your experiences of learner-centred teaching (LCT) approaches.

Lecturer 3: LCT is a type of teaching that aims at reaching a well founded judgment and hence utilize appropriate evaluative standard in trying to determine and understand every concept in the teaching and learning process. It involves in most of the hands- on activities. The teacher becomes a facilitator rather than a sole source of information. Learners contribute to the teaching and learning process as partakers rather than recipients. Both teacher and learners contribute to the lessons content. Teachers easily assess the flow and effectiveness of the lesson.

In learner-centred teaching, learners develop sense of ownership as they contribute toward the facts in the process of teaching and learning, hence understand fully. It simplifies teaching and learning process.

However, learners find it difficult to develop some abstract facts hence takes longer time to come up with points in group discussion. It demands a lot of resources e.g. it is not much simpler than teacher centred system. Lesson preparation or lesson planning shows how learners will be involved in different activities doing delivery of the lesson. Lesson preparation requires learners to bring some resources for use in the next lesson

Learners are motivated through different re- enforcement of different forms. For example; by asking questions based on what they already know in order to build points from what they know to where they don't know, by asking them thought provoking questions and probing for more information

Researcher: Describe to me your current learner-centred teaching classroom practices.

Lecturer 3: Learner-centred teaching is normally achieved through different strategies and techniques. I try to make learners participative and interact with the resources for easy understanding of concepts. I organise my lessons in such a way that learners share ideas in groups, pairs, individually using different strategies. I also involve learners in different activities using methods that are interactive eg think-ink-pair share, pens in the middle.

Learners are involved in different activities such as discussions, debates, role plays, experiments etc. I just facilitate and helping them where. I help the learners to relate what they has been learnt to what is in the real life situation. I ask questions reflecting on what has been learnt.

I create an environment for learners to apply the knowledge learnt by involving them in experiments and let them make their own conclusion and relate to real life situation. During lessons, I guide learners by correcting their error or mistakes in the course or discussion, experiments etc. Yes, I assess the learners each time I teach them. I develop assessment tool to test their understanding of the lesson. All in all my role as a teacher is to see if learners have developed/ acquired the skills learnt

Researcher:Describe in details the reasons for your choice of the learner-centred teaching approaches.

Lecturer 3:I use LCT when teaching. I love it because of its participatory approaches. Learners are always involved in class activities. Yes, they help learners develop skills and knowledge through group work, think-ink-pair-share, experimentation, bus stop plus many more techniques. I choose learner-centred methods because they because they facilitate the participation of learners.

One problem with these methods is that they are too much demanding resources. Again some methods like; one stay three stray, ball game, values clarification are difficult to implement in class because they demand much.

Learner-centred teaching techniques allow learners to participate in different activities assigned to them during lesson delivery. Most of them are participatory. This makes learners interact with resources and share ideas making teaching and learning simple.

Lecturer 4: pre lesson observation interviews

Researcher:Describe your experiences of learner-centred teaching (LCT)approaches.

Lecturer 4:To begin with, learner-centred teaching is a teaching where learners are taking more part in exploring the concept on their own through participatory method facilitated by the teacher. It involves critical thinking, creativity, participatory methods and resources. My role as a teacher is to plan and facilitate the lesson. Learner is to participate in the teaching by thinking, creating and doing.

I always give assessment is to check whether the teaching and learning has taken place. In Learner-centred teaching, the learners become great thinkers while in teacher centred approaches they become passive their brains does a little work and teachers find everything on their own. They have alot of work to do than those using learner-centred approaches.

Learner-centred teaching makes the learners to be thinking and creative, making decisions on their own and solving different problems of daily life. Teachers become great thinkers on how to conduct the teaching interesting by using different participatory methods.

There are some challenges that go with learner-centred teaching. Examples are: needs more different resources such as, human resources, learner-centred teaching materials, enough space, texts and monetary issues. It requires more resources of different types.

Researcher: Describe to me your current learner-centred teaching classroom practices.

Lecturer 4: My lessons start with preparation and planning. My lesson preparation reflects learner-centredness by assigning them with different tasks. I involve learners during lesson preparation by using learner's experiences and new ideas.

At planning stage, I ensure planning interesting participatory methods and resources. Because these will attract learners attention. When introducing the lesson, I ask learners what they know about the concept. Because we want to teach them from known to unknown. By using their prior knowledge to new knowledge.

I usually give learners tasks to do. The reason is I want learners to think, discuss and come up with ideas on their own. They do activities that will bring new ideas of the concept and make them think and use their experiences to come up with new ideas.

I ensure that learners engage in discussions in groups, pairs etc to promote higher order thinking.

I give my learners tasks to do to see if they can come up with new ideas. I also give them resources or I use resource persons.

By asking them questions I help the learners to reflect on what they have learnt

I ask learners to produce or construct or carry out an activity to show what they have learnt to make sure that they have understood the concept. This will learners to apply the knowledge and skills learnt

I guide and support learners' learning by instructing them what to do. This is to let them focus on one thing. Through thorough preparation of activities, resources and appropriate learner-centred methods and also by consolidating learners' activities at the end of each activity, learners are fully supported.

I do assess learners during my lesson by asking them questions, present their findings or reports. The reason is to see if they have learnt something. I give them oral, written and practical assessment. During the assessment, my role is to judge whether they have understood and correct learners mistakes while the learners have to show what they have achieved in the lesson or part of a lesson. Both low order and high order questions are given to learners following the taxonomy or blue print.

I prepare the work for learners to do during lesson delivery, for example, oral questions, written work, discussion work, role- play or drama, planning excursion plus many more. However, I usually face some challenges in excuting my duties, for example;

Oral questions; some questions are off the line, does not relate to the concept

Written work: difficult to prepare as it needs more time, resources and information.

Discussions: it requires interesting topic or concept.

Planning excursion: it needs an environment which is rich in resources.

I organise different tasks or activities to be done by learners themselves that is what I call learner-centred.

Researcher: Describe the reasons for your LCT classroom practices.

Lecturer 4: I use learner-centred teaching because it will help learners to explore, discover, find out new things on their own and become really scientists. Commonly used type of methods and techniques are: participatory methods e.g. bus stop, re – enforcement techniques e.g. verbal, to motivate, attract their interest and attention.

There are some LCT methods that I do not use in Science and Technology e.g. I do, you do, we do. These methods are not related to Science and Technology but English.

I ask learners to think and present or report findings or ask a learner to express their experiences to the class, or discuss something with their friends in groups or pairs. I also learn more things from them.

Lecturer 6: Pre lesson observation interviews

Researcher: Just to find out about learner-centred teaching practices

Lecturer 6: Okay

Researcher: So let me begin. “What do you understand by learner-centred teaching”, that is the first question.

Lecturer 6: Learner-centred teaching is a type of teaching that involves much of learners and enable them to actively participate in the lesson in which they are learning.

Researcher: Right, and based on that, are you saying learners are actively involved in the activities, am just interested in the activities. What activities are learners supposed to do and what actually are lecturers supposed to do during lesson delivery?

Lecturer 6: Starting with the teacher or lecturer, the main activity is to facilitate the teaching and learning , when we talk of learner-centred teaching approaches , whereas the learners are the ones to really do the activities in order for teaching and learning to take place.

Researcher: Alright eeem, any example of activity that can be done by learners?

Lecturer 6: In learner-centred teaching, yaaaah for example eeeeh, the first one is think-pair-share, they may share ideas and another example is doing something as a group, assigning them to do something as a group

Researcher: Alright, what do you think are the benefits or advantages of learner-centred teaching practices?

Lecturer 6: aaaaahheeh, I think , I can give two. The first one is with some of these approaches, they help you to be fast and to cover a lot of content within a short period. The other advantage is that as we are actively involving the learners in activities we are really making them to learn and to discover something on their own and really understand what they are learning as they do the activities on their own

Researcher: Eeeeem okay ,aaaah some people have said learner-centred teaching is demanding in terms of resources. Do you agree with that or you don't agree, if you agree or you don't agree what is the justification?

Lecturer 6: I am agreeing with them , these teaching approaches , these approaches demand a lot of resources because for example with some approaches for example you want some learners to have maybe a passage which you want them to take from books, if you don't have it you will look for alternatives for example you have to photocopy the passage. When you talk of other resources which a teacher has to use, you have to prepare a number of resources as compared to maybe the method of lecturing or explanation where a teacher has to stand in front of the class and start explaining but when we are talking of these teaching approaches you have to prepare a lot of them.

Researcher: You have reminded me of one thing, we just started the new curriculum and you know the context in which we are implementing the new curriculum, aaah would you comfortably say using part of the context is it possible to implement the new curriculum?

Lecturer 6: Yaaah, it's possible because , the content is emphasizing much on the methods and on how we can teach content or topics and as lecturers we use much of these approaches to the learners so that in future they may use them to their pupils as well.

Researcher: Eeeeh, how do you motivate your learners during teaching with learner-centred teaching practices?

Lecturer 6 - aaaah, first of all it begins in the planning whereby when you plan for the methods you have to plan for the methods which will allow learners to interact comfortably, and as they are interacting comfortably you should also show an interest in what they are doing and plan for methods that will make learners to interact with information and also doing maybe reporting of some activities which you require learners to report . I try as much as possible to come up with some questions or activities that may even add to the interest of learners so that they can at least interact.

Researcher: So you are suggesting to me or you are saying at some point in the teaching-learning process, you allow some learners to report?

Lecturer 6: Yaaah, with some approaches, because with some teaching approaches you may assign them different tasks in different groups which means on one group they are discussing something different so at the end I have to give them chance to say to the class what they were discussing so that other learners will learn from what they were discussing, so I really do that.

Researcher: Aaaaah, I remember when I was a student , when a teacher asked a fellow learner in class to report I was not comfortable, I wanted the teacher to say it by himself/herself. So when you ask a learner to say something or report, do you feel the other learners listen to this colleague reporting?

Lecturer 6: (laughed) not only speaking but eeeh what actually happens is that when they are reporting the whole class is quite listening and to some extent they do ask questions which means they also pay attention to what their colleague is saying and at some point I fully feel like what they have been reporting is not enough I come in and consolidate by adding in what have been left out.

Researcher: Before I go to the next question again am just interested you said reporting is done mainly when the learners are put in groups to discuss on an issue. Did I hear you correctly?

Lecturer 6: Yes, yes

Researcher: Okay, okay, I see, eeeh. The main reason why we teach is to present content, am interested to know, what do you think is the role or importance of content to teaching and learning?

Lecturer 6: Aaah the use of the content,, eeeh thus what we want learners to acquire, thus the knowledge that they need, what they need to acquire. It's like, just like we assume they know nothing so it is your responsibility to make the learners know what you want. So it means the content is the knowledge that the learners will need to acquire.

Researcher: So in your case as a Science and Technology lecturer what are your ways of presenting the content? Yes, the approaches

Lecturer 6: The approachess , there are different approaches, or ways we have for example I hope you are interested in learner-centred teaching approaches, so we have something like analytical skills, ..., making a stand , ball bearing and many more.

Researcher: So you use most of them?

Lecturer 6: No, not all of them because I have said they are more so I only have to choose those that will help me, the content I want to deliver or to cover the content in the curriculum.

Researcher: Alright, I should think that when learners are doing their activities you also help them that they can learn, what are some of the things you do to help them?

Lecturer 6: Aaah, first of all as you mentioned about resources, so I have to provide them with the resources so that they come up with their ideas and secondly as they are discussing I try myself to monitor whatever they are doing and to make sure they are doing what I have asked them to do, listening to what they are saying and find out if they are discussing what I have told them to do if they are not discussing the real thing I make sure that they do.

Researcher: Eeeeh , I should say when you were explaining the roles of a teacher and the roles of a learner, I heard you saying one role of the teacher is to act as a facilitator. One of the roles of a facilitator is to guide and support learners as they are learning. How do you guide and support learners as you are teaching?

Lecturer 6: Eeeh, guidance as related to what the teacher does there is to facilitate, that is when a teacher gives information to the learners on what you want them to do or come up with then thereafter that is monitoring activities, moving around and checking wherever they need assistance I have to do so

Researcher: Just for interest sake, as you are presenting the lesson do you assess them and why?

Lecturer 6: Eeeeh, yes I do and the reason is that I have to find out if they are really following what they are required to do. The other way I assess them in order to make or find out if they are understanding the content.

Researcher: How do you assess them?

Lecturer 6: Mostly it's during the lesson or after that is by asking them questions and giving them the chance to ask questions as well if they did not understand.

Researcher: Who do they ask? If the learner asks a question and you see another learner raising a hand to answer do you give them the chance to answer or you just answer them all, just saying let me do it once and for all?

Lecturer 6: No, that is also part of assessment in the class, if there is a question from a learner and another learner wants to answer in fact I do give them the chance that is if there is someone who can answer to find out if they were also following the lesson. So when

they give a correct answer I do evaluate myself that teaching and learning process is taking place in the classroom.

Researcher: Now, eem assessment , I understand now assessment is in categories, we have what

we call the formative or continuous and we have what we call summative, I want to know the roles of the teacher and the roles of the learner during the whole process, be it marking, assessing, preparation , sitting for the test. What are the roles of a teacher and what are the roles of the learners?

Lecturer 6: Okay eehh for the teacher the roles are to prepare the task, if it is a written test it's the role of the teacher to prepare the test questions or prepare that task and thereafter it's the role of the teacher to assess or mark it. I don't know if am using the correct term. Learners are the ones to answer the questions which have been prepared, they are the ones to sit for the questions and answer them.

Researcher: I understand that , so the main task of learners is just to sit for the assessment paper, what other roles?

Lecturer 6: Yaaah , nothing.

Researcher: I will take you back to the classroom assessment, as you are teaching, do you have time to mark that?

Lecturer 6: If I have a certain exercise, that I need to be written and mark at the same time, I do so, like in Science and Technology I usually ask oral questions.

Researcher: So it's like you ask oral questions?

Lecturer 6: Yaaah, mostly I use oral questions

Researcher: Then they respond to them?

Lecturer 6: Yes, and that if it has been discussed at length that is all, I move forward and if am comfortable with that I move forward.

Researcher: That gives me another question again. You ask a question and a learner gives an answer that is correct. Do you have anything that you do to the correct answer or you just proceed?

Lecturer 6: (laughing) it depends to the type of the question .if it requires just the short answer as the learner has given I just proceed, but wherever it demands another question I give another question again based on the previous answer

Researcher: So , when you give or a learner gives a correct answer it's either you choose to proceed or give another question building on the first answer?

Lecturer 6: Yes

Researcher: Finally on the same, am just interested on the assessment, we have open ended questions that learners will choose to say anything and as a lecturer you choose to say some information is correct and you choose to emphasize on it and then we have questions that just need short answers maybe a yes or no or just saying one word and it

gives the whole answer. What questions are mostly commonly used during the summative one or at the end?

Lecturer 6: Alright, during delivery that is what I take it as continuous assessment there are those ones that require one answer, then I just assume that they have understood but sometimes, I have to ask them questions to give out their opinions, from their answers I choose which opinions need further clarification or not or which opinions are correct or are not covered.

Researcher: Now do you use any learner-centred teaching in your classroom if yes when and why?

Lecturer 6: Yes, I do use them eeeeem I use them because some of them as I said already. I use them because they help me to cover a lot of content, they are faster methods thus why I choose them. I have forgotten another question, what is it?

Researcher: I said if you use learner-centred teaching and you gave the reason and am comfortable on that. I said if so and you have given the reason, so we are looking at the approaches which make you move very fast. Apart from that what are the challenges of learner-centred teaching?

Lecturer 6: The challenges of learner-centred approaches as I said earlier is that they enable me to move fast and some are time consuming, and the other challenge is on resources which means you have to prepare enough resources to use that is for such a method to work

, if it means having enough books or preparing for more books, but with this new curriculum where there are not enough books it means you have to prepare for enough resources.

Researcher: Suppose you went to class as a supervisor this time and then you start observing a lesson, what would you expect to see that you would call learner-centred teaching practices?

Lecturer 6: Okay , I will expect the teacher to use the approaches that will enable learners to have their own time to share their ideas either in groups or pairs, that is what we call learner centred practices. Another thing is I will expect the teacher to be guiding the learners not only just sitting but should be moving around assisting the learners. Lastly, I expect the teacher to provide learners with resources that will enable them to interact with the content and really do what they are required to do.

Researcher: Alright now as a Science and Technology lecturer, do you think learner-centred teaching approaches should be applied in class if so why?

Lecturer 6: Yes, because some of these teaching practices will enable you to cover a lot of content , so it's an advantage on it's own as Science and Technology has a lot of content so will need to use such teaching practices. Secondly, they enable learners to actively participate during lesson delivery as Science and Technology is a learning area that requires learners to acquire the skills and knowledge , so if you use them it will enable them to acquire skills and knowledge.

Researcher: Eeeem, just for interest sake, are there any learner-centred approaches that you know about but you have not tried to use them and why?

Lecturer 6: (laughing) Yes, there are many eeeem, for example and some of them I can confess that some of them I don't have enough information about them, I just heard them from people, like for example, I don't know how to use it and pens on the middle, in which the learners after coming up with their ideas they put their pens on the middle and the teacher comes, picks one pen at a time and the learners will be explaining their views but I have never used it but groups or work stations, because listening to each and every learner from one group to another group for me I have never used it.

Researcher: So , eeem until today you have been teaching using learner-centredteaching practices, as a person what is your opinion or perception about learner-centredteaching approaches or in short is it necessary that we should continue to use them, is it necessary as a person to use learner-centredteaching approaches? What do you think?

Lecturer 6: To my side I think it is good to use them as learner-centredteaching practices have got advantages as I have already pointed out. In Science and Technology inorder to cover at least a lot of content you can choose to use some of these learner-centredteaching practices as they are fast and they enable learners to actively participate fully during lesson delivery.

Researcher: Again for interest sake, eeeem I would ,eeem what have been your experience that at a certain point where you wanted to use learner-centred approach but for some reasons you failed to use them?

Lecturer 6: Yes at sometimes , at a certain point I should say so, I prepared my work with these learner-centred methods , as I have already mentioned that with learner-centred methods you have to be guiding and monitoring learners so my lesson began late , I did not start at the right time so using these methods I failed to finish it because it did not start at good time so I had to change the method.

Researcher: Finally what motivates you to use learner-centred methods of teaching?

Lecturer 6: Aaah, two things, first of all I have already pointed it out it enables you to cover a lot of work within a short period of time. Another one is that when you see learners actively participating this will make you to really appreciate that learning is taking place other than just standing and explaining thus lecturing and you also see some of them dozing this did not motivate me but when you see learners actively participating it pleases me very much.

Researcher: Thank you very much for your coming Madam, but before you go is there anything that came to your mind as we were discussing and then you thought you would say that at the end or that's all?

Lecturer 6: Nothing

Researcher: Once again thank you very much and sorry for taking much of your time.
Have a nice day

Lecturer 6: Okay nice day to you too

Researcher: Thank you Madam.

Lecturer 8 responses

Researcher: Please describe your experience of learner-centred teaching

Lecturer 8: This approach allows learners to be the source of information than the other approaches where the teacher was the only source of information. Learner-centred teaching is a teaching approach which shifts from the traditional method of teaching and emphasises much on learner's involvement through active participation. At lesson preparation level I try to shift from teacher centred approach to learner-centred through incorporating learner-centred methods. I involve learners in preparing of resources like drawings.

Learners ask or formulate questions on their own on the topic. They also engage in discussions and debates or working in groups in carrying out projects and solving problems. As a lecturer my role is to facilitate and supervise in the activities as learners work on activities assigned to them and report. From my experience, I feel use of learner-centred teaching methods encourages learners to be creative, critical thinkers and resourceful; it makes learners to be independent when solving problems; - it reduces the lecturers work.

However, learner-centred teaching demands that the learners should produce resources and not the lecturer being the only source of resources; it demands that the learners should interact with the resources much than the lecturers. They are time consuming; there is lack of resources to be used; it's expensive as for the learners to access internet costly. - The library lacks books.

Researcher: Can you describe to me about your LCT classroom practices?

Lecturer 8: I use a variety of methodologies and resources to let the learners participate in lesson effectively. I assess learners' prior knowledge through oral and written questions or quiz in order to motivate them and make them more active in the lesson as this provokes their intellectual capability or cognitive thinking. I ensure that learners link new experiences with existing knowledge through asking which will lead to the new concepts or through informing them.

I guide my learners to engage in discussions and explanations of concepts. I present content to them through question and answer, through lecturing, discussions and explanations of concepts. During lesson deliveries learners also play the role of listening and taking notes on important facts/ concepts, contributing of ideas through active participation.

I engage learners in individual work and group work, taking part in experimenting and project activities. I also facilitate to the learners as they are carrying out their assigned work. Monitoring and supervising learners during experiments is part of my daily routine

work as learners do tasks. This helps to maintain discipline and guide the learners on what to do as they may be out of content.

During the learning process I also use positive reinforcement and varying the teaching methods and resources – It helps to motivate the learners and encourage them to participate. I assist learners to integrate learning into real world situations through involving them in project and research activities, involving them in experiments.

I assess my learners through question and answer, observations; - this is to make sure that I attract learners attention and involvement in the lesson; - To check if the learners are following the lesson and understanding it. During assessment learners are involved at any level i.e. planning, implementation or observation; - they can be involved in identifying items to be assessed.

I give learners assignments; continuous and summative test to help them recall and use what they learned. I ask them to practise what they have learnt through peer teaching or practical activities to help learners to apply the knowledge and skills learnt. This also helps them master what they have learned so that they face positive and challenges.

I plan activities which learners are going to carry out. I improvise as learners are working. This saves time and let learners not lose focus or reduce noise.

I do thorough preparation of activities, resources and appropriate learner-centred teaching methods. I support learning of learners by consolidating learners' activities at the end of each activity.

I involve learners in activities through assigning them to work to do in a team and using IT. I encourage learners to engage in team work and individual work; this is through discussions debate and reporting.

I involve learners in various activities by varying teaching methods which requires critical thinking i.e. debates; galley work; ball bearing and many. I value learner-centred teaching approaches because it encourage critical thinking which is advocated in Science and Technology , for example, ball bearing; galley work, debate, discussions – it's because learners are involved and they use all their senses.

Researcher: Describe the reasons for your LCT classroom practices as described in your explanation.

Lecturer 8: It's the way the learners are participating in the work assigned to them; - they are also to work co-operatively as a team which is quite good.

LCT approach has reduced teachers work and improved collaboration between the teacher and learner – It has improved learners independence and critical thinking efficiency and

resourcefulness. I have learnt that if properly utilised it can improve the education standards in the country especially if it is properly funded and managed.

I am highly motivated.

APPENDIX 9: Pre lesson observation interviews during pilot study

Semi - structured questions for individual interviews

Understanding of learner-centred teaching (LCT)

i. General questions

- a. What is learner-centred teaching (LCT)?
- b. What does it involve?
- c. What are the roles of the teacher, learner, content, assessment?
- d. What are its strengths? Challenges?
- e. What demands does it make on resources?
- f. How does it compare with teacher centred approaches?

ii. LCT in Lesson preparation

- a. How do your lesson preparations reflect learner-centredness?
- b. How do you involve learners during lesson preparation?

2. Implementation of LCT in Science and Technology lessons

i. introduction

How do you prepare/motivate learners to learn? Why?

How do you assess learners' prior knowledge? Why?

How do you assist learners link new experiences with existing knowledge?

ii. Lesson presentation in LCT

What is the role of content in teaching and learning?

How do you present it to learners? Why?

What activities/roles do your learners do during lesson deliveries? Why?

How do they do them?

What activities/roles do you do during lesson deliveries? Why?

How do you promote higher order thinking skills in learners?

How do you help learners to integrate learning into real world situations?

How do you help learners to reflect on their learning? Why?

How do you help learners to apply the knowledge and skills learnt? Why?

iii. Learner guide and support in LCT

How do you guide and support learners' learning? Why? Through thorough preparation of activities, resources and appropriate learner-centred methods. Also by consolidating learners' activities at the end of each activity. To make sure that the success criteria

Do you assess your learners during lessons? How? Why?

What form of assessment do you give to your learners?

During assessments, what are your roles? learners' roles?

At what level of assessment should learners be involved? How? Why?

3. Lecturers experiences about the use of LCT

Do you use LCT? How? When? Why not?

What form does it take?

What are its challenges?

What is it that you do that you call learner-centred?

Should LCT methods be applied in teaching Science and Technology ? Why?

What type of methods and techniques do you regularly use when teaching? Why?

Are there any LCT methods you know about but have never used them? Why?

How do you involve learners during teaching and learning processes?

What motivates you to use LCT approaches?

APPENDIX 10: Lesson observation notes

Lecturer 1: Lesson 1

25th January,

2019

CLASS: E

Subject: Science and Technology

Topic: animals and their environment

Teaching and learning resources: preserved bottled animals, e.g. snakes, chameleon, primary school standard 5-8 text books

Time: 10.00- 11.00

Class size: 30

Lecturer 1: Hello class

Learners: Hello madam

Lecturer 1: How are you this afternoon?

Learners: we are fine how are you madam

Lecturer 1: Aaaah we all come from homes and in our homes we have certain things that we see every day as we move around for example we , you see some animals , some animals, many of them. Am I right? Preamble- learners engagement through listening

Learners: Yes!

Lecturer 1: We all have seen animals whether in our homes or in the bush. I would like you to mention some of the animals you see in your homes. (Learners raised hands up.

Lecturer pointed at one learner). Yes!Assessmen of previous knowledge- learner engagement through QPN

Learner 1: chicken

Lecturer 1: Chicken, Yes (pointed at another learner)

Learner 2: Cattle

Lecturer 1: Cattle , yes mmmmh

Learner 3: Goats

Lecturer 1: Goats , Yes (pointed at another learner)

Learner 4: Pigs

Lecturer 1: Yes, yes, small , small, small animals

Learner 5: Ants.

Lecturer 1: There are so many animals that we see in our homes. Yes .last time we were learning about plants and their environment, plants and their environment. What, how can you define an environment, how can you define an environment (female learner raised up a hand, said something but was not heard clearly due to low voice. Lecturer pointed at another learner). Yes!

Learner 6: Anything around us that's what she says.

Lecturer 1: Any other answer? Any other answer apart from what she has said?

Learner 7: Anything around us, thus what she says.

Lecturer 1: Any other answer, any other answer ?

Learner 8: Or anything that is around an environment

Lecturer 1: Aaah. That is environment. We also talked about the plants aaah after they have manufactured their food, that is at the end they have what, aaah glucose and then what, the process of photosynthesis , do you remember it?

Learner 9: said something

Lecturer 1: Aaah the end product , what are they?

Learner 10: Oxygen

Lecturer 1: Aaaaah what did we say is the use of oxygen? (Learners raised up hands) Yes.

Learner 11: It's used in the process of respiration.

Lecturer 1: Where is it on the plants? Do we need oxygen?

Learner 12: Yes we do need oxygen. Review of previous lesson- learner engagement through QPN

Lecturer 1: Thank you very much. Why do you think are animals important in our everyday life? Do we need them, what are their importance? (Learners raised hands up. Lecturer pointed at learners for a response). Yes, eeemmmm how, what are the importance?

Learner 13: We eat them as food, others are dangerous.

Lecturer 1: Yes (Pointing at another learner)

Learner 14; Like dogs are for protection.

Lecturer 1: Yes

Learner 15: They provide manure for agriculture activities

Lecturer 1: What else?

Learner 16: Source of income.

Lecturer 1: So really they are really important. So today we are going to look at animals and their environment , and their environment. (Then wrote the topic on the chalk board).

What do we know about animals? Okay, I want you to go back in time , go back in time when you were in primary school level. When I say back in time, aaah, in primary school, I want you to tell me when you heard about animals, what came into your mind when you were at primary school? What are the importances of animals? (Learners raised hands up.

Lecturer pointed at learners for a response). Yes

Learner 17: animals we eat at home

Lecturer 1: To him he said the animals he knew were those he eats at home, were those he used to eat maybe like chicken, goats , sheep etc . What about you?

Learner 18: harmful animals

Lecturer 1: Animals are harmful to us for example, what?

Learner 19: a lion(assessment of previous knowledge through QPN- learner engagement)

Lecturer 1: Yes, a lion. Did you ever see it as you were young? Have you ever seen the lion that time. Maybe this time but in pictures. Have you ever seen a lion face to face? Okay thank you so much.

This time find somewhere to write. I want you to have a writing pad. Somewhere you are going to write. I want you to think about the misconceptions about animals and their environment. I want you to think first then you write. We are going to use think –ink- share method. I want you to write about the misconceptions about animals. I am giving you a minute , a minute. I said write the misconceptions that you have about animals please (each learner was seen busy writing something in their notebooks).

Lecturer 1: Okay thank you. Now, be with a friend and share. can you share with your friend what you have written? Share with a friend (Briefly pairs shared notes. Lecturer interrupted). Okay thank you, thank you, I hope you have shared the ideas. I want a pair to tell us what you have discussed. Tell us what you have shared. (some learners raised up hands. Lecturer chose a pair to share with the class what they had discussed). Yes! can you share.

Learner 20 (female): When you see an owl is a bad omen.

Lecturer 1: Misconceptions, misconceptions please!

Learner 21:Animals like frogs making sound, they mean that it will be raining soon.

Lecturer 1: Yes, this pair (pointed at another pair).

Learner 22: Some birds when you see or hear them it means it is going to rain, rain is about to come.

Lecturer 1: Yes

Learner 23: Some parts of animals are not eaten by children for example eggs. Eggs must not be eaten by children.

Lecturer 1: Yes! very bad

Learner 24: Animals like frogs are fallen from heaven during rainy season, and some animals are holy, very sacred

Lecturer 1: Alright, some animals are holy, very sacred, yes like python, very scarified. Can you clap hands for yourself for the good work? (Hand clapping by learners-reinforcement). Some animals, they produce fire when you look at them. They produce fire. When you see a snake, or a black cat it's a bad omen, which is not true, those are just misconceptions. Thank you very much. (lecturer added some misconceptions, learners listened, jotted down some notes).

Lecturer distributed Primary school learner's books and teacher's guide for standard 5 -8).

Lecturer 1: Alright, I have given you the books, have given you the books, the learners' books and teachers' guide. I want you to examine them then you have to find out what is taught about animals and their environment. I want you to find out, what actually is taught about animals and their environment. Open up where there are animals and their environment, explore what is taught. When you find them, just write them somewhere so that you don't forget. Write them somewhere (Learners flipped through the primary school learners' books and teachers' guides. They analysed the books to check if they contained topics about animals and their environment. They jotted down some points. Lecturer moved around the groups to monitor the group discussions).

Lecturer 1: I hope you have identified the class and the name of the topic in standard 5 and 6. Have you done it? I want you to do another thing. After you have identified them I want you to identify the strategies you are going to use to teach the topic. Identify the strategies to use for teaching the topics (Learners discussed and worked on the tasks in their groups using the text books as the lecturer was moving around to check work progress). Have you found them? I want volunteers to come up and write what they have found. First of all which class? (Learners raised hands up. Reported their findings about the strategies on the topics that they found in standard 7 and 8 and said, there are no strategies. No strategy has been indicated in the books. However, they mentioned the strategies they thought could be used to teach the topics) Yes.

Learner 23: In standard 7.

Lecturer 1: Yes

Learner 24: In standard 8.

Lecturer 1: So in standard 8 they are teaching about animals and also in standard 7. What about in standard 6?

Learner 25: Yes

Lecturer 1: Now have you identified the strategies that you are going to use or have they written them? Anything from the book?

Learner 26: No

Lecturer 1: Now as teachers, we need to use learner-centred methods to teach our learners, is it? They have not indicated them so as teachers we need to use them. What can we use then? What can we use as teachers, are we going to use lecturer method? (Some learners raised hands up). Yes

Learner 27: KWL

Lecturer 1: What is it, KWL?

Learner 27: I know, I want to know and I have learnt

Lecturer 1: Eeeeh thank you very much, very good, clap hands for him (Hand clapping by learners). Yes! (Lecturer pointed at another learner)

Learner 28: Can use group discussion.

Lecturer 1: Eeeeh yes they used discussion, what else? Yes!

Learner 29: Think-ink-share

Lecturer 1: what else? Yes!

Learner 30: Quick write

Lecturer 1: Yes, what else?

Learner 31: excursion, walk around talk around

Lecturer 1: Yes!

Learner 32: Ball bearing.

Lecturer 1: Yes

Learner 33: Jigsaw.

Lecturer 1: There are many of them and as teachers we have to use them. We are going to eeeh teach from standard 1 to 8, so as teachers we are going to use them as teachers. So I just want us to go out, just for three minutes , try to find out if you can see animals. Animals from the environment. If you find it you have to kill it bring it dead or so maybe it might be dangerous. (Learners went outside to collect the animals. Lecturer followed them. Later the lecturer announced time remaining). A minute to go , okay can we go back?

Learners: went back to the classroom carrying those animals

Lecturer 1: Alright we went around to our local environment. We went around to find some animals in the environment. Which animals have you come across? Please share with the class the animals that you saw when you went outside.

Learner 34: spiders

Lecturer 1: Spiders eeeeh , yes

Learner 34: Butterfly

Lecturer 1: butterfly, yes!

Learner 35: ants, grasshoppers

Lecturer 1: Thank you very much. Yes you have seen those animals but what challenges can learners meet as they go outside into their environment? (Some learners raised hands

up). Okay, no no no , I want you to find somewhere to write, using the walk around methods. When you hear a clap, when you hear a clap. When I clap hands once, walk around, when I clap hands twice, then stop and talk to a friend. (lecturer clapped hands, learners walked around, then she clapped hands twice and learners stopped to share ideas and jotted down some points. Lecturer encouraged each learner to contribute towards the discussion).

Lecturer 1: Okay, yes talk. (Clapped hands) Yes, it's walk around! Okay go back to your places. Can you tell me what have you discussed? We are dealing with challenges. Have you found? I want anyone to talk. talk around. clapp hands for yourselves. (Handclapping by learners- reinforcement)

Both learners and lecturer talked to each other during the activity and presentations.

Learner 35: Scarcity of some animals, some animal you we cannot find them, some animals are dangerous. Some animals are poisonous.

Lecturer 1: They say scarce of some , some animal you we cannot find them in our environment. Yes , Some animals are dangerous. Yes some animals are poisonous to our lives and hazardous to our life as well. Now some animals that are very dangerous you cannot touch them. Yes , clap hands for yourself (hand clapping by all learners). If you bring them to the learners, they will just run away .yes some animals are dangerous, harmful, and difficult to catch, so what are the solutions to the challenges found? Yes how can we do it?

Learner 36: Use of illustrations, drawings and just explaining to them

Lecturer 1: By use of illustrations. Mind you any illustration is the last option to be done but you have to use real objects. As a teacher start by real things, as a teacher the first thing is to use the real object. So have concrete things. Can you bring a snake or a frog , or a lion to the class? So what are you going to do? (Learners raised hands up). Yes! Okay what can you do?

Learner 37: preserve the animals

Lecturer 1: Yes with some of the situations we need to preserve the animals for example we have a snake, if preserved it's easy for learners to come and use it because it is dead. For a grasshopper, can you catch it? It flies away so you can have it and preserve it. Then , so for a chameleon , can you catch? You can only preserve it for learners to use. We need as teachers to be more resourceful for example this one, you want the intestines what are you going to do? Can you kill your own goat, ohhh no but by the time we are eating it you can just have a piece and preserve it. So we are saying some of the solutions can be by preserving.

Lecturer 1: Alright , thank you so much, now we are going into our home groups. Aaaaah before we go into our home groups we want to talk about animals, animals, what do we mean? We need to talk about classifying animals, and also classifying them further according to their groups. After that we are going to talk about how they survive and why are they important. Please in your groups, in your groups. Can we go into our groups, I

want to give you some tasks. Please into your groups we have 5 groups. Can I have 5 groups please? Please? Come on we are going to use the teachers' guides, make sure there is a teachers guide for standard 7. No, no no, wait, this group, two groups, can you move, another group should move to the back. Group number 3 eeeh this is your work, this is your work number 1, number 1. Number 2 this one, number 3 eeheooohhh this is number 4. I have given you work to do. Do it fast, faster (Distributed chart papers and pentel pens to each group through group secretaries. Assigned a task to each group. Each group had a different task).

Lecturer 1: Group number 1 classify animals, classify animals, group number 2 classify vertebrates animals to their body temperature, group number 3, you are going to write a summary about the units we have have done, a summary, eeeeh this is group number 5, you are going to do survival mechanisms of the animals, how do they survive. And the last one the importance of teaching learners about animals and their environment. Here there are 2 units, you are going to get the important facts. Do it fast , we are remaining with 5 minutes, 5 minutes. Bring in the ideas so that we have good participation (Learners went into groups, discussed/ worked on the assigned tasks in their groups. Lecturer moved around to check work progress, assist those with some problems, etc). If you have finished you can paste, whatever you have done, stop discussing your tasks, you can paste on the walls.

Lecturer 1: If you are through you can past your work. Paste paste, paste (Group leaders pasted their chart papers on the walls). Okay, can you take your seats. Will start with this

presentation and the summary will come at the end. I want people to come to talk about what they have done. Just one at a time .we are going to start with group number 1, classifying animals, classifying animals, okay. A volunteer from each group should present what each group has.

Learners: Group 1 leader presented. Other learners were attentively listening and jotted down notes

Lecturer 1: Can we clap hands for them (hand clap!). Group number 2 on classifying vertebrates according to their body temperature.

Learners: Group 2 leader presented

Lecturer 1: Okay can we clap hands for her, her? The next to present are the importance noo, no, no survival, mechanism for in animals,

Learners: Group 5 leader presented

Lecturer 1: Can we give them a Mandela wave? Okay now let's talk about the importance of teaching learners about animals and their environment. Is it good that learners should know them, is it good to teach them?

Learners: Group 4 secretary presented

Lecturer 1: Can we give them reinforcement? Okay stand there, because of that we need to clap hands (Hand clapping).The last group has summarized what we have learnt today, just stand there, because of that ,clap hands for them (Hand clapping. Group representatives

went and presented their work starting with group 1. Two female Learners and three male learners presented).

Lecturer 1: They have stated the types of vertebrates and further classified them into warm blooded and cool blooded animals because of that, clap hands for them (Learners clapped hands for group number 3). They have also done the invertebrates, and they have classified them into four groups, protozoa, nematodes, anthropods etc. Thank you. Okay that is about animals and their environment.

Lecturer 1: Now we have seen the two groups of animals based on vertebral column , is it? We are just taking one character of vertebral animals. Vertebral animals are animals that have an endoskeleton and exoskeleton . What is an endoskeleton ?

Learner 37: animals whose skeletons are inside the body

Lecturer 1: Good, what is an example of an endoskeleton, one word. (Learners raised hands up). Yes

Learner 38: human beings

Lecturer 1: Yes it is human beings, I wanted one word vertebrates or invertebrates, thus what I wanted of animals which have the skeleton inside their body, inside the skin?

Learner 39: They are vertebral animals.

Lecturer 1: What about the exoskeleton?

Learner 40: in exoskeletons, the bones are outside the body

Lecturer 1: In vertebral animals so the example of the endoskeleton is the man. I do not have the example of the exoskeleton, maybe next time. Okay after looking at that , what are vertebrates animals? (Learners raised hands up) Yes

Learner 41: Are animals with a backbones.

Lecturer 1: Do you agree, do you agree?

Learners: Yes

Lecturer 1: How about the invertebrates? (Learners raised hands up) Yes

Learner 42: Animals without a backbone

Lecturer 1: Yes animals without a backbone. Can all of you touch where there is your backbone, a backbone, do you have a backbone. So under what group are we?

Learners: Under the vertebrates

Lecturer 1: Under the vertebrates, thus where we are. Most of the times, we do not put man as an example of vertebrate animals. We always put other things. Okay, eeeh I had this in mind, I also had some summaries but because you have done good work it is very well, so you are going to paste this in your classroom. I also have the summaries, have also classified them in vertebrates and invertebrates, cold and warm blooded.

(after each group had finished with its presentation, the lecturer asked them to clap hands for their colleagues. Hand clapping by learners - reinforcement. Explained some points for quiet a long time while learners were listening. Displayed a chart paper wit examples of

vertebrate animals on them. He also use artificial materials or models of a human skeleton).

Alright, now can we mention the challenges that a learner can find when dealing with the animals in their environment, in their environment, you have learnt it (Learner raised hands up), yes

Learner 42: Some animals are scarce.

Lecturer 1: Yes

Learner 43: They are dangerous.

Lecturer 1: Yes

Learner 44: They are poisonous

Lecturer 1: Very good, very good. Can we define, aaah what is an invertebrate animal? Yes (Pointed at a learner)

Learner 45: They are animals without a backbone

Lecturer 1: (hang her own chart paper). Compare your answers with my work and see where we agree or disagree. I will leave this chart paper in this class for you to continue studying or using it. What are the challenges that learners face as they learn about animals? Can we define what is meant by invertebrates? What have you learned? I have these questions and answer them orally.

Learner 46: Animals without a backbone. Thank you for being a nice audience and thank you for your participation that is the end of my presentation or lesson.

30th January,

2019

Lecturer 1: lesson 2

Subject: Science and Technology

Topic: Mixtures

Time: 13:30-14:30

Class size: 30

Teaching and learning resources: cylinders, distillation apparatus, text books, ...

Lecturer 1: Good afternoon class.

Learners: Good afternoon, madam.

Lecturer 1: what are mixtures? (Learners raised hands up. Lecturer pointed at some learners for their responses)

Learner 1: a mixture is a solution made from different ingredients.

Learner 2: A mixture is formed when different homogenous particles are put together regardless of their quantities.

Learner 3: combination of substances, putting two or more things together so that, putting things in water.....

Learner 4: when two or more substances are put together

Lecturer 1: we categorized the mixtures into two. What are these?

Learner 3: homogenous and heterogeneous mixtures.

Lecturer 1: what is another name for homogeneous mixture?

Learner 4: Solution

Lecturer 1: Can you define what a heterogeneous mixture is? What is another name for a heterogeneous mixture? How about a homogeneous mixture?

Learners: gave answers to the questions.

Lecturer 1: That's what we learnt last time. There are some misconceptions about mixtures. What are these misconceptions about mixtures?

Learner 5: Air is not a mixture.

Lecturer 1: Air is not a mixture, is that true?

Learners: no, it's not true.

Lecturer 1: let us look into the books (standard 5-8 text books) I have put on the tables. I want you to go to the books and see if the mixtures are covered. Do we see mixtures being covered in these books? (Learners collected primary school learners' text books and teacher's guides from the lecturer's desk. They started working on the task in their groups. Later the lecturer asked them to report about their findings).

Lecturer 1: Do we have mixtures in standard 5?

Learners: no

Lecturer 1: Standard 6?

Learners: no

Lecturer 1: Standard 7?

Learners: no

Lecturer 1: Standard 8?

Learners: yes

Lecturer: can you go to the activities? Is it important to you as learners to know about these mixtures?

Learners: yes.

Lecturer 1: you as primary school teachers you need to know about mixtures. Why do you as a teacher need to know about mixtures? Is it important to teach mixtures in primary schools? is it important for primary school learners to know about mixtures?

Learners: yes.

Lecturer 1: Why should primary school learners need to know about mixtures. I give you 1 minute to do the work in pairs. Can you think- pair and share why it is important to teach about mixtures in primary schools?

Learners: did as instructed (In pairs, they discussed and shared about the importance of teaching mixtures to learners).

Lecturer 1: stop discussing the question. Can pairs tell the class what they have discussed?

Learners :(Mentioned the importance of teaching mixtures in primary schools) for example, it helps learners to know how to separate things.

Lecturer 1: (asked further questions about the importance of mixtures. Most questions were of higher order and thought provoking). Have you ever heard of mixtures at home?

Learners: yes.

Lecturer 1: what are these?

Learner 9: cooking nsima, preparation of tea

Lecturer 1: (gave an explanation on the importance of mixtures. Learners listened and wrote important points in their note books as lecturer gave explanation on importance of mixtures) mixtures are really important to everyday life. What forms of mixtures do you know? in your groups discuss the forms of mixtures that you know about. Form groups and discuss.

Learners: went into groups and started discussing about forms of mixtures. Lecturer monitored the activity.

Lecturer 1: put your pens at the middle. I want you to put a pen on the middle. When I pick a pen, the owner of the pen must give an answer to the question (learners did as advised). Lecturer went around, stopped at a work station, then picked a pen and asked the owner of the pen to tell the class what they had discussed in the group which he/she belonged to.

Learners: (responded in their groups by mentioning forms of mixtures as their pens were picked by the lecturer). Some of the answers were;

Liquids and liquids

Gasses and gasses

Solids and liquids

Solids and solids.

Lecturer 1: (Picked pens for a number of learners). Look at this basin. In this basin, I have with me maize seeds, beans, and chalk pieces. This is an example of a mixture. Can you think about other examples of mixtures?

Learners; gave more examples/forms of mixtures, e.g. fizzy drinks, crude oil

Lecturer 1: clap hands for your friends. (Learners did as instructed). Lets talk about factors that will affect the rate of solids dissolving into a solvent. Factors that affect solvents. What are the factors that affect the rate of mixture? (Learners raised their hands up. Lecturer pointed at some learners to give their answers)

Learner 10: Temperature

Learner 11: Size of particles

Learner 12: Stirring

Lecturer 1: (gave an explanation of how temperature, and size of particles affected the rate of solids dissolving into a solvent/ solubility). Stand up. Walk around! What can be the challenges when we are teaching mixtures? I want you to stand up and walk around and when I clap hands you should stop and discuss. Now, walk around, walk around. (Learners stood up and walked around to mix with each other. Lecturer clapped hands). Okay, stop! Pair with a friend and discuss challenges faced when teaching about mixtures to learners

(learners stopped and formed pairs. Each pair was discussing challenges faced when teaching mixtures).

Lecturer 1: ok, can you go to your places? Go to your places (Learners went back to their seats).What are the challenges?

Learner 13: Lack of resources

Learner 14: Lack of knowledge/expertise

Learner 15: Large class

Lecturer 1: explain your answers to clarify your points (learners did as instructed). Make sure you always find solutions to such challenges.

Lecturer 1: (reminded learners about scientific investigations they learnt previously). do you remember about scientific investigation? You will use this knowledge as a prerequisite in the next activity. What are the steps in a scientific investigation ?How can we go about it?

Learner 16: Identify the problem

Learner 17: Planning about the investigation

Lecturer 1: I want you to be in your groups or form groups of 4 -5 members. I want you to discuss an experiment using your knowledge. Think of an experiment that you can use on mixtures and think how you can design it. Correction; I want you to think of an experiment on how you can separate mixtures and then design it (Learners went into groups. Discussed procedures to separate mixtures. No resources were given to the

learners- learners were made to think about and identify teaching and learning resources to be used in the experiment for themselves. Later, the lecturer started bringing resources to the learners in their groups).

Lecturer 1: alright, you should stop the discussions now. Please tell us, what is it that you can separate and what are the procedures? (learners in their groups raised hands up and lecturer pointed at one learner from each group to say something).

Learners: gave explanations as follows;

Group 1 learner: to separate mixture of sugar and common salt in water: evaporation. Then lecturer: gave them apparatus for evaporation.

Group 2 learner: mixture of beans and maize grain: hand picking.

Group 3 learner: flour and maize particles: sieving.

Group 4 learner: flour and water: decanting.

Group 5 learner: iron and non- iron: ***magnetizing***.

(Lecturer distributed apparatus and other teaching and learning resources to learners according to the type of mixture and method of separating the same mentioned by a group)

Learners: All learners discussed the procedures for and designed an experiment according to the method of separating mixtures as assigned by the lecturer. Each group was given different method of separating mixtures. One group mentioned that they wanted to separate cooking oil from paraffin.

Lecturer 1: we started by designing experiments. Now we are going to do the actual experiments on separation of mixtures. Please understand my instructions and then do the experiment. After the experiment we will have a gallery walk.

Learners: Did the experiments on separating mixtures in their groups as lecturer walked around to monitor, assess and assist learners during the work- checked on how learners performed the experiments.

Lecturer 1: ok, you have 5 minutes to go to finish doing the experiments. A group which finishes their task must come in front to report about their work. (Learners continued working on their experiments. Later, group leaders reported to class about the experiment they did). Please stop doing the experiment. I want group leaders to come in front to present their work.

Learners: did as instructed by the lecturer- group presentations to class- group leaders went in front to make presentations on behalf of their groups.

Lecturer 1: Can mixtures or the processes we are doing be used in every day life? Can we use them in everyday life?

Learners: yes!

Lecturer 1: (gave detailed explanation of the methods of separating mixtures, for example, winnowing, floatation- she demonstrated winnowing and floatation methods with examples to learners). ok, we can separate maize from flour by winnowing. We can also do it by floating. Thus maize grains from pieces of flexafoams.

Lecturer 1: explained the concepts about mixtures- floatation, winnowing, filtration, etc.

Showed sample mixtures to learners

Learners: listened, observed mixtures and jotted down notes

Lecturer: any questions about what we learned today? (there was dead silence). Okay this is the end of the lesson.

Lesson presentation details for lecturer 2

29th January, 2019

Lecturer 2: Lesson 1

CLASS D

Subject: Science and Technology

Topic: teaching of plants and their environment

Number of learners 23

Time: 10:00-11.00

Seating plan: Learners seated in linear arrangement.

Lecturer 2: Okay, eeeem if my memory serves me very well, in our last lesson we tackled this topic of plants and their environment, teaching of plants and their environment. Eeeem, do you still remember anything that we covered last week?

Learners: Yes!

Lecturer 2: Okay thanks very much. I will be throwing a ball and who ever catches it should tell us. I will give you three seconds to think of what we covered last time on plants and environment. I will use this ball. I will just throw this ball once you get it say whatever you remember, just share with the class. Eeeeh is it clear?

(Lecturer threw ball randomly to a learner, asked him or her to state what they learnt in the previous lesson, and in turn the learner with the ball would throw it to the lecturer after answering the question. Lecturer lecturer threw it to another learner for another opinion. She called learners by name).

Learner 1: explained what they remembered when the ball fell into their hands.

Lecturer 2: Okay, Yessss!

Learner 2: the relationship between plants and the environment

Lecturer 2: Okay, thank you very much, the relationship between plants and the environment. Eeeeh, eeeh, eeemm just share with us anything.

Learner 3: Eeeem, it was about misconceptions

Lecturer 2: Eeeeh good , thanks very much and lastly Mr. Nkhoma?

Learner 4:the relationship between plants and environment

Lecturer 2:Eeeeh, eeeh, thanks very much, thus what we had last week, we looked at the relationship between plants and their environment. Thus how we can care for the environment. if you are a really practicing teacher, it is imperative to interact with nature in your local environment. The importance of teaching the topic to learners is to instill in learners the aspect or knowledge that will help them in conserving the environment.(The lecturer explained the importance of teaching plants and their environment. She explained the importance of teaching primary school learners using the local environment when teaching about plants).When teaching about plants to primary school learners you should bear in mind the dangers of some plants . (As the lecturer was talking she was observed writing on the chalk board).Okay! So we just want to continue today and look at the other aspect of teaching plants and their environment

Learners: Listening and writing in there notebooks.

Lecturer 2: As a teacher when doing your job you always take learners to the environment, okay, thus through excursion in their local community. There are other things to take care of for example the know-how of the environment. Thus the first thing, it is to know that some plants are poisonous, some plants are harmful. So the first thing is to be careful because the environment is the source of our resources. You need to take note of that. Now..... (Learners: listening). We also need to know about classification of plants,

classification of plants. We can classify plants based on several attributes, based on several factors. Can you just give us any one of the two? Let us brainstorm one or two , what things should we look for? Any one or two factors? How you can classify plants? How can you classify plants?

Learners:(some learners raised their hands up. Lecturer pointed at one learner)

Lecturer 2: yes sir!

Learner 5: shape of leaves

Lecturer 2: Okay, fine. What else should we consider? Yes Mr. Damiano, where are they found? I thought they are found in Migowi or Makawa.

Learner 6: Hilly places

Lecturer 2: Yes, Okay, maybe in hilly places, eeeh alright, alright. Plants can be classified into basically , we can have two, flowering and non- flowering plants. We want to other basic classification of plants. Do we still have some?

Learners: yes!

Lecturer 2: some basics for classifying plants could be; some plants do have flowers and some do not have. Now we want to be in our groups, or we can use rows. Yes, that row, groups. Now be in groups and classify plants into many groups. Can you form three groups? Okay , this will be group number 1, and group number 2, and group number 3. (Lecturer then shared markers to the 3 groups formed by the learners). Classify the plants

according to their similarities and their differences. I am going to give you 10 minutes. Discuss and write down whatever you discuss. (No plants were brought to class and learners were not taken outside the class). We want to classify plants into as many, as many, as many as possible attributes regarding classification of plants. In our groups let us write classifications according to similarities, then I will take a scenario when you have kids, maybe you take them out to observe characteristics of plants, look at roots, leaves, stems.

Lecturer 2: Once again our focus is to look at similarities, differences in as far as classification of plants are concerned. Let's do that.

Learners: (formed three groups of four to five members. did their work in their groups while the lecturer moved around to explain to groups what they would exactly be doing, gave assistance to groups 2, 3 and 1. Lecturer continued to move around assisting learners in their groups. Announced the time 3 minutes left).

Lecturer 2: You have three minutes, three minutes remaining. A minute. You are almost done, you are almost done, Okay. I hope you are done. Let's hear from group number 1. So let's hear from group 1 members.

Learner 7: read out group number 1 points. He presented the classification of plants according to flowers, leaves, stems, and roots.

Lecturer 2: Ahaaa, thus all from group number 1, anything, comments, corrections?(No comment or no questions were given by the learners). Good, thus great. Let's give them a

hand please. Let's have group number 2, group number 2, group number 2 now to present. Can group two learners present their work please?

Learner 8: read out group number 2 points while the rest of the members listened and looked on.

They presented the same work as group 1.

Lecturer 2: Any other comment from group number 2? Group number 2 maybe you have a comment? (group 2 members were silent). Thus what we had from group 2, can other groups comment on group two work? (No comment was given). Let's give them a clap kind of reinforcement. Clap hands for the presentation. (learners clapped hands).

Lecturer 2: Let's have group number 3, so far the last group. Group number 3.

Learner 9: (spread chart and started the presentation). We classified plants into flowering and non-flowering plants (They had a similar task as group 1 and 2. All the three groups had similar answers and finished at almost the same time).

Lecturer 2: Okay, thus all what they have presented. Okay any other comment from group number 3 members? Thank you, let's give them the reinforcement (learners performed the type of reinforcement). Eeeh, thank you very much. This is how as a teacher will be focusing when we look at classification of plants. Eeeh, maybe if you look at flowers, stems, roots and leaves. You can also give examples of flowers, these are flowering plants. On leaves you can further classify them further on types of leaves for example simple and compound, shape, and also arrangements of leaves and shape. Take

for example, maybe we can look at arrangement of leaves . Can you just remember any one arrangement? (some learners raised hands up). Yes

Learner 11: some have parallel arrangement

Lecturer 2: Can you explain or draw a parallel leaf as part of classification to other learners?

Learner 11: Drew a leaf and displayed on the walls for others to see.

Lecturer 2: Alright , some have parallel arrangement, Okay. How does a parallel leaf looks like?

Learner 11: just a drawing?

Lecturer 2: Yes, yes, Madam Pangani, a parallel leaf. Yes a parallel leaf.

Learner 11: gave an explanation of a leaf withparallel arrangement. She illustrated her answer by drawing a leaf on the chalk board.

Lecturer 2: Eeeh, but how does a parallel and opposite differ? Are they the same? (some learners raised up their hands and lecturer pointed at a learner) Yes, Sir!

Learner 12: said something

Lecturer 2: How are the veins arranged?

Learner 13: Veins are arranged either parallel or networking.

Lecturer 2: Veins are just networked. Veins can be arranged in parallel or networked for example in a maize plant , it's leaves are parallel. Some leaves are networked thus the

opposite of the parallel one. This is basically the arrangement of leaves. What will it be?
(lecturer pointed at another learner for an answer) Yes, Sir.

Learner 14: Boldly.

Lecturer 2: How does this look like? How does a bodily look like? Explain to me fast. Yes
, Mr. Billiat

Learner 14: These are two to three leaves from the same point.

Lecturer 2: Is it like that? Thus some of the areas a teacher can focus on when he or she is teaching or takes the class to the local environment. When we come to flowers or stem, what will be the focus? We have the climbing stem, underground and creeping stem. What is the example of a creeping stem? Is creeping and climbing the same? Different? Can you name examples of plants with creeping stems? (Learners tried to give answers e.g. kapinga. The lecturer kept his eyes on lesson notes as he was facilitating the lesson).

Learner 15: for example kapinga or yams

Lecturer 2: Yes, Kapinga, eeeeh. Or yams they always climb, eeeeh. And so we have underground stems. We can also look at roots for example tap roots. The examples of plants with tap roots?

Learner 16: black jack

Lecturer 2: Yes , black jack has a tap root. Yes. What about examples of fibrous type of roots? Yes .

Learner 17: Cassava, cassava, cassava.

Lecturer 2: Yes Sir.

Learner 18: Maize plant

Lecturer 3: Yes Sir , maize. It has several roots , there is no main root.

Lecturer 2: let's give ntchentche reinforcement (Then lecturer gave consolidation to whatever learners presented. She explained something on learners' responses or answers. She emphasised on attributes of plants to focus on when teaching primary school learners more especially when they have been taken on a field trip.).

(Learnersactivities included listening, responding to questions, discussing or brainstorming questions, reporting or making presentations, writing notes. At times learners brought teaching and learning resources or raw materials-

Lecturer 2: (an example of a situation where the lecturer gave an explanation; leaves-arrangement of leaves- opposite, others alternative, some whorled.

Stems; climbing stems, creeping stems.

Roots; Tap root, fibrous roots).

Lecturer 2: What could be important points about this topic-classification of plants as teachers? Maybe for , as a teacher what should we focus on as we are teaching? In five points as a teacher what should you look for when teaching classification of plants? Eeeeh

, just think of any three to four points to consider when teaching this topic, classification of plants. Pair with your friend and discuss. 3 minutes are enough. Discuss in pairs the important points when teaching the topic classification of plants(learners discussed in pairs possible answers about the facts to look for when teaching classification of plants.The lecturer went round, gave clarification to the task to one group at a time).

Lecturer 2: groups to give what you have discussed.Share with the class your findings. Let's share what we have discussed. Just one, we will look at similarities , differences. Yes , Florence's group and Esther, I have mentioned one.

Learner 16: similarities and differences where plants found methods to be used. Resources availability.

Lecturer 2: (knew most of learners by name. Explained and expanded the learners responses. She also added / edited/deleted some responses from the learners' answers. She explained concepts while writing on the chalkboard as learners were responding to the questions, listening and observing).Again, types of plants okay. Okay group, plants leaves. Yes , Mr. Lemani's group.

Learner 19: Resources availability

Lecturer 2: Okay. Thanks very much. Let's hear from Mwatiwa's group

Learner 20: types of plants, some are poisonous , some are not

Lecturer 2: Yes, types of plants some are poisonous , some are not. Last group?

Learner 21: The methods used

Lecturer 2: The methods to be used. Okay, do we have any other points to be considered?

Learner 22: Ability of class

Lecturer 2: Ability of class, eeeh right. As teachers we always need to take care of these points here but some are not relevant. Your book, teachers guide will direct you on what to focus on. At your preparatory stage you need on, what will be the materials to be used. After that methods, this being classification of plants needs hands on methods. As a teacher, you need to focus on: materials to be raised, methods to be used. What are some of the methods to use as a teacher in this topic? Madam Mwandama!

Learner 23: Jigsaw, okay, methods.

Lecturer 2: Yes Sir

Learner 24: Experimenting

Lecturer 2: eeeh experimentation. It's not necessarily a skill but method. Yes , Sir.

Learner 25: Field trip.

Lecturer 2: The best can be excursion trip. Yes but it's an excursion, you take your learners to the field. The best so far as you take your kids outside and make them see and learn. Another method that could be used?

Learner 26: A sage goes together with a project

Lecturer 2: Project. As teachers these are some of the methods to use and these will instill knowledge and skills in learners. What have we covered today? Just put your pen on the middle. I will pick it and you will say what you have learnt today. Yes , whose pen is this?

Learner 27: explained what was learnt in the day.

Lecturer 2: Yes , thank you Sir. Yes, what have you learnt?

Learner 28: There are some plants which are flowering and some are not.

Lecturer 2: Good. Yes, Sir.

Learner 29: explained what was learnt in the day

Lecturer 2: Thank you very much . Eeeeh, this marks the end of our discussion today and our next lesson will focus on photosynthesis and possibly explore how the food making process is all about in plants.

This is the end of the lesson.

Time :11:00 am.

12th February,

2019

Lecturer 2: lesson 2

Subject: Science and Technology

Time: 11.00 – 12.00

Topic: teaching animals and their environment

Teaching, learning and assessment resources: word cards with animal names

Classroom setting: learners in groups facing each other, 5-6 members per group

Class size: 28

Lecturer 2: (entered class and started distributing pieces of papers to all learners). Write any animals that you know about on the piece of paper that I have given you. (Learners quickly wrote the names of the animals on the pieces of papers as instructed by the lecturer). Please, paste your answers on the chalk board.

Learners: quickly wrote the answers and pasted them on the chalkboard as demanded by the teacher.

Lecturer 2: (wrote the day's topic on the chalkboard). Can two learners come in front to cluster the animals into groups the way they want? (two learners volunteered and went to the front of the class). You can consult your classmates if you wish to do so. Please class assist your colleagues in clustering the animals.

Learners: two volunteer learners were doing the clustering activity, consulted their colleagues about how the clustering could be done.

Lecturer 2: The animals written on the cards be clustered or categorized into three. (After clustering the animals the lecturer told the class to clap hands for their two colleagues).

Learners: clap! Clap!

Lecturer 2: How or what criteria was used to cluster the animals?

Learners: told the lecturer that it was vertebrates and invertebrates animals.

Lecturer 2: (introduced the day's lesson). Can you think of the meaning of metamorphosis?

What is metamorphosis? (Later after two minutes)- can you pair with a colleague? Share with a your partner what you think.

Learners: shared their ideas in pairs, later reported to class about their discussions.

Lecturer 2: (explained the meaning of metamorphosis). Can you state types of metamorphosis?

Learners: (raised hands up, and lecturer pointed at one learner for a response). Types of metamorphosis.....

Lecturer 2: (She explained the term metamorphosis after the learners answers – clarified the concept). What are some of the challenges learners will face when you are teaching them the concepts under animals? Can you go into your groups?

Learners: quickly and quietly went into their home groups

Lecturer 2: (distributed chart papers and pentel pens to groups. Gave learners tasks to do in their respective groups). Groups 1-3, you will discuss the question- 'what challenges do learners face when learning about metamorphosis?', and groups 4-5 you will look at the question- 'what are the survival mechanisms of animals?'

Learners: discussed the assigned tasks in their respective groups while lecturer moved around to assess the learners discussion. (Classroom had other teaching, learning and assessment resources which were not used during the lesson, for example, hanging charts, dead animals, e.g frogs, snail, birds, mice. In other words, real dead animals were seen in the laboratory where learners learnt from. However, they were few at least one from each category).

Lecturer 2: it's time, please stop whatever you are doing. Paste or hang your work on the chalk board. Can group leaders make presentations about your work?.

Learners: group leaders hung the chart papers and presented their work one by one.

Lecturer 2: explained to class the learners' answers- consolidation. Later she invited questions from learners but none asked him.

Learners: were listening, some were writing. One learner asked the lecturer to clarify a certain point.

Note: at times lecturer asked learners to attempt answering/responding to a question

Learner: asked the lecturer why inadequate time was considered a challenge when teaching about metamorphosis.

Lecturer 2: You need to know about the challenges when teaching the concepts about animals so that your planning to teach should be effective. How can you assess your

learners in large classes? (Learners raised hands up, lecturer pointed at some learners for answers).

Learners: (Gave answers to the question). One learner told the class that an example given by a certain learner was incorrect and irrelevant.

Lecturer 2: Primary school learners could be assessed during a lesson through..... Now I want each one of you to develop assessment tools/items. The items could be used either during a lesson or after the lesson. Please, do the task at your own time.

Lecturer 2: what did you learn in today's lesson?

Learners: Responded to the question.

Lecturer 2: This marks the end of the lesson.

20th February, 2019

Lecturer 2: lesson 3

Topic: teaching of state of matter.

Time: 11:00- 12.00

Number of learners: 25

Lecturer 2: So just to set us as a reminder, what is matter? What is matter? So what is matter?

Learner 1: is anything that has mass and occupies space

Lecturer 2: Eeeeh, so matter is anything that has mass and occupies space . Okay. There are two aspects, having mass and occupying space. If a particular thing has mass and at the same time occupies space that qualifies to be matter. Just think of any any any two examples of matter. Am giving you five seconds, two examples of matter, two examples of Just think of two examples of matter (learners raised hands up. Lecturer pointed at learners one at a time for a response).

Lecturer 2: Yes Mr. eeeehMphaso.

Learner 2: volume

Lecturer 2: Matter, an example of matter according to Mr. Mphaso is volume, eeeh kkkkkk, nooo, it's not .it's and that thing which occupies space and is related to mass. What is another word for mass? Yes Sir (Lecturer pointed at another learner).

Learner 3: Stones

Lecturer 2: I said two

Learner 3: Stone eeeh stones, water.

Lecturer 2: Yes eeeh so water and stones. Yes Madam (Pointed at another learner)

Learner 4: Human being

Lecturer 2: Someone said about human beings. Yes Mr. Mphaso , thus the examples of matter; stones, human beings, alright? Anything that you can think of is matter. Yes (Lecturer wanted learner 2 to give answer after failing to give a correct one at the first attempt. Learner 2 did not say anything) .is still thinking, yes is still thinking. Yes Mr. Mwatiwa (Lecturer pointed at another learner).

Learner 5: Soil

Lecturer 2: Yes it should be soil. What else? I thought five seconds was enough, I say think of two , two examples of matter. Okay, think!

Learner 5: Chair

Lecturer 2: Yes a chair, right , what else? We have a chair, what else do we have?

Learner 6: Oxygen

Lecturer 2: Oxygen, alright. Thanks so much, so those are examples of matter. Eeeeh am sure these are things in relation to eeem some similarities which they have eeeem, eeem, we are in groups, alright?

Learners: Yes madam.

Lecturer 2: (wrote carbon dioxide (CO₂), soot, steam, smoke, ice). Yaaaah, let us discuss whether these things ,they are related in one way or another, group these items. Let us group these elements in groups in, in, in, groups where they can fit and can be sharing some attributes. Right, we have got carbon, smoke, soot, tin , ice, ice blocks, okay. Group them into attributes which are similar, okay. Let us be in groups to group these items

Learners: went into group discussions. They were putting:carbon, smoke, soot, tin , ice, ice blocks according to their similar attributes (lecturer moved around to check the quality of discussions).

Lecturer 2: Eeeem, I hope you are done with your discussions (Learners said yes. Lecturer asked each group to report their findings. Some learners reported on behalf of their groups). Eeeeh, is it true that there are some groups, according to what features which are relatively eeem related to each other? These things brings us to the state of matter. From what we have discussed, let's give three states of matter. What are the three states of matter? They are already there am sure (some learners raised hands up).

Lecturer 2: Yes Madam, Mangani.

Learner 4: Solids

Lecturer 2: We have solids, okay, we have solids. Yes , Madam Kandaya

Learner 5: Liquids

Lecturer 2: Liquids. And lastly, yes , yes Mr. Billiat

Learner 6: Gases

Lecturer 2: Gases. Okay, eeemmm, this is what I was speaking and we always teach in primary school about matter. And if you look at the three states of matter, matter is visible and some are invisible. Isn't it?

Learners: Yes

Lecturer 2: And to those that are invisible might be seen as are not existing , alright?

Learners: Yes!

Lecturer 2: And are also used in class by learners and whatever they learn have examples from within their environment. What do you think are the reasons for teaching these three states of matter in primary schools? Or why do we teach our learners these topics? Eeeem

, I think we are in twos, let's share , why do we teach these topics in primary schools?. I think we are in twos, let us share our views. I think 5 minutes is enough (learners in pairs discussed the possible reasons for teaching matter in primary schools).

Lecturer 2: I hope you are almost done?

Learners: Yes

Lecturer 2: Alright, thank you very much. Eeeemm, I think you are done with the discussion Learners: Yes

Lecturer 2: Let's have....Okay, let's have our first team to report.(Then pointed at a group for the presentation). Yes!

Learner 7: Primary School learners will develop an understanding of how things are made up of

Help learners know functions of matter.

Help learners differentiate things in life.

Lecturer 2: Okay, develop an understanding of how things are made up of. Okay. Thank you very much. Mr. Mphaso's group must be prepared. Let us have the group at the back to report

Learner 8: carbon dioxide , which shall make gas, soot and steam, fog , ice falls under solids

Lecturer 2:Into two groups, again , okay, okay, carbon dioxide , which shall make gas, soot and steam, fog , ice falls under solids. Okay. The group at the middle, can you report?

Learner 9: Carbon dioxide –gas, smoke- gas. Liquid we have ice and soot.

Lecturer 2: Alright. Carbon dioxide, eeh carbon dioxide, gas. Okay, smoke, gas. Liquid we have ice and soot. Alright. Alright, right. Ice cream, right , right. Yes let's hear from the first group.

Learner 10:Carbon dioxide, steam are under gas. Soot, ice and smoke are under solids.

Lecturer 2: Carbon dioxide, steam are under gas, alright eeh, under gas. Soot, ice and smoke are under solids. Eeeem , you may appreciate that we have different categories of these materials depending on what features they are connected with . As teachers we are now always having this in mind that something must be gas, something must be solids, and something must be what? Liquids. What do we call all this something? Thus state of matter.

Learner 11: Teaching of states of matter helps learners to know how to separate mixtures

Helps learners appreciate the building block of nature.

Understand the change the way we live in.

Lecturer 2: The teaching of state of matter, changes of states of matter or property of matter.

This eem, it helps learners to know how to separate what?..... Mixtures. Thank you very much. Mr. Kazembe's group, how best can learners understand the environment? Mr. Lemani's pair.

Learner 12: Know the functions of state of matter eeh. Maybe they can group things in life. Eeh acquire skills and knowledge on how things are made.

Lecturer 2: In addition to what we have here we also have the environment, it helps us to appreciate the objects of nature. Thus everything we see is made of nature, right. It also helps learners to understand the change where they live. Things change because of different eem things. We also appreciate how things are made in the wilderness. We said a number of items such as misconceptions which learners or pupils have. So as a teacher we should try to correct such misconceptions. What are some misconceptions about matter in pupils? (learners raised hands. Lecturer pointed at one learner for a response).

Learner 13: Particles of solids have no motion

Lecturer 2: Particles of solids have no motion. But then what is the truth about this misconception.? Another misconception is on particles in solids, liquids, and gas. Gas has no mass, what is the truth now because this is a misconception?

Learner 14: Yes, anything.

Lecturer 2: Another misconception? Yes, Mr. Lemani.

Learner 12: I think.... steam is a hot air

Lecturer 2: Is a thought but what is the truth? Mrs. Chimbalanga! What is the truth? This is a misconception?

Learner 15: Kkkkkk Yes, I thought is still thinking it over.

Lecturer 2: Aaaah , steam is a gas, is it a misconception? What is the real thing? What is the fact now?

Learner 15: Steam is a liquid

Lecturer 2: Come again.

Learner 15: Eeeeh. Steam is a gas

Lecturer 2: Is it a solid? Is it liquid? One answer.

Learner 15: it is eeeh, gas.

Lecturer 2: So this is a misconception? The truth is steam is a liquid, that's the truth of matter. And also the misconception that smoke is air or gas. This is one of the misconceptions, what is the truth of the matter? (some learners raised their hands up.

Lecturer pointed at one learner for an answer). Yes!

Learner 16: It is a gas

Lecturer 2: Eeeeh, right.is it gas, liquid, or solid? One answer please

Learner 17: Smoke is solid

Lecturer : Smoke is solid, right. As smoke rises can lead to the collection of sooth .the truth is smoke is a solid not a gas. Air expands, what is the truth?

Learners: True

Lecturer 2: Right. Let us now quickly look at properties of matter. Yes, sir (Lecturer pointed at a male learner)

Learner 18: Eeeeh, between air and gas which is a matter? But air, which is one of the state of matter ?

Lecturer 2: We have three states of matter. Gas includes air, and this air includes oxygen, carbon dioxide , hydrogen etc the list continues. Air is one of the example of gas. Get that point. Okay we are in three groups, can you discuss properties of matter?I want us to look at the properties of the state of matter. In three groups, let us look at the properties of matter. I want us to eeeem look at these eeem properties.

Lecturer 2: Okay, try to find the properties in each category which is liquid, solid or gas, then focus on shape, okay and volume and also on density and also focus on compressibility again and also look at expansion. Okay so since we are in three groups eeeem, the group at the back, group 3, you will pick solids in terms of shape, volume, eeeem density, compressibility and also look at thermo expansion. Okay, the middle group, group 2, you will look at liquid, right. Then the other group, group 1, you will take gas, and you focus on those five areas. (lecturer distributed chart papers and pental pens to groups through group leaders). Some markers are not writing well so use a good marker. Am giving you ten minutes . 10 minutes is enough so I will be time conscious that ten minutes is enough. (Learners went into group discussions. Lecturer moved around to monitor learners' work.)

Lecturer 2:You are done, done (one group: Yes). Aaaah – okay, just paste it somewhere. You can paste it here no problem (group 3 had finished their task. They pasted it on a wall as instructed by their lecturer). Just a minute to go.If you are done paste it here (Groups 1

and 2 also pasted their work). Thank you very much, those are the results of the properties of matter, solids, liquids or gas. Let us have one one one point from this group. Let us hear from our friends in terms of solids.

Learner 19: presented on behalf of group 3 about properties of solids

Lecturer 2: Right.Eeeem, eeem, eeem, thus group number 3 on solids, right. Solids have indefinite shape and have no volume? What do you mean?

Learner 19: Solids have definite shape and have volume

Lecturer 2: So it has. Solids have a fixed volume. Can you make the correction? What about group number 2?

Learner 20: solids have high densities, they can be compressed, they expand.

Lecturer 2: Okay, thank you very much. You looked on solids in terms of density. Solids have the highest density among the 3 states of matter in terms of compression. It can be compressed, no it can not be compressed. Just add not there. On expansion it has low expansion rate when the temperature is raised. Clap hands for your friends (Learners clapped hands as reinforcement). Let's go to the next group on liquids.

Learner 21: Group 2 secretary made a presentation about liquids

Lecturer 2: Any other comment, from the group or class? Any other issue on complexity, okay, right.Its okay what about on volume?

Learner 21: fixed volume

Lecturer 2: Okay, so liquids have fixed volume, about weight eeeeh.

Learner 21: High density, slightly compressed

Lecturer 2: Density , it is high, compressibility is slightly compressed. Let's come to our last group on gas.

Learner 22: No shape, has volume, low density, compressible

Lecturer 2: Okay, alright. Gas has no shape. It has volume, and has low density, and compressibility. Eeeeh, right , any contributions? It has no shape correct, it has volume, what do you say? It has volume? Just add no. As for density, it has the lowest density and it has the highest rate of expansion. Let's give them ntchetché kind of reinforcement (Learners did as requested by the lecturer). Is that the ntchetché? (Learners perform the reinforcement activity)

Lecturer 2: Yes, so far this is what we have discussed. Anything from the class? So far this is what we have discussed. What have you learnt?

Learner 23: We have looked at why we teach this topic in primary schools.

Lecturer 2: Yes, you have been so quite today, say something.

Lecturer 23: Okay, 3 states of matter.

Lecturer 2: Yes, Mr. Mpaso.

Learner 24: We have done misconceptions about the 3 states of matter.

Lecturer 2: This marks the end of our lesson today.

January, 2019

Lecturer 3: lesson 1

CLASS

Topic: Teaching of plants and their environment.

Time: 11:00 -12.00

Number of learners: 24

Lecturer 3: Good morning ladies and gentlemen

Learners: good morning madam

Lecturer 3: How are you?

Learners: we are fine. How are you madam?

Lecturer 3: Okay, am fine. It's time for Science and Technology . Okay, could you please stand up and make a circle? Stand up, hold hands with your friend (learners stood up, held hands with each other and formed a circle).

Lecturer 3: Okay, you can now leave the hands of your friends. We were learning about resources and I want one to tell me what you understand by the nature table? What do you understand by nature table? We are going to use this ball (lecturer picked ball from her desk and showed it to learners), if you have it , it means you are going to answer the question (learners looked at the ball and said okay in response to the lecturer's instructions. Lecturer threw the ball to a learner and the one who caught it had to respond).

Learner 1: it is used to store the specimen.

Lecturer 3: Okay, so what? Are you finished, which is used to store the specimen? Okay it's a good try. Thank you; can you throw the ball to someone who can help you? (Learner threw the ball to another learner)

Learner 2: Which are from the environment..... natural things.

Lecturer 3: is that true that a nature table is where we store natural things? Can you throw the ball to that one? Is it true, what can you improve on that one?

Learner 3: it is a space in a science corner where we display objects, specimen from the environment

Lecturer 3: Yes, it 's true, anyone with a different answer?

Learner 4: it is a space in a science corner where..... (learner 4 spoke while seated). Lecturer 3: Can you raise your hand?-lecturer encouraging learners to contribute to classroom discussions. He said it is a space in a science corner where we..... I want that last part.

Learner 4: We display objects, specimen.

Lecturer 3: Can you just mention two resources which are displayed on the nature table?

Two resources!

Learner 5: leaves, samples of dried fish

Lecturer 3: Thank you very much. So this is about yesterday's lesson. Can you please go back to your places? I have these things in my hands, what are these things? ((lecturer had samples of plants in her hands- had shown them to learners. Classroom environment- lecturer brought real objects to class for learning)).

Learners: Parts of different plants.

Lecturer 3: Parts of different plants. Parts of different plants. In short they are plants which you can display on the nature table. Today , we are we want to learn more about plants and their environment or plants which are found in the environment. So these are plants, found in the environment (Showed learners parts of plants and said these are plants). So I have some questions to ask. When I clap hands once move around and mix and when I clap hands twice you have to stop and find a partner and listen to the question and discuss the answer to that question, after that we will listen to the discussions. We have enough space here- lecturer prepared instructional material. (Lecturer clapped hands once, learners started moving around mingling with friends. After a few seconds she clapped hands twice, learners stopped moving and formed pairs. Lecturer asked a question). What are plants? What are plants? (learners discussed the question). Please give your answers as pairs.

Lecturer 3: Okay stop! Time is over. Yes, can you give us your discussion? What have you discussed about plants? (lecturer controlled time and class discussions).

Learner 6: They are living things in an environment

Lecturer 3: They are living things in an environment. Yes, anyone with an addition to that?

Learner 7: they are living things and are also vegetation found in the environment.

Lecturer 3: Oh you are saying , they are living things and are also vegetation found in the environment. Yes, any addition?

Learner 8: And they also make their own food

Lecturer 3: And they also make their own food, good thus through the process called photosynthesis. So we are saying plants are living organisms, living organisms that produce, vegetative and reproductive plants, reproductive plants. So these are plants – lecturer consolidated learners presentations. Clapped hands again, move! (Learners moved again so that they could form new pairs once the lecturer clapped hands twice.)

Lecturer 3: (Clapped hands twice, asked another question) Please no noise. Yes, where can we find these plants? Discuss with your partner (learners stopped moving, formed new pairs and started discussing the question).

Lecturer 3: (Clapped hands). Time is over. Can you tell us where we can find plants?

Learner 9: We can find these plants on the ground, land, water, on rocks.

Lecturer 3: Is there any addition to that?

Learner 10: We can find these plants on other plants.

Lecturer 3: Any other idea? Another one!- lecturer encouraged learners to think about alternative answers in addition to what was discussed in the pairs.

Learner 11: Yes, in biology laboratory as specimen.

Lecturer 3: So you should make sure that our laboratory should have them. Yes.

Learner 12; In churches as decorations.

Lecturer 3: Yes! (Pointed at another learner)

Learner 13: On the walls.

Lecturer 3: So we can find plants on land, or on other plants, rocks, stones, ground. So let's move on. You are not coming here why?

Learners: said something

Lecturer 3: (Clapped hands twice). Discuss with your friend the properties and characteristics of these plants. What are the characteristics of these plants?- learners encouraged to share ideas and learn from each other

(Pair discussions amongst the learners. Lecturer clapped hands again- Clap, clap). It's time up; we now want to hear from you, the characteristics of plants. Yes, this pair!

Learner 14: They are green in colour.

Lecturer 3: Yes (pointing at another learner).

Learner 14: They make their own food.

Lecturer 3: Yes.

Learner 15: Provide oxygen to other plants

Lecturer 3: any pair to add on? (Some learners raise hands up. Lecturer pointed at one learner. Lecturer used QPN although learners were in pairs). Yes.

Learner 16: Are for respiration.

Lecturer 3: Yes, what can you say?

Learner 17: They can move. Their parts can move towards the direction of light.

Lecturer 3: Yes.

Learner 18: They can produce.

Lecturer 3: Good, eeeeh, yes.

Learner 19: They can feed.

Lecturer 3: Yes another pair!

Learner 20: They can change their direction.

Lecturer 3: Yes.

Learner 21: They can breathe.

(Learners shared answers to the class before the next question was asked. They also gave answers for properties of plants. Lecturer had lesson notes where she was reading from. She used hand clapping as re-inforcement).

Lecturer 3: Yes they are living things. They can change direction. These are the properties and characteristics of plants. Can you clap hands once for yourselves? (Learners clapped hands). Aaaah let's go and sit down (pairs disbanded. Learners went back to their seats and sat down). Now we are about to go to the world and teach. Not so? (Learners said yes-chorus answer). So it means we can meet this topic. We can teach this topic. The thing in your mind is what I am going to teach. Is it, not so? Yes, there is scientific knowledge. It

means you need to impart knowledge to learners. What do you understand when we say scientific knowledge? What do you understand? Can you tell us?

Learner 22: (Learners thought of the answers individually). A new knowledge.

Lecturer 3: What knowledge if you say it's new knowledge? It's not clear here? Someone!

Learner 23: Awareness of the living and non-living organisms, in the environment.

Lecturer 3: Anyone with a different idea?

Learner 24: Is knowledge, a concept or idea of science?

Lecturer 3: thus scientific knowledge, which means you are going to teach learners knowledge or ideas about science. What are skills? Someone!

Learner 25: Are processes that you acquire, that you carried out to tell the learners about scientific knowledge or ideas about science.

Lecturer 3: Can you give me an example of skills? You said skills are? Anyone?

Learner 26: This one said kicking the ball.

Lecturer 3: Is that a skill? This is an activity. What skills can you get if you kick a ball?
(Hands raised. Lecturer pointed at a learner). Yes.

Learner 27: The skill of targeting

Lecturer 3: Maybe, can you give us some? Someone!

Learner 27: the skill of scoring. When you throw a ball, throwing is a skill. Yes scoring is a skill.

Lecturer 3: Aaaah, that one is not a skill (learner mentioned a wrong answer)- lecturer corrected learners response. Could have asked fellow learners' opinion first. Throwing is not a skill. What do you do when someone is throwing a ball? Yes. When someone is throwing we observe now you have remembered can you give me another skill?

Learner 28: A skill of experimenting not experimentation

Lecturer 3: can someone give us the last one? I want to go to another question. Yes skill of what?

Learner 29: Yes, creation, creativity

Lecturer 3: ooooh no the skill of creating? Aaaah unati creativity (did you say creativity?). Okay thus about skills. What about attitude? What are they? Attitude and values. What is an attitude? What is the difference between skill and attitude? What are attitudes?

Learner 29: The way you feel towards something. Maybe in an activity. The way we feel towards something. Maybe in an activity how would you feel towards the activity? Thus the attitude.

Lecturer 3: Can you give me one example of an attitude?

Learner 29: What , honesty, to be honesty.

Lecturer 3: Yes it is an attitude. Another attitude?

Learner 30: Open mindedness.

Lecturer 3: Yes, that is an attitude, attitudes are different from skills. When we are going to teach we have to prepare other things, that is the success criteria. What do you understand is it a new thing. Yes what is it? Success criteria is a term , what is it?

Learner 31: What learners are supposed to achieve by the end of the lesson. Points for learners to achieve.

Lecturer 3: So you are going to teach, and will use these things. So when you are going to teach you will use these things in the lesson for example a scientific knowledge and they will develop skills, attitudes and values and you will be using scientific knowledge. Now I want you to know what we are going to teach or what we are teaching in primary schools. Is it good to know? Why?

Learner 32: To have knowledge.

Lecturer 3: Yes..... Now we want to identify topics about plants, they have started from standard 5 – 8. After identifying the topic, identify the skills, attitudes and values and also the success criteria. You are going to write this information in a diagram on a chart paper and the diagram should look like this (lecturer drew sample table for learners to follow- learners observed as lecturer drew diagram on chalk board).

TOPIC	CONCEPT	SKILLS	ATTITUDES AND VALUE	SUCCESS CRITERIA

Lecturer 3: So you are going to have a diagram like this, that is for each class from standard 5 – 8. That is knowledge, scientific knowledge, skills and attitudes and values. Group leaders come in front and get the books and A4 papers for your answers (She distributed primary school learners books to learners as reference materials). I am giving you 10 minutes. Please do it fast. You have to write on the papers (group leaders went to the front to get primary school learners' books and teachers' guides for standards 5-8. Groups started doing the activity as instructed by the lecturer. The lecturer went round the classroom, clarified the task to the learners and went back to her table).

Lecturer 3: If in one class there are 4 topics you have to write all of them (lecturer moved from one group to another once again to check work progress later after 5 minutes announced remaining time). We have about 5 minutes. Some of you have not finished yet. I have added 5 minutes more (that meant total time for the activity was 15 minutes). Do not worry about time, we are late by 10 minutes, I will add another 10 minutes (the class started 10 minutes late. The lecturer assured learners that she would end the lesson 10 minutes after the normal time). You have 4 minutes to finish . eeeehh ana inu kkkk (eeehh you children! kkkkkk).

Lecturer 3: Okay, time up, stop writing. Put your paper on the table. Leave your papers with answers on the working station. Leave the paper here. We are going to look at what our friends were discussing. Can you stand and move? If there is a question you will just put a question mark. This group, you will move there, this there and that there. Each group should visit all the working stations until you come back to your own working station.

(Learners started moving from one station to another and checking the work done by their friends. After a few minutes, the lecturer clapped hands- clap, clap: she then gave an instruction to the learners). Move. Hey, this group must go there and this group there (learners moved to different work stations where they observed their colleagues' work, listened to the presenter, asked questions, brainstormed some points/ideas).

Lecturer 3: Okay, time up, we should go back to our places; go back to your places. Please do it quickly (groups disbanded. Learners went back to their seats). Aaaaah, you have seen what your friends have written and your work. Any differences in the work?

Learners: not really (chorus answer)

Lecturer 3: So you have written the same and you have seen now you know what you are going to do in primary schools, especially what you are going to teach on plants only, it's on plants only. You are going to teach those topics and the learners should have that scientific knowledge, develop those skills and attitudes and values and those are the scientific knowledge you are going to use. Thank you for listening. Now I want someone to tell me the only interesting part he or she learnt today –assessment of learning (learners raised hands up). Yes (pointing at some learners).

Learner 33: Characteristics of plants.

Lecturer 3: Was interested on what, characteristics of plants. Another one. Yes tangondiuza ineyo (just tell me).

Learner 34: Places, we can find plants.

Lecturer 3: The last one. I want a volunteer please. Yes (pointing at one learner).

Learner 35: Topics we can use when teaching plants.

Lecturer 3: Thank you. Tomorrow we are going to continue with classifying of plants.

Leaders bring the books to the front and the rest you can go.

Note: Sample plants were shown to learners as something which could be put on a nature table. She used learners answers to clarify or expand on something.

5th February, 2019

Lecturer 3: lesson 2

Number of learners: 20

Time: 11.00 -12.00

Topic: teaching of plants and their environment

Teaching, learning and assessment resources: rulers, primary school learners' books and teacher's guides for standard 5-8

Classroom environment: free environment, learners could ask questions at any time, interrupt teaching

Lecturer 3: explained about previous topic. Where can you get materials for making teaching, learning and assessment resources?

Learners: from the local environment, we can buy from shops

Lecturer 3: introduced new topic - teaching of plants and their environment. What challenges and misconceptions do learners have as they learn about plants and their environment? Think about the answers to this question individually. Later share with a partner.

Learners: Discussed in pairs after thinking about the possible answers.

Lecturer 3: explain some of the misconceptions;

Learner 1: plants get their food from the soil through roots, seeds are produced in factories

Lecturer 3: Repeated the learners' responses. You need to remove these misconceptions in your learners.

Learner 2: stopped lecturer and called for clarification on the statement, 'plants get their food from the soil'. The learner said that he felt it was not a misconception because the soil contains water.

Lecturer 3: who can explain and clarify his thinking/question? The lecturer gave chance to fellow learners to explain the question

Learner 3: explained why it was a misconception

Lecturer 3: can you identify topics taught at primary school level under plants and their environment? Can you be in four groups? (Learners formed groups of 5-6 members).

Lecturer instructed groups to send a representative to collect standard 5-8 Science and Technology text books from him.

Lecturer 3: distributed to each group teachers' guides and learners' books for one class, chart papers. He announced 5 minutes for the activity. He then drew the table below as a guide;

Class	Topic

Learners: working in groups (one group had two members only yet the rest had five to six members. Lecturer did not intervene).

Lecturer 3: moved around to check learners' work

Learner s: interacted with content through reading text books, describing, etc.

Lecturer 3: asked learners to paste their chart papers on walls. Instructed learners that they would use gallery tour to check on their friends' work. Advised learners that each group go to their work stations first where there was their chart paper. (Each group was observed visiting each work station until they came back to their own work. The lecturer controlled the learners' movement from one group to another through hand clapping. The learners read, discussed and asked questions about their colleagues' work. The lecturer did not give enough time to learners to discuss their colleagues work. I,e, hand clapping was done

within a very short space of time). Now each group has visited each work station, can you go back to your places?

Lecturer 3: please, give your observations about your colleagues' work.

Learner 4: Can that group (pointing at group 2) clarify their work? I don't understand most of their points. (Group 2 secretary clarified the groups work)

Lecturer 3: what are your views about the clarification that has been made? Any further questions? (Learners discussed group 2 secretary's explanations and response. Later the lecturer came up with further explanations -an example of a democratic classroom).

Learners: at times they interrupted the lecturer during explanations/teaching. They could let the lecturer know that what she said was not correct.

Lecturer 3: some of her questions were leading questions; talked a lot than the learners. Can you identify scientific skills, knowledge, attitudes and values from the primary school Science and Technology text books? What is that learners can acquire after learning the topics?

Learners: were in groups of 5-6 members discussing the tasks

Lecturer 3: Drew a sample table below as a guide:

Knowledge	Skills	Values	Attitudes

Learners: listed facts from text books. Lecturer distributed chart papers to group leaders.

(As groups discussed the activity, lecturer moved around the class to monitor the activities).

Learners: read the text books, discussed it, analysed the text content

Lecturer 3: Advised learners to leave the chart papers on the table/working stations where they were working. Told learners to visit each working station to appreciate their colleagues' work. Guided the learners how they could move from one place to another by hands clapping.

Learners: groups moved from one work station to another after the lecturer's instruction. They stayed on a station for 2-3 minutes.

Lecturer 3: Go back to your places. If you have any comments or questions about your friends' work, you are free to do so now. When a question was asked, the lecturer gave chances to learners to answer the question or make a comment first before he picked it up.

Learners added, subtracted or edited their colleagues' work.

Lecturer 3: when teaching primary school learners try to ensure that they acquire the skills, knowledge, values and attitudes. Alright, what have you learnt today? (Learners raised hands up and explained what they had learnt in the day's lesson)

Lecturer 3: what topics can be taught to learners in primary schools under plants and their environment? What are some of the skills, primary school learners can learn under plants and the environment?

Lecturer 3: next time you will learn about..... this marks the end of the lesson

19/02/19

Lecturer 3: Lesson 3

Topic: Human skeletons

Time: 11.00 – 12.00

Number of learners: 18

Teaching and learning resources: Human skeleton model, primary school Science and Technology text books, learners books.

Classroom arrangement: linear, each group had 4-5 members

Lecturer 3: Good morning ladies and gentlemen

Learners: Good morning madam

Lecturer 3: How are you?

Learners: We are fine and how are you too?

Lecturer 3: Okay am also fine. Maybe some learners are not in. Members of this group where are they? (pointed at one side of the classroom where members of a certain group used to sit. This implied that the class was made up of permanent groups occupying permanent places). Hey!

Lecturer 3: Okay, last time we were exploring on animals and their environment. And we have investigated so many things for example reproduction of animals, their classifications, feeding of animals and survival for oh no mechanisms for their survival. Now, on survivals eeeh mechanism for their survival we have at least two to three things. One of them is protection. Do you remember that one? That animals, they protect themselves for survival. Now (a learner interrupted by knocking at the door for him to be allowed entry since he was late for class). Yes come in. (Later some learners were getting into the classroom as the lesson was progressing).

Lecturer 3: I want you to tell your friend the examples of protection measures animals take for their survival. What mechanism do animals use for protecting themselves for survival?Is it clear?

Learners: Yes

Lecturer 3: Now, have a friend , tell him, how animals protect themselves for survival. Share with your friend (learners in their pairs started discussing about protective means animals use).

Lecturer 3: Okay, I want to listen from different pairs. Can pairs share with the whole class?
Yes, what can you tell us? (lecturer pointed at a pair to share and she was asking follow up questions based on learners responses. She also explained learners' answers).

Learners: Reported to class one by one. Some of the answers were;

Learner 1: Changing the colours

Lecturer 3: Good. Can we hear from that pair? That one!

Learner 2: Camouflage

Lecturer 3: What? I mean that pair. Camouflage? Thus changing colour?

Yes, this pair

Learner 3: Slippery like the fish

Lecturer 3: Yes, Madam (Pointed at another pair).

Learner 4: hissing sound

Lecturer 3: What? Okay. What about this pair? Eeeeh

Learner 5: Biting ,eeeh. Producing sound making other animals to run away, examples like frogs

Lecturer 3: Okay, Madam. Speak louder

Learner 5: They run away.

Lecturer 3: They run away. Another one, eeeh. Okay, now I want to concentrate on one of your answers about animal protection i.e running away. Running away means what? In the other way we say what?

Learner 6: locomotion or movement

Lecturer 3: Yes, locomotion or movement to protect themselves. These animals, they move, what causes them to move?

Learner 7: Legs

Lecturer 3: What? They have what?

Learner 8: Bones

Lecturer 3: They have bones. The collection of bones is called what?

Learner 9: Skeleton.

Lecturer 3: But the board is dirty someone to clean it? In today's lesson we will discuss about human skeleton. We want to explore more about skeletons. Human skeleton. Now when we are talking of a skeleton. (She brought a model of human skeleton and displayed it to learners for them to see it). That one is a model of a human skeleton. So we want to investigate or explore more about that but I have a question and this is the first thing to do when we want to teach about human skeleton. Why do we teach the topic about human skeleton to learners? Why should human skeleton be taught to primary school learners? Why? Now, who wants to answer that question? Why do we teach about human skeleton?

Learners: looking on, listening and thinking about the answers

Lecturer 3: Today's lesson will answer my question, think of activities that will help you to answer the question please do it individually. In order to answer that we must think of activities that will help us to answer that question. What activities? Think of activities that will help us to answer that question. If you have an answer, raise a hand. Am saying why

do we teach that eehh concept of skill to learners? Now I want us to come up with activities to help us answer the question. What activities should you do? Is it clear?

Learner 10: Playing

Lecturer 3: Playing what?

Learner 10: Playing games.

Lecturer 3: Playing games on what? What kind of games are we going to play?

Learner 10: For body exercises

Lecturer 3: Okay. Eeeh another one.

Learner 11: Walking and jumping

Lecturer 3: Yes. Walking and jumping. We are talking of games. By doing games. Other activities can be what? Maybe I can say, eehh. Dancing is in the group of games, eehh.

Learner 12: Researching

Lecturer 3: Researching, on what?

Learner 12: Researching on what causes the movement.

Lecturer 3: Yes I agree with that but researching on what? Maybe you can research on prior knowledge of learners. Another thing?

Learner 13: exploring misconceptions and errors of learners about skeletons

Lecturer 3: Yes, exploring misconceptions and errors of learners about skeletons.

Learner 14: exploring challenges, challenges we face when teaching

Lecturer 3: Yaaah Mr. President, challenges, you are correct challenges we face when teaching. I think we can stop on that we have five answers and also five groups. We have also to explore what we are going to teach our learners. So we have what eeeeh.(Distributed activities to the groups. Each group was given a task to do as regards the activities mentioned by learners above. Each group had a different task to do). In your groups, in your groups, you are going to explore, investigate these things. Here you are using phone. Have you brought a phone? Which group has a phone? Please am giving you ten minutes. Is it enough? Magetsiathimaeheh!

Lecturer 3: You have something to say? you raised a hand.

Learner : Madam, can you clarify what is it we are supposed to do?

Lecturer 3: Do that work, investigate, here, what are we going to do?. Because there is no electricity, so we are going to use what?

Learners: Plan B.

Lecturer 3: use your plan B. What are we going to do we as teachers? You are exploring what you are going to teach. Mr. Magulula, what is the question? Do it. so you have to discuss (Lecture distributed primary school science text books for standard 5-8 and questions on papers to learners. Learners were doing the activities as lecturer moved around to check quality of learners' discussions, to assist those with problems, watching and listening to the learners discussions. Guided learners on how task should be done). Ten minutes, it is enough, not so? You were supposed to use a phone, no problem you are going to do it. In your groups choose one member who is going to present. Should we

please do it fast? Am giving two minutes to those groups, that group 2 minutes, that group, 2 minutes.

Lecturer 3: Okay , its time. Stop! Now what you are going to do is this. You should move once you hear a hand clap. You will be allowed to stay 3 minutes at a work station. You have chosen someone to stay on that group to present, so that one is going to explain what you have discussed to the visitors who are going to come there. So this group you will move,eeeh. Wait .this group you move to that group, that group to that group . Wait, am going to clap my hands once and you move , will give you 3 minutes, when I clap my hands twice you move to another group, like that until you come back to your original group. Okay, but the movement has to be the same (Clapped hands once, learners moved as instructed. After 3 minutes, lecturer clapped hands again, learners moved to another group so on and so forth).

Learners: moved clock wise to different groups work. They spent 3 minutes at each work station. One member of each group explained there work to visitors. (gallery tour though started as one stays three astray class activity).

Lecturer 3: Clap clap move. Magulula you are here?

Clap clap move

Clap clap move

Clap clap, can we move? Now we are in our original positions. (Learners moved from one work station to another. Upon reaching a work station, the one remaining gave an explanation to the visiting members. The visiting members were allowed to ask questions

for clarification, make additions or subtractions to the points raised by the previous groups. Lecturer encouraged learners learning from each other and peer assessment).

So, we have discussed, we have explored, we have investigated those activities and now we are able to answer that question. But I want you to answer that question in your groups. You can come up with many answers, I don't know how many answers, but write the answers down quickly.

Lecturer 3: In your home groups can you answer the question why it is important to teach primary school learners about the human skeleton? I give you 3 minutes to try to come up with the answer of the question. Why do we teach the concept of human skeleton in primary school? Now from what you have discussed can you answer? Write down the answers to that question. Now answer, you write the answers from that question in 3 minutes. Write the answers to that question in your groups. Why should we teach that concept? Write more answers, more answers.

Learners: Responded

Lecturer 3: Okay, time is over, eeheh, anyone can come, which group is ready. Stop! Stop! Can anybody come in front to sit on this chair to explain to the class what his or her group discussed? One should come here and tell us your answers. (The lecturer then asked some learners to go and occupy a seat one after another to share what they had learnt in the day. Using author's chair learners gave out answers). Which group is ready. Loveness' group.

Learner 15: To clear out misconceptions about human skeleton. (One learner while sitting on the chair read out his group's findings).

Lecturer 3: So you have 2 and it is good to teach this concept to learners? What should we do with you?

Learner 15: Give me a Mandela wave

Lecturer 3: Mandela wave! Good (learners performed the Mandela wave). Another group!

Learner 16: went forward and reported

Lecturer 3: It's the same. Can you read them? come again, eeeeh,

Learner 16: read the work again. That's all.

Lecturer 3: Let's just give them a hand (Learners clapped hands for the report). Any other group with different answers, any group with different answers now from the given ones? We want different answers from the given ones.

Learner 17: To let learners know what brings about movement in human beings.

Lecturer 3: Okay, what kind of reinforcement?

Learner 17: I want Jumbo

Lecturer 3: Jumbo to him please. Any group with a different answer?

Learner 18: To have good postures of their bodies. Is that good class?

Learners: Yes

Lecturer 3: Okay ,can we give him a hand as well. (Learners clapped hands as instructed by the lecturer). Okay , so today we have learnt why we have to teach this topic to learners and we had different answers. So tomorrow we are going to learn more about the skeleton, is it clear? (Learners: Yes!). Okay , this marks the end of aaah, no no. Anyone with a question please?

Learners: No

Lecturer 3: So this marks the end of the lesson , bye till tomorrow.

Lesson observation details for lecturer 4

14th

January, 2019

Lecturer 4: lesson 1

Topic: Plants and their Environment

Class size: 24 learners

Time: 11.00-12.00

Teaching and learning resources: chart papers, pental pens, primary school learners' books and teachers' guides

Numberof learners per group: 5-6

Classroomenvironment: linear sitting plan, all learners were facing the chalkboard where the lecturer was, adequate seats, old chart papers hanging on walls with textual or diagrammatic or pictorial information

Lecturer 4: (entred the classroom, wrote on the chalk board about the day's topic). Good morning everyone.

Learners: Good morning sir

Lecturer 4: Thank you, aaah, with us here we have visitors who would like to see how we interact during lessons delivery. So I ask you to be free, don't be ashamed, you should be in your normal situation.

Lecturer 4: Today's lesson is about plants and their environment. You might be aware of what plants are, what the environment is all about. I want you to get your pen, and a piece of paper. Write all what you know about plants and their environment. Write anything that you know about plants and the environment. I will give you 5 minutes (Learners quickly got their note books and pens, were busy individually writing about plants).

Lecturer4: (after 5 minutes)Right can you wind up? Right , can you stop writing? I will ask some to eeeh, read out what you have scribbled on that piece of paper. Anybody who is ready? (Some learners raised hands up. Lecturer asked some learners to share what they had written down. As learners were saying the points, the lecturer jotted each point on the chalk board). Yes Sir!

Learner 1: Plants do not move

Lecturer 4: Yes, is that all?

Learner 2: classification of plants ..

Lecturer 4: Yes.

Learner 3: Plants respire

Lecturer 4: Right, thank you very much (A female learner raised her hands up). Yes Madam

Eunice, what do you have? What have you written?

Learner 4: Eeeeh classification of plants.

Lecturer 4: Someone?

Learner 5: three parts of plants; roots, stem and leaves.

Lecturer 4: Yes, someone

Learner 6: Plants produce their own food

Lecturer 4: Yes, eeeem Mr. Mpasol

Learner 7: Identification of plants

Lecturer 4: The identification of plants. Yes Madam, what is it?

Learner 8: Plants use carbon dioxide for respiration

Lecturer 4: Anybody with a different idea from what has been raised. Yes, anybody? Those of us who have different ideas? (Pointed at a learner) Yes.

Learner 9: Plants do not move

Lecturer 4: Plants do not move. A different idea? Yes Eunice. What do you have?

Learner 10: Characteristics of plants

Lecturer 4: Characteristics of plants, what else can you say, something, can grow. Okay
.any different information, Yes Machaka?

Learner 11: importance of plants.

Lecturer 4: Yes , what do you have? You have a different idea, manures, medicine. Alright
any different concept that you can add. Yes

Learner 12: Conditions which could result into plants growth.

Lecturer 4: Can you give one ?

Learner 12: Yes, for plants to grow needs water.

Lecturer 4: Yes?

Learner 13: Life span of plants.

Lecturer 4: Yes can you say something? Yes, Magaletta, anything that you need to
add?Sorry, yes, lastly

Learner 14: Yes, the relationship between plants and the environment.

Lecturer 4: The relationship between plants and environment. So this is the information
which you have in relation to plants and the environment. So what we have listed here are
some of the things we need to discuss as we are learning the concepts of plants and
environment.

Lecturer 4: Now, eeeeh, one of the concepts here is that plants do not move, plants do not move. Now that concept will take us through to another activity about the misconceptions that learners have as they learn about plants and environment. Are you in groups?

Learners: No

Lecturer 4: So I will ask you to form groups or let us be in our usual groups (Learners quickly formed groups). So I will ask 2 members from each group to come forward to collect some materials (2 group representatives went to the lecturer's desk to collect teaching and learning resources). You are from which group? Yes, you are from which group?

Learners: 4

Lecturer 4: 4 its okay. (Distributed teaching and learning resources -two learners from each group went and collected a chart paper and a task written on a piece of paper- tasks were different from one another).So what do you have there? Can I have your attention please? There is information written there so that is one of the misconceptions that learners have. I want you to write down what learners say about that misconception. Thus one of the misconceptions. What is it that makes learners to have that misconception?Then come up with the correction to that misconception, how you can correct that misconception. Write something why learners take it that way and then write down the correct way to that misconception. Is that clear? Yaah, we will have 10 minutes. (Learners performed the activity)

Lecturer 4: Write, why learners have that misconception and thereafter write its correction
Eeeeh can you stop writing! What you have to do now is, we want to appreciate the work you have come up with as we have different concepts. So what we are going to do is, leave that chart there (at the work station). This group, go to that side, that group there, and you here (Lecturer instructed learners how they could move to other work stations).

Lectuer 4: So I will give you 2 minutes to read whatever is there (Learners moved to other groups to read and critique what had been written by the other groups. After 2 minutes, the lecturer instructed groups to move to another work station until they visited each station). Attention! Can we rotate? (Changing groups.Learners rotated- this is a modified bus stop activity though not clearly done).

Lecturer 4: Can we move to the next group! (Learners moved to the next group and eventually visited all groups. checking and reading their colleagues' work. They moved around to all work stations-read, discussed thier colleagues' work and asked questions for clarifications). Let's go back to where we belong. (Learners went back to their original/home groups).

Lecturer 4: Right, what are your observations based on the work that you have seen, what other groups came up with based on the concept that plants are not living things? Why do learners have that misconception that plants do not move? They do not talk, they do not feed, and they do not have senses? Thus what the learners have but now what corrections can be made? Right, from your own observation and the groups work, what can you say?

Can we share? (Learners raised hands up/ Lecturer pointed at some learners to respond).

Yes!

Learner 15: Plants do not talk. They do not feed.

Lecturer 4: Okay , plants do not have senses. Yes, Madalo!

Learner 16: gave her response to class

Lecturer 4: Right, what correction can we have that learners are going to the right direction?

What is your take now from what we have? What could you say? (Learners raised their hands up and lecturer pointed at one learner). Yes, Madalo.

Learner 16: Plants, they do feed but is that feeding different from the feeding we know.

What they know is when feeding we use hands so they think that plants do not feed.

Lecturer 4: plants feed through the roots. Why do learners think in that way?

Learners: fertilizers and manure are applied to the soil

Lecturer 4: Anything?

Learner 17: Plants can die, have it's own life span, they grow and can stay for a certain period and die.

Lecturer 4: Yes! (Pointing at another learner)

Learner 18:Plants can respond to stimuli

Lecturer 4: You can enlighten there, plants can respond to stimuli. Yes, good. Plants so if you are growing plants where there is shade, the plants will grow towards that light. We have that as something we talk about plants. Anything else? Let's go to the other misconception about plants that learners have that plants get their food from the soil through their roots. What makes them think that way? (Learners raised hands up. Lecturer pointed at a learner). Yes!

Learner 19: Yes, those manure, can be food, so learners associate the applying of fertilizer or manure, so learners associate it with food.

Lecturer 4: But what is the reality for applying manure or fertilizers, what is the role of manure or fertilizer?

Learner 19: to fasten growth of plants

Lecturer 4: Yes to fasten the growth. What is the general view now in relation to the plants and environment? What corrections are we getting now? The plants get their food through the process of photosynthesis. We need to stress that concept that plants manufactures their own food. The other misconception is that seeds are made in factories. Seeds are produced from the factory. Why do learners think so? Can you say something? What makes learners to have that misconception?

Learner 20: when they go into shops they find packs of seeds or bags of seeds. During planting season farmers get seeds from the shops.

Lecturer 4: Right, because when they go into shops they find packs of seeds or bags of seeds, so that knowledge comes to them that they are made in factories. What correction can we make?

Learner 21: They are made by plants themselves

Lecturer 4: They are made by plants themselves. The process of manufacturing their seeds is what ? how , the question is open to the whole group. Plants produce seeds. How do plants do it?

Learner 22: By pollination.

Lecturer 4: Yes, by pollination. (some learners raised their hands up. Lecturer pointed at one learner) Yes ,Partrick!

Learner 23: By fertilization.

Lecturer 4: These processes fertilization and pollination go together, first is fertilization then pollination. Yes thus through the fusion of the male and female gametes. Haaah, thus the good work we have come up with (to interact with the learners- explained or expanded on learners' answers). He emphasised to learners that they should try to remove misconceptions from learners in primary schools when teaching Science and Technology . The lecturer used learners' previous knowledge to explain concepts. There were no experiments, no demonstrations. Finally he commended the learners for the good work done).

Lecturer 4: Now, as we are there we want to have another activity. This activity will be done individually. What topics on plants and their environment, do learners learn under the topic plants and their environment from standard 5 – 8? Think of topics that learners learn from standards 5-8 that are related to plants and their environment. Come up with one or two. Then you are going to share with someone sitting next to you. Yes, let's do the exercise (learners doing the exercise individually-lecturer drew a table and instructed learners to tabulate their findings as shown below).

Standard	Topic
5	Relationships between plants
6	External parts of a plants
7	Pollination, fruits and seed dispersal

Lecturer 4: Right, eeem, can we share? (Learners formed pairs, then went into pair discussions). I guess you have shared (Learners said yes!). You have already shared?

Learners: Yes!

Lecturer 4: Right, fine. Yes , now can we hear from any three pairs? (Learners raised their hands up. Lecturer pointed at one learner). Yes!

Learner 24: Flowering and non-flowering plants

Lecturer 4: Yes this pair

Learner 25: Seed dispersal

Lecturer 4: Fine. Yes!

Learner 26: Seed germination.

Lecturer 4: Yes, that pair

Learner 27: Pollination.

Lecturer 4: Yes, another pair

Learner 28: The relationship between plants and the environment

Lecturer 4: Fine. Yes , Madam, what have you shared?

Learner 29: Pollination

Lecturer 4: Okay. A different topic now. Yes!

Learner 30: Parts of a plant.

Lecturer 4: So the next exercise is to analyse the teacher's guide and the text books, to find out from which class can those topics be taught, that is pollination, germination, seed dispersal , parts of a plant. We will do the same as we have done before. This time come and collect the teacher's guides and learners' books and identify from which topics these concepts are taught. One member from each group to come and collect the teacher's guide and learners' books. (Learners through group leaders went to the lecturer's desk to collect primary school Science and Technology teacher's guides and learner's books for standard 5-8. They started doing the activity. Lecturer went around the groups to monitor the progress of the discussions. Later lecturer asked the learners to report their work through their secretaries as the lecturer was writing the answers on the chart).

Lecturer 4: Eeeh, I want to give you What are the results? Group 4 tell us something, which class are you?

Learner 31: Standard 5

Lecturer 4: Which topic is that? Yes!

Learner 31: Classification of animals

Lecturer 4: Yes, but we are on classification of plants. Oh, you have made a mistake. What is it?

Learner 31: Sorry madam

Lecturer 4: Eeeem, yes group 3 just give us , tell us something.

Learner 32: External parts of plants

Lecturer 4: Right. Group 1 give us 2 points. Yes!

Learner 33: Flowering and non-flowering plants.

Lecturer 4: What is the second one?

Learner 34: Seed germination.

Lecturer 4: Right, the other group probably the last group. Yes say something apart from what is given here.

Learner 35: Pollination and

Lecturer 4: What?

Learner 35: Pollination , roots and seed dispersal

Lecturer 4: Okay. Give us the other one.

Learner 35: said something

Lecturer 4: What, at all it's already there. This is from standard 6. I want you to say what is in standard 6

Learner 35: explained something

Lecturer 4: So thus according to the teacher's guide, that is on the topic plants and environment as we have analyzed them ((as learners were reporting, lecturer was busy writing the answers on the chalk board. He told the class that the answers were according to lecturer's guide). Thanks a lot, go back to your places.

Lecturer 4: Right, can you go back to your places? Let us assume that you taught these topics in primary schools, what are the scientific skills which learners need to display after the lesson? What scientific skill will you need so that the learners will develop? What scientific skill will they develop? I need answers from each and every member. (Learners raised hands up). Yes!

Learner 36: Learners will acquire the skill of explanation.

Lecturer 4: Yes! (pointing at another learner)

Learner 37: Observation,

Lecturer 4: noo rephrase it. Yes!

Learner 37: Observing.

Lecturer 4: Yes what skill will learners need?

Learner 38: Hypothesizing

Lecturer 4: Yes!

Learner 39: Communication

Lecturer 4: Right. What else?

Learner 40: Inferring, or making informed guesses.

Lecturer 4: What other skills?

Learner 41: Evaluating

Lecturer 4: Thus drawing conclusion from what the learners have observed. Fine.

Learner 42: Yes! Identifying

Lecturer 4: thank you, can you go in your places. Okay. So as we teach eeeem learners these topics which they should acquired we should make sure.....So this department. This discussion takes us to the end of the lesson, plants and environment. When we meet next time we will concentrate on classification of plants that will be in our next lesson. Thank you very for your participation . I will need the books as you are going back to your class.

23rd January, 2019

Lecturer 4: Lesson 2

Subject: Science and Technology

Topic: Classification of plants

Time: 8:30- 9.30

Topic: Classification of plants

Class size: 24 learners

Classroom environment: chart papers hung on walls, learners seated in rows facing the chalkboard, democratic,

Lecturer 4: good morning class

Learners: good morning sir.

Lecturer 4: (Started rubbing the chalk board then asked a question): who can remind us on the previous lesson?(Learners raised hands up. Lecturer pointed at some learners to answer the question)

Learner 1: we learned about plants and their environment.

Lecturer 4: what were the issues?

Learner 2: we learned about misconceptions (The questioning continued and learners responded as expected).

Lecturer 4: Today, we are going to focus on classification of plants. Can you write anything that you would like to know, that you would like to learn?or what is that you want to learn from classification of plants? Give areas which you want to learn about.(Learners quickly wrote answers to the question. After 2 minutes, the lecturer went on talking).

Lecturer 4: right can we hear what you wrote?

Learners: characteristics of plants, meaning of classification, classification of plants, ways of classifying plants, importance of classifying plants.

Lecturer 4: you will learn what you have listed. Even the syllabus has more or less the same topics for you to learn. First, we are going to understand the meaning of classification. Can you define the term, “classification”?

Learners: Thing (a grouping) according to their behaviours.

Lecturer 4: Into how many groups can we classify plants? Individually think about the answer, then later you share with someone close to you and then your pair must share with the class. Write the names of the groups of plants on the chalk board as per your discussions. (Learners shared in pairs then with the whole class- Then, the lecturer wrote on the chalk board the topic: Classes of Plants).

Lecturer 4: when you finish then write names of groups of plants. Let’s hear how many groups? Learners: flowering plants and non-flowering plants.

Lecturer 4: Flowering plants are also known as angiosperms. Non-flowering plants are also called gymnosperms. These technical terms are for you college students. Don’t give them to primary school learners. We may further put the plants into four groups.

Learners: listening, taking down notes, asking questions for clarifications

Lecturer 4: What are these classes? He continues to mention them;

Plants with no proper root system

Plants with proper root system

Plants with proper root system with needle shaped leaves

Flowering plants (lecturer allowed learners to take notes)

Lecturer 4: I would like you to go into groups and come up with examples of plants to each of the four categories above. Can group leaders come forward to collect chart papers from my desk?

(Learners went into their permanent groups of 5-6 members each as instructed by the lecturer. Distributed materials from in front of the class and learners received them- worked on the task in their groups). Each group will do a task different from the rest. This group will do question 1, that group task 2, ...

Group one question- give examples of plants with proper root system

Group three question- give examples of plants with no proper root system

Group four question – discuss examples of flowering plants

Learners: group leaders collected chart papers from the lecturer but no samples of plants and their products were brought to class as teaching and learning resources

Lecturer 4: can we do that in 10 minutes time? each group must start working on their task. (He started going around giving clarification to the task and assisting learners as to come up with examples. While the learners were working, the lecturer went in front and took his

chart papers, preparing them ready for pasting. Then went around again, checking the progress, one group at a time).

Learners: each group appointed one person as a secretary. (Though the groups looked small some learners just observed and contributed nothing during the group discussions. They just sat idle. However, an argument arose amongst the learners; sorgam simapira ayi, ndimapira, mmmmm nanga kachewere- discussion was mostly in vernacular). Most learners actively participated in the discussions.

Lecturer 4: right, can we have a presenter and come forward?(Meaning a member from each group to make a presentation). Group 4 must start preparing their work.((groups were not yet ready with a presenter- when the lecturer asked groups to present their work, everybody were looking at one another. Learner from group 4 pasted their chart. Group secretaries one by one went to the front to present).

Learner 1: Examples of flowering plants are beans, potatoes, cotton, peas, buffalo beans

Lecturer 4: Do you have any observations from the presentation?

Learner 2: what are buffalo beans? Some learners tried to give answers in vernacular, e.g. kabaifa, kalongonda,

Lecturer 4: can group 4 members explain how buffalo beans can be identified?

Learner: its kabaifa.

Lecturer 4: group 4, what can we do for you?

Learners: you mean reinforcement?

Lecturer 4: yes!

Learners: Bakhabakha.

(Group 3 learners pasted their chart and gave examples of plants which have no proper root system).

Learner 3: sweat potatoes, cassava, carrots.

Learner4: Is it that any plant without tap root is a plant without proper root system?How can we know that a plant has no proper root system

Lecturer 4: can group three members put in their views?

Learner 5: i am also confused about the plants. I want to know about other plants like tubers.

Lecturer 4: gave an explanation to clarify the questions raised. Can anybody give more suggestions or additional information on the questions raised?

Learners: some learners gave more examples about plants

Lecturer 4: group 3 has displayed its work. Please check and identify a plant which has been wrongly placed

Learners: algae

Lecturer 4: yes algae and ferns. These two must be taken out. I will explain further on these two plants but for now I will remove them. What type of tree is a??

Lecturer 4: those listed are just similar to those of group 4. Therefore these examples are not correct. He further guided the learners about plants with no proper root system and asked them to come up with some examples.

Learner 4: Algae, mosses.

Lecturer 4: some names of trees are not found in Malawi. I feel there is need to explain their characteristics (both the lecturer and the learners tried to describe such trees).

Learner 5: what type of tree is?

Lecturer 4: what reinforcement would you like?

Learners: chimpanzee

Lecturer 4: group 2! (Learners pasted their chart paper and gave examples of plants);

Learner 6: needle shaped leaves eg palm, hedges, coconut.

Lecturer 4: what type of reinforcement would you like?

Learner 5: kutsogolo kwabwino, kumbuyo kwabwino. Wautali. (Reinforcement was done.

The exercise went on with other groups).

Lecturer 4: yes, looking to a presenter for a type of reinforcement.

Learner 6: Shuwa type of reinforcement.

Lecturer 4: can you clarify? clap hands for any questions from anybody?

Learners: asked questions and lecturer responded to them.

Lecturer 4: Look at the presentations again. Remove all the answers or information that you feel are irrelevant and incorrect. Which responses must be removed? You asked questions, I will answer them later after through research from the books. Where can we find namasupuni?

Learners: gave responses to the question

Lecturer 4: can you clap hands for.....?? (Hand clapping by learners).

Lecturer 4: what have we learnt today?

Learners: Flowering plants, Non-flowering plants, Further classes.

Lecturer 4: females, you need to contribute also (females had been silent for a long time during the lesson). okay, next time we shall look at further classification of flowering plants. We will use the flowers for further plant classification. Any questions?

Lecturer 4: Lesson 3

07/02/19

Number of learners: 20

Time: 7.30-8.30

Subject: Science and Technology

Topic: Classification of plants

Lecturer 4: (entered classroom. Wrote topic of the day's lesson on the chalk board). Okay, good morning class! (All learners stood up, and responded to the greeting)

Learners: Good morning sir

Lecturer 4: Okay, how are you?

Learners: We are fine, how are you too?

Lecturer 4: Ah, am alright. Please, sit down. Get your note book and pen. Right, ah I want you to get your exercise book and a pen. Get your exercise book and a pen. Yah be prepared. I want you to write any 6 things that if you go outside you will find them. Any six things. I want you quickly, write those things. Any sikisi (six) things that you can write that can be found outside. Do that in pairs.

Learners: (quickly wrote the things as asked by the lecturer. After 3 minutes....)

Lecturer 4: If you have finished writing can you raise up your hand (Learners raised hands up). Any six, can I check? (checking.....). okay, good, good, yes, any six things. Alright, can you exchange the list of the things? Each one of you should read aloud, aloud not around but once you get your list can you read aloud the list of things your friend that your friend has written? Read aloud your partner's work to a friend. Each learner read aloud to a friend.

Learners: took turns to read aloud what their friends had written.

Lecturer 4: Alright, I want a representative of any pair to come and use this chair to tell us what they have written, but before coming here, can you come up with a final list as a pair, come up with a final list as a pair. Come up with a final list of the things, come up with a

final list as a pair. Come up with a final list. Look at the list of a friend and then if you have one or two things in common write them as one. Write them as one and come up with a final list (Learners were busy discussing, comparing and merging points to come up with one list). Have you finished? Have you finished?

Learners; Yes, sir!

Lecturer 4: Can representatives come upfront to present to the class what you have written? I want any representative of the pair to come here (meaning the front) and sit on the chair. Alright, okay can you, which pair would like to come and tell us their consolidated list of things that can be found outside? Which pair can come? (Learners raised hands up!) Yes! (Learners did as advised. Pairs presented their findings to the class).

Note: No topic was indicated yet.

Learner 1: houses, cars, trees and grass.

Lecturer 4: (Wrote on the chalk board). Anything that you have written. (Learner 1 continued mentioning what he had written. Later lecturer instructed other learners to appraise their colleagues by clapping hands).

Learners: clapped hands

Lecturer 4: Another pair please should present.

Learner 2: mango, blue gum, star grass, leaves

Lecturer 4: Leaves, aha, what else?

Learner 2: soil

Lecturer 4: Aha what else?

Learner 2: grass

Lecturer 4: Aha .

Lecturer 4: (wrote on the chalkboard). Okay. But before you go. What type of appreciation or what kind of reinforcement would you like to be given?

Learner 2: Cokecoke

Lecturer 4: Okay, can you give this pair cokecoke? (coke sounding) Thank you can you go?

Learners: { Hand clapping}.

Lecturer 4: Another pair. Is there any pair with different answers? {Nobody responded}. You should come and give us a different list not repeating the same, okay? Which pair would like to come? Yes!

Learner 3: Soil already mentioned but insects

Lecturer 4: Aha , another one?

Learner 3: Plants, eeh people (that's all)

Lecturer 4: That's all very good. What type of appreciation or reinforcement would you like to be given?

Learners: Crecom.

Lecturer 4: Can you give the pair Crecom? Crecom! Aha can you demonstrate? (A learner demonstrated Crecom reinforcement to class). Yes, can we do it? Can we do it? Can we do it? (Learners performed Crecom hands). Very good, very good, very good. Okay I think ah do we have a pair that has got a different, a totally different list of things other than these that are listed here? Do we have, but mostly are these things that we can find outside, isn't it?

Learners: Yes!

Lecturer 5: Alright ah now ah which of these things are plants? Which of the items you have listed here are plants? Now this question goes to all of us. Which of the things here are plants? (Learners raised hands. Lecturer pointed at one learner). Yes!

Learner 3: trees.

Lecturer 4: trees, thank you, umh! Can you give other names of plants that you can find outside? (another learner stood up to say something but the lecturer refused him saying it was not his turn). Not you but that other one.

Learner 4: Grass

Lecturer 4: Grass, aha what else? So we only have these as plants here. The only plants here. Okay, fine, fine. Now apart from these three listed plants, what are the other names of the plants that you can find outside? Apart from the three trees, grasses, you have said plants, but can you give names, give names of the plants that you can find if you go outside. Names of the plants. Trees yes but what are the names of the trees? Any two names of the

trees that you can find outside? Any two names, just give me their names (Learners raised hands). Yes!

Learner 5: Mango

Lecturer 4: Aha, I want another one, mango tree, what else?

Learner 6: Bluegum.

.

Lecturer 4: So if we go outside we will find bluegum, is it? (Learners said yes) Okay, what else can we find apart from mango, bluegum, just outside what else can we find? Umh!

Learner 7: star grass

Lecturer 4: star grass okay. So if we go outside we will find these ones? Now do you think that these plants, these are the plants, are these plants in books?

Learner 8: Yes

Lecturer 4: (The lecture was writing the answers on the chalkboard. However he did not name the learners but simply pointed at them). Today, we are going to discuss whether plants can be put in groups. Eh, can you spot the plants in the books? (learners said yes). Alright, so ah what we are going to discuss today is to find out whether plants can be put into groups. Can these plants be put in groups?

Learners: yes

Lecturer 4: We are going to find out whether plants can be put in groups. I don't know how many groups but we will find out, we will be finding out whether or we will be trying to answer the question, can plants be put into groups? This is the question we are to be answering today. Now I will ask you in your groups to go outside and collect different plants. You are going to bring them in the classroom and try to find out whether they can actually be put into groups. Either 79 groups, 200 groups, that we don't know. At this moment in time ah, may we in our groups go outside and collect different types of plants, Ah you have ten minutes for that.

Lecturer 4: Can we go outside to collect different plants and bring them into the class? I am giving you 10 minutes for the activity. (Learners went outside the class to collect samples of plants. After 10 minutes the lecturer said); go back to your class. (Lecturer monitored collection of plants by the learners. Learners did as instructed. When they went to class the lecturer advised learners to classify the plants into groups. He told them to record their findings in a table form. Lecturer went around to clarify the task to learners).

Lecturer 4: Now put the plants in the groups according to their classification. Record your results here. (Each group received a chart paper and a pen for recording the answers).

Learners: Discussing the plants and classifying them into groups.

Lecturer 4: (Reminded learners about the question) Can plants be put into groups? (He told learners that their work or analysis of the plants should help them answer the question).

Five minutes remaining for you to wind up your work the lecturer went around and posed further questions for example, what is making you think that these are flowering plants and these are non flowering plants? Please justify your answers.

Lecturer 4: can you stop!! Can you display your work please? When you have displayed your work move around to check or see your colleagues work. This group will go to another group and see what their friends have come up with. You can add if you feel your friends have left some things.

Learners: Did as instructed by their lecture.

Lecturer 4: Explained to learners how they should move around from one group work to another. Make sure you appreciate what your colleagues have done. If you feel something is wrong you can add, subtract or edit some sentences.

Learners: Moved from one work station to another to learn from each other. There was no expert at the work station.

Lecturer 4: Ok, can you move to the next stage. Appreciate and add on the columns.

Learners: Moved round to different work stations until they came back to their original places.

Lecturer 4: Consolidated the lesson by asking one learner from each group to display their work. He asked for volunteers.

Learners: Group 3, presented their work to the class. Where plants were put into flowering and non- flowering plants. Flowering plants: mango, plant x, plant x2, star grass and non flowering plants: algae, moss.

Learner 9: We didnt know the names of some plantsbut we managed to classfy them.

Lecturer 4: where can star grass be exactly put? Why? Star is known as kapinga in local language.

Learner 5: (Tried to explain and argue about star grass). Star grass is not a flowering plant.

Lecturer 4: Let me give you time to study about star grass and report in the next lesson. Think about other plants like mashroom, algae and moose: Are they the same as star grass? Please find out whether they are the same.

Learners: Came up with flowering and non flowering plants.

Lecturer 4: How best can these topics flowering and non-flowering plants be taught in primary school? Can you be pairs? Discuss how you can teach flowering and non flowering plants to primary school pupils. Just write down two points only. I am giving you two minutes only for the activity.

Learners: Discussed in pairs how they could teach the topic in standard 7.

Lecturer 4: Moved around to check what learners were doing. Can you be in threes to share your findings? {Learners went into groups of three}. Discuss how each method can be used in teaching the topic. Some of these methods are time consuming. You also need to discuss how best the resources can be used.

Learners: Discussed the new question as the teacher moved around.

Lecturer 4: (Seemed not prepared points just came in just to pass away the time). How best can resources be used to teach flowering and non-flowering plants? Discuss in your groups.

Learners: did as instructed by their lecturer. Later they reported their work to the class

Lecturer 4: When teaching this topic, appropriate methods should be used to effect learning. Secondly, the resources that you use should directly assist learners to understand the topic. Use adequate resources at the same time, you the teacher must have adequate knowledge about classification of plants. The methods must be appropriate and the teaching and learning resources must be directly related to the topic, you need to use adequate resources from the local environment. As a teacher you must know the topic.

He finally explained the summary of the lesson to the learners. Clear the tables and desks and place the items on the nature table. This marks the end of the lesson.

Lecturer 4 lesson 4

19/0219

Topic: classification of plants

Time: 08:30 to 09:30

Class size: 24

Lecturer 4: Good morning class

Learners: Good morning sir

Lecturer 4: last time, we did a topic in Science and Technology , what was that?

Learners: flowering and non-flowering plants.

Lecturer 4: ok, can you write any two examples of flowering and non-flowering plants? If you are finished raise up your hand. Ok, who can give us names of plants which are flowering and non-flowering plants? (Learners raised hands up)

Lecturer 4: Checked and just said alright/no depending on whether he was satisfied or not.

Who can give us the names of the non-flowering plants?

Learner 1:Non-flowering plants: confers.

Lecturer 4: What about flowering plants?

Learner 2: Flowering plants; mango tree and guava tree

Lecturer 4: What did we say are flowering plants?

Learner 3: are plants that produce flowers

Lecturer 4: what about non- flowering plants?

Learner 4: are plants that do not produce flowers

Lecturer 4: Rewarded the learner by telling the class to clap hands for her. we had some juggles on star grass whether it is flowering or non- flowering. What have you found? (This was left unfinished in the previous lesson- learners were advised to research on it so that they could find the right answer).

Learner 4:(Some learners raised their hands up)star grass is a flowering plant because it produces seeds.

Lecturer 4: can plants be classified further?

Learners: Yes. (The lecturer refused chorus answers).

Lecturer 4: Alright, today's lesson is 'can plants be classified further?'. ok, today's lesson is going to answer the question. Who can formulate questions which could answer today's lesson?

Learners: (came up with the following questions); do plants have the same leaf arrangement? Do plants have the same root arrangement? Do plants have the same type of stem?(these questions were meant to investigate plants for further classification- learners were given autonomy and empowered to raise their own questions-decide on questions which would lead the lesson- an element of learner-centred teaching).

Lecturer 5: We have three questions to answer. (He then read out the three questions). so, we go outside the classroom and collect different plants from the local environment in order to answer the three questions.

Learner 5: a learner asked a question for clarification.

Lecturer 4: answered the question to clarify the points.

Learners: the class went outside to collect different plants

Lecturer 4: advised learners to collect as many plants as possible. After 15 minutes the he told learners to go back to class.

Learners: Collected any plant that they saw/found from the environment.

Lecturer 4: Didn't tell learners what to collect. He just watched as the learners collected the items/specimens. (When the learners went back to class lecturer instructed them to use their materials to answer the three questions that they raised)

Lecturer 4: the first thing is to answer the first question and then you continue with other questions. You have 10 minutes for this activity. (Learners started classifying plants into groups while the lecturer was moving around from one group to another giving clarification of the task. All the groups were doing a similar activity). Record your findings in a table form.

Learners: worked on the task based on the three questions they raised (investigation, observation).

Lecturer 4: (was explaining some concepts/terms as learners were doing the task, moved around the classroom to check learners progress, listening to learners discussions, guiding them what to do, asking probing questions as they were discussing the task, for example); you classified this plant as how about....??.

Lecturer 4: it's time. Can we stop whatever we are doing? Please, stop! At this juncture, can we hear from the groups? Can you come for presentation? (group secretaries went forward to make presentations)

Learners: Tikufunanso lady teachers m'menemo (we also want to see female teachers in your group- of presenters. This statement was made by fellow learners after observing that those who volunteered to make presentations were male learners only).

Learner 6: (presented group 1 findings. A lady learner did it). Plants are classified according to leaf arrangement, roots and stem as well.

Learner 7: (Group 2) did the same but with detailed explanations.

Learner 8: (Group 3) did it showing a chart and all explanations came from there.

Lecturer 4: we are not very clear about digitized leaf arrangement and underground stem whilst others were saying stem on the ground and not underground. Now, what methods can you use to teach this topic in primary school? Just two methods. Be in pairs and discuss. Ok, very quickly, what is it?

Learners: did as instructed and reported to class what they had discussed.

Lecturer 4: so, today, we have managed to answer questions. Thank you until we meet in the next lesson.

End of lesson

Lesson observation details for lecturer 5

Date: 21th January,
2019.

Lecturer 5: Lesson 1

Class F

Lecturer 5:

Topic: Concepts in Plants

Subject: Science and Technology

Time: 8:30-9:30

Class size: 27

Lecturer 5: We have time to learn Science and Technology . You meet Mr X- the researcher and two staff members. They have come here to be with us. Feel free. You could see them going around they want to take some pictures, some video clips which we can use ah discussing the approaches of teaching and learning science so you are required to participate, contribute where necessary, okay?

Learners: Yes (in unison).

Lecturer 5: Today is what? (Learners responded by giving the day's date. Lecturer wrote it on the chalk board). Look at me, I was thinking of 30. Ok, over the weekend we had a lesson in which I invited everyone to attend, that was a makeup lesson, ok. We are going to conclude that work in another makeup lesson but as of today, we will we are going to lay foundation on what we have been studying on plants growth and what development. I just want you to think of what you have learnt ah in that lesson. So just a minute, remind yourself and think of that, I will ask questions randomly to find out if you still remember

(lecturer paused for a minute to give learners to think of what they learnt in the previous lesson. Learners were busy writing down points. Lecturer looked on and then he continued to speak).

Lecturer 5: Right, what is it that we covered previously? What is it that we covered previously? tell me what you have written (Some learners raised hands up). And yes! (Pointing at one learner)

Learner 1: Classification in plants,

Lecturer 5: Classification in plants, is he right? A big hand to that (reinforcement/reward to learners). Next, em he

Learner 2: Indicators of what plant growth.

Lecturer 5: Right, a hand. Ladies! Yes, you have been touching your eyes. What can be the other concept we covered?

Learner 3: types of mixtures

Lecturer 5: Please, raise up your voice

Learner 3: Types of mixtures

Lecturer 5: Types of what?

Learner 4: Mixtures

Lecturer 5: Mixtures. And that was covered over the weekend. Very very related to plants.
Very related to plants.

Learner 5: Water

Lecturer 5: and what?

Learner 5: development.

Lecturer 5: A big hand to that. Now what else on the concepts we covered? I want you to think of other concepts other than growth and development which may be there. Think of a number of aspects, concepts, any which can be covered under plants. Think of. And then you write it down. A minute is enough for that. What other concepts or elements can be covered under this type of plants? Right, plants have a number of concepts apart from growth and development. Think of any and write down. Right, hands up so you give your answer. What is it that we have also learnt under plants? (Learners raised hands up)

Lecturer 5: Yes (pointing at a learner)

Learner 6: Food making in plants.

Lecturer 5: Food making in plants. In a process known as?

Learners: (in unison) photosynthesis.

Lecturer 5: Any other concepts? Umh

Learners: Reproduction in plants.

Lecturer 5: Reproduction in plants. Isn't it? All concepts are very correct, any other? I see only hands from gents what about from ladies? Emhe

Learners: types of little plants.

Lecturer 5: what?

Learners: types of little plants.

Lecturer 5: That is under what?

Learners: classification.

Lecturer 5: Okay

Learner 7: root system,

Lecturer 5: root system. Enhe

Learner 8: seed dispersal.

Lecturer 5: Very good for that because root system is also related to plant classification but that is unique. Enhe

Learner 8: no, you have not taken my task correctly.

Lecturer 5: Think of other features but come under plants

Learner 8: germination was already reflected,

Lecturer 5: enhe

Learner 9: respiration in plants can also be one other aspect

Lecturer 5: plants parts and their enhe, finally the external structure of a what

Learners: of a plant (chorus answer).

Lecturer 5: In this lesson, we are going to see..... to discuss some of the aspects which we can teach in the primary school. Find the aspects which we can teach in the primary school which are found directly under plants. Some may not be there. Ah, we will have a number

of tasks. The first task, we will form up a group in numbering system and then we will work independently in groups. After that we will have to analyse that after reporting we will analyse some material to find out. Are these concepts found in the primary school Teachers' Guides or learners' books? So that we can learn. Okay?

Learners: yes

Lecturer 5: Now can you count one to five? Count one to five. (Some learners asked if counting would start from their desk). No, we are starting here (learners counted themselves from 1 to 5 as a way of forming groups). Okay, the ones can make their group here

Learners: Okay

Lecturer 5: The ones here-to his right hand. The twos can make their group here the threes, the fours,,,,(learners moving to form groups. Lecturer continued allocating the other groups up to 5. He then wrote the following on the chalk board;Photosynthesis, Translocation, Vascular bundles, Reproduction in plants, Seed dispersal, Uptake of water).

Lecturer 5: Now listen please,in your groups look at some of the tasks involved in having what may be called.....?

Learners: photosynthesis.

Lecturer 5: The other task may come under what may be called translocation and pass your what? Ah the other task that ah is related to what we call reproduction in plants not just

reproduction to tell, and then ah what other aspect to be ah, one other aspect to be to look at or to tell could be seed dispersal. We have already ended up in having: photosynthesis, reproduction, vascular bundles, and then we have seed what?

Learners: dispersal

Lecturer 5: dispersal. And related to ah this is right. And related to the tasks, you will find that there are four tasks but there is one more task that has to do with acting on. So send one member and one member at a time will pick a piece of paper from my table. Alright? (Selected group members went upfront to where the lecturer was to get pieces of papers) Just take, just take.

Lecturer 5: Now we will start from here, listen, because the tasks are not the same. Okay? Group one, can you read the tasks that are written there on the paper? Quickly (one learner read out the tasks) Are you through? Two. Quickly please. (One learner read out the tasks). Three (one learner read out the tasks). four (one learner read out the tasks). five (one learner read out the tasks) Ok, now of all the tasks you are going to be given limited time, maximum of 8 minutes. Ah we will add a few minutes if it will be desirable. I will give you pens, ah markers and charts so that your ideas must be put on that.

Lecturer 5: Okay. So you have already been provided with a chart. Many of these concepts are found within the same learners book, am I right? So there is need for you to record that. Write down one thing you know as a necessary concept. (Lecturer distributed pen and markers and chart papers to the groups- group discussions started and lecturer 5 walked

around during group work). You get a point, you write it on the chart. (Group discussions continued. Lecturer checked his time, collected stick papers -seal tape, distributed them to the groups). 3 minutes remaining. (group discussions still in progress. Lecturer 5 moved around again to check work progress....whispered to group members “you need to write your point on a chart sometime you may hear time is out ndiye.....). I am expecting that those who are fast writers are done by now. Ten minutes gone but I can still see one group working (some groups still doing group discussions).

Lecturer 5: Okay, the time is over, can you display your charts? Those who are late, remain in your groups, I will tell you what to do. Just display the chart, there on the wall, find somewhere to display the charts. Those who are through as possible. The chart should be displayed.

Learners: displayed chart papers on the chalk board and other places within the classroom.

Lecturer 5: Now can you stand close to where there is your chart? Go and stand close to where there is your chart. Now can you pay attention? One member will remain there as a resource person. We are going to conduct what is known as gallery walk. So as the members from another station come, that expert must explain and you are also allowed to add any other point that you could feel that point is not clear on teacher addition, okay. So we will move ah clockwise, we will start here, and then the first group will move to the other group and then there so that we visit all the other stations. But only one member should remain at a station. One member remains there. And the task will take only five

minutes..... (lecturer moved around then announced, 'move to other stations, he continued moving to other groups. Clapped hands and announced, 'move to other stations'. Learners continued moving from one work station to another.) Go to the last station. You will find that you have covered your what?

Learners: our own work station.

Lecturer 5: Can you pay attention? You will find that when we say go to the last station, you have covered your what?

Learners: Our own work station.

Lecturer 5: And the approach I have used is called what?

Learners: Gallery walk.

Lecturer 5: Can you take a sit so that we can refresh this method? How it is used, advantages and disadvantages and then we will move to the last activity? I just want to find out if you can answer this question; how do plants absorb water? Close your eyes. (Learner attempted to answer the question). How do plants absorb water? Explain how water absorption takes place in plants? (a learner raised hands up. Lecturer pointed at him). Yes!

Learner 10: ah of osmosis

Lecturer 5: Good. Apart from osmosis, what other factors can assist? Enhe (while pointing at a learner)

Learner 11: temperature

Lecturer 5: Very good. Enhe! (Pointed at another learner)

Learner 12: humidity, light intensity.

Lecturer 5: Light intensity, any other? Is temperature and light Intensity the same?

Learner 13: They are different.

Lecturer 5: Ok, I want to find out from real factors or concepts other than temperature and what was this?

Learners: Humidity (chorus answer)

Lecturer 5: We can have other factors which will include pressure, capillarity rise, okay? (Learners chorused a yes!) Transpiration cool, these are other factors. (Lecturer then went to another chart paper). I want also to find out, what are vascular bundles? What are Vascular bundles?

Learner 13: said something in an attempt to give an answer. Vascular bundles.....

Lecturer 5: What are Vascular bundles? Non volunteer please. I know you can all, you can try (pointed at a non volunteer learner to give an answer).

Learner 14: vascular bundles? It is not clear.

Lecturer 5: okay. What are vascular bundles?

Learner 14: Special structures within the plant, the factory which make what transportation substances

Lecturer 5: Special structures, okay, within the plant, the factory which make what transportation substances. We have two types, what are these vascular bundles? What are these? (Some learners raised hands up. Lecturer pointed at one learner). Eya (Yes!)

Learner 15: Xylem.

Lecturer 5: Xylem, what else? And then the other is?

Learner 15: The phloem.

Lecturer 5: Ok, you have seen we have applied what is called the gallery walk, what do you think are the strengths advantages of this method if used in the primary school?

Learner 16: it encourages critical thinking, it can be used to cover a lot of work

Lecturer 5: ok, it can be used to cover a lot of what, work. How many concepts?

Learners: 5

Lecturer 5: 5 concepts. We teach ah the old I mean the older IPTE handbook in a certain unit we covered a lot of work. We discovered the whole term that there are ah a lot of work to be covered, very wide, a wide topic. So it can assist you to cover a lot of work. Any other advantage?

Learner 16: you can encourage learner participation.

Lecturer 5: Another advantage? (Pointed at a learner who raised hands up) yes!

Learner 6: critical thinking.

Lecturer 5: How do we encourage critical thinking by gallery walk? According to the nature of the tasks? How can it be encouraged? You will still note that some of the questions are open ended, that requires you to do what?

Learners: the nature of the question.

Lecturer 5: Where you have give, list, mention, so the nature of questions must promote?

Learners: critical thinking.

Lecturer 5: So thenature of the questions. Now let's have challenges which you have experienced as you were moving. Challenges, we will start from there (learners raised hands up. Lecturer pointed at him to give an answer- use of learners practical experience

Learner 5: timeconsuming

Lecturer 5: How much time did I say time, I found that people were still working? So I said time, time so that the presenter can finish. Okay, another disadvantage? This side, umhu

Learner 17: if not structured it ca not benefit other learners

Lecturer 5: Meaning the teacher has not made sure that the papers are clear and okay, by putting one of the groups there and a problem with one question. For the question that was not well structured, I had to explain, so I clarified what I wanted. So if not well structured, learners may what?

Learner 18: learners will not understand

Lecturer 5: Any other?

Learner 10: it is bias to fast learners, slow learners can not capture a lot of concepts

Lecturer 5: very good. Biasness is there, we have combination of abilities, average ability et i above ability, below so fast learners so in this situation only fast learners can capture a lot of concepts as much as they can. In this case, the teacher can think of how to support

what, slow learners. Now the next activity which I want to pause to you is to find out to analyse from the primary curriculum which of the concepts that we have covered in this topic we have shared are there any related to the primary curriculum? Shortly to be assigned we will look at several topics, when you go out, you will be teaching the same topics, find out what concepts are directly linked to primary school curriculum. Go through the unit.

Lecturer 5: Alright, I will give you ah teacher's books and learners' books find out go through the units (Lecturer distributed primary school Science and Technology learner's books and teacher's guide for standard 5-8 to learners). Draw a table. In standard 4, we have Agriculture, Science and what?

Learners: And Technology (Learners went into their groups and started working on the tasks from the text books)

Lecturer 5: In standard 5 we have Science and Technology up to standard 8 (groups discussing the task. After 5 minutes, the lecturer stopped the group discussions). Now we want to find out from each group what they have ah found found, according to their analysis. We will start from here. Are there any connections you have noted? Is it done as in college?

Learner 19: standard 7 text book- flowering plants

Lecturer 5: first tell us ah you are using standard?

Learner 20: standard 7

Lecturer 5: (clapped hands- class was making noise) can you listen?Start again?

Learner 21: flowering plants

Lecturer 5: Okay, before you proceed, you have mentioned flowering and under what topic is this related to our primary schools and are they not related to that?

Learner 23: said something on behalf of his group

Lecturer 5: Okay, you can now finish. (Learner concluded his answer) Okay, a big hand to the group members. Let us now have another group's analysis

Learner 22: a learner from another group reported on behalf of the other group members

Lecturer 5: umhu. Okay, so there is direct link with what we have discussed, not so

Learners: Yes!

Lecturer 5: a big hand(learners speak). Alright, which book is this?

Learner 23: standard 7 the functions of the leaf,

Lecturer 5: Photosynthesis is one of them not so?

Learners: Yes

Lecturer 5: Another group!

Learner 16: explained something on behalf of his group

Lecturer 5: We have looked at standard 7, 5 and we have come back to 7, isn't it? (Learners said yes in unison). What about standard 6?

Learners: 5

Lecturer 5: ok, let's hear from standard 5. (a group representative reported for standard 5).

Ok, a big hand to that group which have standard 5 (learners clapped hands).

Learner 16: There are some connections food making in plants.

Lecturer 5: Can you read that? Can you listen? (hand clapping from learners after the lecturer instructed them to do so) ehee.

Learner 18: Standard 5.

Lecturer 5: So we can take note. What about 8, do we have a standard 8 teacher's guide?

Learners: M'book mulibe

Lecturer 5: No, I have read it. There is work that is directly linked with this topic.

Learner 19: Completely, there's no connection. Not directly to plants.

Lecturer 5: Can you read out what you have you have, you have said it is there.

Learner 19: So directly to plants

Lecturer 5: So directly to plants, isn't it? Now at this point, I want you to make two circles, two circles. Let's come here. Make sure that you are paired with somebody (learners did as instructed). Okay, what we want to do what we want to do is what we call ball bearing. This is one of the technique or teaching method which we can use to check on what we have learnt. So I want you to ah the inner circle to be fixed. I will allow the outer circle members to move ah three steps just share what you have learnt and then move to another station three steps. Alright, start!

Learners: (Made 2 circles and in pairs started discussing what they had learnt. One person in the inner circle and the other in the outer circle formed pairs).

Lecturer 5: (clapped hands and said) 'move 3 steps'. Move to another station (learners did as instructed. Discussions by new pairs). Again clapped hands and said move three steps. (Discussions with new pairs were observed). Move to the last station (learners did as instructed and pairs held discussions).

Lecturer 5: then clapped hands again and said stop go back go back to your places. We have put these stations even approaches in order to adapt what the environment that you will use. Isn't it? And the other thing you should take note is that I have tried to make analysis and to make corrections so that whatever we learn here make sure you make good search. How it is connected or related. That's another important task for you, when you go to the library remember that you link what you learn in class with what is there. mnh

Learner 20: what will happen if the number of learners in a particular class is over 100? Shall we still use two circles?

Lecturer 5: No, two circles cannot be enough. You go to Kapeni, you will find many learners. So general circles can be accommodated if the room is spacious. If not spacious you can be allowed to change.

Learner 21: so we need a lot of resources?

Lecturer 5: Exactly. So I want you to think that you have so many books that will support learners. As you are there, am going to give the monitor or monitress. I have attached one

task to one of the topics. The other task is part of the assignment. Am going to give you one paper to prepare to draw your drafts and work of that other task will be done. Okay. That will be added and added to your continuous assessment because sometimes you find that the other learners may fail and get 2 out of 20 and the other one get 18 Out of 20 so you make arrangement so that you are at a better place.

Lecturer 5: Thank you so much for your attention also thanking our visitors for coming. First is Mr X, a big hand to him (a hand clap by learners) a big hand to the technician, photographer (a hand clap) and Mr Y the assistant researcher.

18/02/19

Lecturer 5: lesson 2

Subject: Science and Technology

Topic: light energy

Time: 8:30- 9.30

Class size: 25

Lecturer 5: good morning ladies and gentlemen

Learners: good morning sir!

Lecturer 5: let us make a circle over there (At the back of the class)

Learners: Went to the place and made a circle (Lecturer had a ball in his hand)

Lecturer 5: what topic did we do last time? (He threw the ball to a learner in order to answer the question. He instructed the learners to throw the ball to another learner of their choice if they failed the question or if another question was fired.)

Learner 1: Electricity

Lecturer 5: what concepts did we cover?

Learner 2: electricity

Lecturer 5: what are effects of electricity?

Learner 3: magnetic effects, heating effects e.g. cooker and chemical effects.

Lecturer 5: a big hand to everybody and take your seats (Learners clapped hands once and went back to their seats). Today's lesson is light energy. As teachers, we need to master how we can teach this topic light energy. I want you to write any concept under light energy (Each learner was busy writing). Share with your friend (pairs were formed and shared notes). What are these concepts? (Learners reported to class)

Learners: Sources of light

Properties of light

Application of properties of light

Investigations on properties of light

Categories of sources of light

Importance of light

Technologies which make use of light

Lecturer 5: I want you to be in my shoes. Think of any success criteria for these concepts mentioned. (Each learner was busy writing in their notebooks/modules). Right, let's report our work to class. (Learners raised their hands up. Lecturer pointed at some learners one by one to give answers)

Learner 4: learners must be able to;

- describe sources of light,

- explain the importance of light,

- investigate properties of light,

- Analyze categories of light.

- Apply knowledge of light energy to everyday life

Lecturer 5: now we are going to design investigations on properties of light. Let's come up with properties of light. (Learners raised their hands up. Lecturer pointed at one learner).

Learner 5: Light travels in a straight line

- Light can be refracted

- Light can be reflected

- Light has got speed

- Light can be dispersed

- Light can be converged

Lecturer 5: Which among these properties can be investigated in primary schools using locally available resources?

Light Travels in a straight line

Light can be converged

Light can be Reflected

Light can be Refracted?

Learners: All of them

Lecturer 5: I am going to number you 1-5. I need you to be in 5 groups to demonstrate the properties of light. Count 1-5 to form groups.

Learners: counted themselves from number 1-5 and finally formed groups according to each learner's number, i.e. the 1s went one group, so too with the 2s, 3s, 4s, and 5s. The lecturer distributed the tasks as follows;

Group 1 = light travels in straight line

Group 2 = light can be refracted

Group 3 = light can be reflected

Group 4 = light can be dispersed

Group 5 = light can be converged

Lecturer 5: think of how you can design an investigation on the properties and think of resources that you can use.

Learners: Started working in their groups by coming up with the procedures that could be followed when investigating properties of light (Lecturer moved from group to group to

monitor the work progress. Assisted learners who had problems. After sometime lecturer advised groups to display their work).

Lecturer 5: I want groups to display your charts and present your work. Each group has to stand where the chart is displayed. We are going to conduct gallery walk. (Group secretaries pasted their chart papers. Each group assigned a person to remain at their chart paper as the rest visited other group work charts).

Learners: walked to different work stations to see how other groups had designed investigations on properties of light.

Lecturer 5: are you through? (Learners: Yes) Now you can go to your seats. Now, let's report to class the work that has been done starting with group number 2. (He went through each group's work with the learners to ensure the work was edited and corrected. Lecturer was reading and correcting learners' work).

Learner 1 (group 2 secretary): Light can be refracted

resources: container, ruler, water and pen

Procedures:

Pour H₂O into the container

Put a pen in it

Observe if the pen can be bent

Learner 2 (Group 3 secretary): Light can be reflected.

Resources: mirror

Procedure

Face the mirror to the source of light

Turn the mirror at different points so that light hit the mirror

Then observe

Reporting went on for all the groups.

Lecturer 5: Take note that locally available resources can be used to design experiments on properties of light. (He showed the learners different apparatus that could be used to investigate properties of light. Then he started explaining more about designs the learners came up with, one after the other).

Lecturer 5: Using the experiment you have designed, get resources on your own and conduct experiments to investigate properties of light (This was an assignment given to the learners).

Things in the lesson

Learners designed experiments on properties of light alone

Learners came up with success criteria for this topic 'light energy'

Learners came up with concepts under this topic 'light energy'

Learners were given assignment to do to conduct experiment using resources they could get.

01/03/19

Lecturer 5: lesson 3

Subject: Science and Technology

Topic: Central Nervous System

Time: 1:30- 2.30pm

Class size: 27

Lecturer 5: it's time for Science and Technology . Do you remember what we covered last time?

Learners: Yes.

Lecturer 5: what was that?

Learners: it was about light and properties of light

Lecturer 5: today, I will begin the lesson differently. I will display a chart. (Displayed chart paper that showed a tree diagram). What do we call what is displayed on chart? What do you call what is displayed?

Learners: Mind mapping, M-chart etc.

Lecturer 5: no, this is a concept mapping. (He wrote concept Map Energy). Today, we are going to do something different other than energy. We are going to look at coordination. What is coordination?

Learner 1: It is the linkage of systems in the body.

Lecturer 5: we are going to look at central nervous system. What do you think can be covered under the central nervous system? Any concepts that can be covered under that? I want you to quickly write any concepts under this (Learners quickly wrote something in their note books).

Lecturer 5: now walk around, talk around and share with your friend what you have written. What are the concepts? (Learners did as instructed). Now let's share as a class.

Learners: Parts of the brain

- Care of the brain

- Functions of the brain

- Types of neurons

- Problems associated with the nervous system

- Reflex actions

Lecturer 5: which could be the order of these concepts when you want to teach the topic in the primary school?

Learner 2: Parts of the brain

- Functions of the brain

- Care of the brain

- Types of neurons

Problems associated with brain

Lecturer 5: I am going to organize you into groups. Count 1-5 (learners counted numbers 1 – 5). Can the ones, twos, form their groups? So too with threes, fours and fives? (Learners formed their groups).

Lecturer 5: displayed the model of nervous system. He explained the components of central nervous system eg, brain, spinal cord. He then displayed a chart with activities or tasks on central nervous system. (Learners in their groups started working on the tasks as assigned by the lecturer).

Group 1: how would the structure of the brain and spinal cord be compared

Group 2: how would a teacher illustrate a nerve impulses are taken to and from

Sensory cell

Motor cell

Association neurons

Group 3: outline elements involved in a reflex action. How do reflex action take place?

Group 4: illustrate a simple reflex arch by means of a drawing

Group 5: how would you demonstrate a spinal reflex action, knee jerk.

Lecturer 5: Maximum time is 10 minutes (time determination for an activity was done by the lecturer all the times regardless of how hard the task was). After sometime lecturer announced the time ‘1 minute more for slow writers’. At one point you are going to disband

and go to your original group and you are going to share. When I clap my hands, you are going to stand up and I will tell you where to go. (Lecturer clapped hands and said go to your home groups).

Lecturer 5: Now, I want you to explain one at a time. Maximum time 10 minutes

Learners: in their original groups they started sharing information one at a time. Questions were allowed for explanation

Lecturer 5: I will ask you randomly, how would the structure of brain and spinal cord be compared? Use the elements

Learner 3: Using a model that show brain and spinal cord

Learner 4: brain-grey matter outside. Spinal cord-grey matter inside

Learner 5: brain-has folding. Spinal cord-no folding.

Lecturer 5: continued with other tasks.

The lesson continued out of time. 14:50

Lesson observation details for lecturer 6

18/01/19

Lecturer 6: Lesson 1

Lecturer 6: entered classroom and wrote topic on chalk board.

Topic: Plants Reproduction

Time: 8:30

Class size: 25

Teaching, learning and assessment resources: primary school Science and Technology text books for standard 5 to 8

Classroom environment: linear sitting arrangement all learners faced the front where lecturer sits, class had 25 learners

Lecturer 6: Good morning

Learners: Good morning sir

Lecturer 6: How are you?

Learners: we are fine, how are you too?

Lecturer 6: Am fine. Today we are going to have a Science and Technology lesson but the difference is that you are going to see one of our colleagues in the teaching profession. Are you there?

Learners: yes!

Lecturer 6: Today we are going to talk of reproduction in plants, reproduction in plants. Right, can you just stand up for a minute? (learners stood up in response). What I want you to do is to write as quickly as possible, as quickly as possible the modes of reproduction in plants. Individually think and write what you know as a means of plants reproduction. (Each learner was busy writing. Lecturer repeated the question several times while encouraging learners to write the answer as quickly as possible). Remember what we said about plants reproduction. Modes of reproduction in plants or ways of reproduction in

plants. What you know as a means of reproduction in plants, plant reproduction. Write as quickly as possible, what you know as modes or means of reproduction in plants. (After 2 minutes the lecturer continued speaking)

Lecturer 6: I think you have written, is it so? (Learners: yes!) Right. Can you get to the person close to you? Can you get to the person close to you? (Learners started forming pairs). You must share what you have written. If you are not sure on what you have written you can ask me (pairs started sharing notes about the modes of reproduction in plants as sexual and asexual reproduction while the lecturer looked on).

Lecturer 6: Right, can you sit down? I am sure you have shared the modes, means, or ways of reproduction in plants. Can I have the answers? What are the modes of reproduction in plants? (Learners raised hands up. The lecturer pointed at one learner)

Lecturer 6: Yes! (Pointing at learners one by one).

Learner 1: Sexual reproduction.

Lecturer 6: Sexual reproduction. What is the other means?

Learner 2: asexual reproduction

Lecturer 6: Yes, asexual reproduction, Good. There are two ways that takes place in reproduction of plants. So let us look at asexual reproduction as a means of reproduction but before we go in detail about asexual reproduction, what is the difference between sexual

and asexual reproduction? Is there any difference? Is there any difference? (Learners raised hands up. The lecturer pointed at one learner to give an answer to the question.)

Learner 3: in asexual reproduction only one sex while asexual reproduction requires both male and female gametes.

Lecturer 6: how about this one? (Pointing at the word asexual reproduction with a ruler). There was dead silence from the learners. No response. Then the lecturer started explaining about asexual reproduction. Right, in this one, gametes are not involved, for example, cuttings

Lecturer 6: Yes. But on the first, who can give a better explanation? (Some learners raised up their hands and lecturer pointed at one). Yes!

Learner 4: sexual involves male and female gametes.

Lecturer 6: Very good, sexual reproduction involves male and female gametes. In sexual reproduction the male and female gametes are involved. What about in asexual reproduction?

Learner 5: In this one you.....Usually, genes are not used but cutting to produce so many plants. Asexual involves neither meiosis nor fusion of gametes. It does not involve the fusion of gametes.

(The lecturer then re-explained sexual reproduction and gave examples. Answered questions by himself and gave an example to elaborate his point).

Lecturer 6: I will give you the old books, it's where you will get the information. The revised ones are not giving us information. I will give you a task to do.(primary school Science and Technology learners' books for standards 5 to 8 and teachers' guides to the learners). The task that you are going to do, you will be in groups but in each group I require 5 members. Is it clear? Be in the groups of fives (learners went into groups of 5 members each). Are we in the groups of 5s? In group 1 can you count 1 to 5? Do the same in all the groups. (Group members counted themselves from 1 to 5)

I think you have given the numbers to each other. So the ones should be here(showing learners a space to occupy), the twos should be here, threes here and the fours at the back. (Learners got into new/ expert groups).

Lecturer 6: Can you listen now to me? Those in the group of the ones can you discuss or look at the examples of asexual reproduction, each one of you should get the information because you are going to be an expert and will share the information to the whole group. Are you there? The 2s look at what is involved in vegetative propagation and the advantages of sexual reproduction in plants, the 3s look at the disadvantages of sexual reproduction, the 4s look at the advantages of asexual reproduction and its disadvantage and group 5 look at Advantages of sexual reproduction. Are my instructions clear? Are my instructions clear? So I will give you 5 minutes to source the information and discuss

as a group and later you are going to report in your original groups. Find somewhere to write because when you go back to your original groups you become an expert, you are going to deliver that.(The lecturer assigned different tasks to each group. Advised the learners to ensure that they read a passage from the text books, understood it fully because at the end they would go back to their original (home) groups where they would share what they learnt from the passage. The lecturer used a jig-saw method of teaching).

Learners: formed the expert groups and started discussing the assigned tasks to come up with answers. Figure 2 shows learners in group discussions.

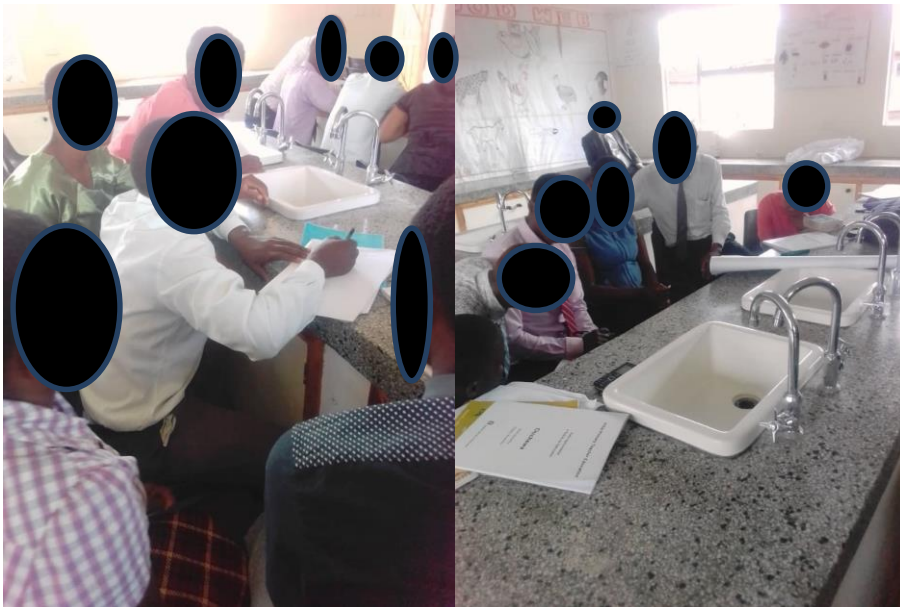


Figure 2: Learners in group discussions

As learners were in group discussions the lecturer was moving around to check work progress, assist learners to who had problems, clarify the questions where need arose).He

encouraged each learner to participate in the discussions of the tasks not just listening to others talking.

As can be seen from figure 2 above, the seating plan is linear. In the right hand side picture one learner is making a contribution and the rest of the learners are listening. This implies that learners can learn from each other.

Lecturer 6: We are remaining with few minutes, can you do it as quickly as possible. Are you through? Are you through?

Learners: No (Some groups said no indicating that they were still working on their assigned tasks).

Lecturer 6: Try to do it fast. How far are you? (Lecturer moved around to check on the groups which were still discussing their task)

Learners: we are almost done.

Lecturer 6: You are almost done? Right. Am sure we are done. Can you go back to your original groups now? Right, this time in each group we are having an expert. Right, for the sake of time can we go back to our original groups and share what we have? and in each group we have an expert on that part, so you as an expert you are going to share to your friends. So we will start by number 1 in each group, you will discuss what you have learnt to your friends (in their home groups, learners started discussing/sharing what they had learnt from the expert groups. It was observed that some groups were still working on their task even though the lecturer had instructed them to start making presentations).Others are

free to argue or ask questions. (Teacher gave autonomy to learners. Learners- the experts started sharing information with their home group members).

Lecturer 6: Are we through with our presentations? Are we through with our presentations? Right, eeeem I am sure you are through. Are you through sharing the presentations? Am sure you have finished. Am sure from the presentations you have shared as a group you now have the information. Right this time, from this group can you tell us what you know about asexual reproduction? (a learner stood up to give an answer)

Learner 6: It develops into another plant.

Lecturer 6: Eeeem, eeeem , good. It develops into another plant. Can you give us some more information for example cuttings? Can you raise your voice?

Learner 6: a bud of a plant and another bud join or combine them to make a new plant.

Lecturer 6: Yes, eeeeh, of the two , if one of the plant. Yes budding, what happens with the buds?

Learner 6: You cut the bud and they will merge and become one plant.

Lecturer 6: Are we going to have the same fruits?

Learner 6: yes

Lecturer 6: Why? Do you think these plants will have different characteristics?

Learner 7: If the plant is a good variety and the other a poor variety, the good plant will help the other to become a better variety.

Lecturer 6: Thus true. Now this other group (after group 1 members presented their work, lecturer went to another group). Can you explain what happens with the cuttings?

Learner 8: Eeeeh , aaah, to make one stem and produce an offspring

Lecturer 6: Raise your voice ..

Learner 8: The off spring will be the same because they are of the same spices.

Lecturer 6: Is there any reason for that?

Learner 8: They make one stem and make one plant and produce the off spring of the same spices

Lecturer 6: Yes. that group you should present something on advantages and disadvantages of asexual reproduction (lecturer wanted another group to make a presentation). Yes, can you tell us some of the advantages and disadvantages of asexual reproduction? (Learners raised hands up and lecturer pointed at one of them to give an answer to the question).

Learner 9: stems and bulbs

Lecturer 6: Try to raise your voice.

Learner 9: stems and bulbs

Lecturer 6: Very good. But I just want now to know from you. Can you put your pens together in front of your desks? (learners did as instructed). If I pick a pen the owner is supposed to say something or respond to a question or what s/he had learnt. I want you to

give me the examples of asexual plants. Can you tell two or three examples of asexual reproduction? What are really these examples of asexual plant, just an example? Holding a learner's pen he asked the owner of the pen to give an answer.

Learner 9: Parts of the plants used such as roots, stems and bulbs

Lecturer 6: Parts of the plants used such as roots, stems and bulbs. You have that, bamboos. Yes. Which is an example of plant which can make bulbs?

Learner 10: onion

Lecturer 6: Onion, good another example of plant? repeated the learners' answers (**explanation method**). He then encouraged the learners to come up with series of questions based on parts of plants and their method of reproduction pertaining to asexual reproduction

Learner 11: bananas

Lecturer 6: So we have a number of them. Any other examples. Now examples of plants that can produce suckers? (Learners raised hands up and lecturer pointed at one of them)

Learner 12: Bamboos

Lecturer 6: Now the last group. (The lecturer asked the last group to have their work presented. A member from the last group stood up and made a presentation). What resources can you use when teaching this topic? What do you think can be used?

Learner 13: Parts of plants

Lecturer 6: Parts of plants. For which part of reproduction?

Learner 14: Sexual reproduction

Lecturer asked follow up questions based on the learners answers; and clarified where possible. It was noted that one learner was tasked a lot. When a learner answered a question the lecturer asked him/her to explain the concept- this probed the learner's understanding of the topic.

Lecturer 6: Sexual reproduction. What else? What things will you want to use to teach this lesson, what are you going to use? from this lesson what resources you can use when teaching this topic?

Learner 14: Stems, rhizomes and onions, drawings

Lecturer 6: Drawings, maybe it will not produce the real thing or picture of that thing

Learner 15: Real objects

Lecturer 6: Real objects. Good. Any other thing can be used to show real things. We can use the local environment because there are plants around

So these are the resources which we can use to teach this topic. With these resources it will be easy to teach the lesson and will instill knowledge to learners.

(Learners gave answers while teacher wrote on chalk board. In some cases teacher failed to name learner as a result they simply pointed at a learner and said yes...

Teacher's roles: guiding learners in the lesson, supervising and monitoring learners' activities, giving/assigning tasks, distributing resources.

Lecturer 6: Good. Now this time around let's stand up. Get somewhere to write. Get somewhere to write. So I want you to write a letter to the author. Do you know what an author is? Tell him what you have learnt today, start with dear telling him, today we have learnt so, so ,so! Be brief. Do that quickly. (Every learner was busy writing in his/her note book a letter to the author explaining what they had learnt on the day. After two minutes, the lecturer stopped the activity. However, most learners were still writing their letters). Right, I want you to read the letter you have written whether to your parents or someone. Who can start? It seems everyone is busy writing. He pointed at two learners and asked them to stand in front of the class. (learners while standing in front of the class: read the letters).

Learners: Yes, Sir (some learners responded in agreement to the lecturer's observation that everybody was busy writing. Nevertheless, a learner rose up and went to the front to read her letter to the author)

Lecturer 6: Good, next! (Another learner stood up, went to the front and read his letter).

Eeeh, so you wrote researcher as your author, okay

Learner 16: (smiling) yes, sir.

(Method: a letter to the author- lecturer just told learners to state what they had learnt. However, in this method learners can also ask questions, express agreements or disagreements, give own examples on a topic, raise critical objections. Besides learners should have formed groups to exchange and discuss the contents of the letters. There was need for a summariser of ideas in each group. Finally, the summariser should have given a report to the whole class about the main issues raised. This method, a letter to the author, is one way of lecturer assessing if learning had taken place).

Lecturer 6: Okay, thank you. You can check in your books on page 39, we have a list of things and you can use the internet to supplement what you have learnt. This marks the end of the lesson. Let us rush to the kitchen for tea so that we will not be late for the other lesson but before you go bring the books back. (Learners returned the text books and rushed out for tea).

25th January, 2019

Lecturer 6: Lesson 2

Subject: Science and Technology

Topic: Seed Dispersal.

Time: 11.00- 12.00

Teaching and learning resources: Science and Technology text books, different seeds and chart papers

Class size: 23 learners

Seating arrangement: linear- all learners faced the chalkboard where the teacher was standing

Lecturer 6: Good morning class

Learners: good morning sir.

Lecturer 6: We are proceeding from where we stopped last week. Can you stand up? (All learners stood up). Talk to your friend close to you and remind each other what we did last week. Learners shared notes as seen in figure XX and then pairs presented to class what they had discussed. Use of learners' previous knowledge by the lecturer to connect with the new lesson.

Lecturer 6: Ok, any pair to share us?

Learners: Raised hands up. Lecturer pointed at one learner to give answers.

Learner 1: parts of plant, types of pollination.

Lecturer 6: Today, we are going to look at seed dispersal. I want you to write the meaning of seed dispersal. I give you 12 seconds, quickly'.(Lecturer used quick write method of teaching).

Lecturer 6: 'Who is ready to give the meaning of seed dispersal?' (Use of question and answer by the lecturer. Learners raised hands up- lecturer pointed at learners to answer).

Learner 2: the scattering of seeds or fruits away from parent plant.

Learner 3: the spread out of fruits or seeds from the parent.

Lecturer 6: any similarities between these two definitions?’(Encouraged critical thinking and analysis in learners). The definitions here are very correct. From the definitions, is there anything important?

Learners: No (chorus response)

Lecturer 6: I want you to be in groups of 4. In your groups, discuss the importance of seed dispersal. (Learners discussed the importance of seed dispersal. After five minutes the lecturer told them to stop the group discussions. All groups were working on a common task. After discussing the question the lecturer advised the groups to disband in order to form new groups).

Lecturer 6: Please count yourselves from 1 to 4. (Learners counted themselves from 1 to 4 while in their home groups). Ok, the 1s to remain and the 2s, 3s, and 4s to move away. The 2s to move two steps clockwise, the 3s to move three steps and the 4s to move 4 steps clockwise. Each work station will be visited by members from other groups. The ones should share and the visitors do the same. (the 2s, 3s and 4s moved around, visiting each group to learn from and share their answers. Finally, the lecturer asked one learner to say the expected answers to the whole class. This is a modified version of one stays three astray teaching practice. Under one stays and three astray groups were supposed to have different

tasks not a common one. Learners shared what they brought from their home groups. Each group had new members).

Learner 4: Prevents over-crowding, reduces competitions for light, water and nutrients, reduces diseases, and increases chances of survival of species.

(Finally the lecturer added some points and then explained about them an element of teacher centredness).

Lecturer 6: Now, write the types of seed dispersal that you know. (Learners quickly wrote something in their note books). Can I have answers from you? (Lecturer pointed at one of the learners who raised their hands up).

Learner 5: Wind dispersal, explosive mechanism, water dispersal and animal dispersal (Lecturer encouraged individual work in the learners. In this case the lecturer was assessing the learners if they understood the types of seed dispersal).

Lecturer 6: be in 4 groups. I will share books and look at the type of dispersal corresponding to the group you are belonging to, i.e. group 1 type 1, group 2 type 2, group 3 type 3, group 4 type 4. I will also share different seeds and paper to groups to come up with characteristics of seed dispersal. So group 1 to discuss wind dispersal, group 2 explosive mechanisms, group 3 water dispersal, and group 4 animal dispersal. (He then distributed Science and Technology books, different seeds and chart papers to groups).

Lecturer 6: come up with characteristics of seed dispersal method assigned to your group'.
Group secretaries to record the answers on the chart papers. (Distribution of teaching and learning resources was mostly done by the lecturer; this means there was less empowerment to learners. Learners discussed characteristics of each type of seed dispersal. Later after 5 minutes lecturer asked;)
Are you through?'

Learners: yes. (This is group discussions although it started as Jigsaw teaching practice).

Lecturer 6: Each group to display their work on the chart papers and one member from each group to explain what they had written. The other learners should walk around to learn from other groups' work. Finally the members who remained in the groups must have a walk around as well to get information from other groups -gallery walk teaching method.

Learners: did as instructed. i.e. (Groups displayed their work on chat papers and learners walked around to learn from other groups' work. Finally the presenters had a chance to walk around as well to get information from other groups)

Lecturer 6: Any characteristic that you need further explanation or clarification about?
(Some learners asked questions. Then lecturer explained and clarified on selected topics.
This is explanation method commonly used under teacher centred method. It was observed

that the lecturer responded to questions from learners. He should have given chance to fellow learners to give answers first).

Lecturer 6: prepare a chair for anyone who can come and explain what we have learned.

Some learners occupied the chair one after another and explained what they had learned from the day's lesson -authors chair method. It is one form of formative assessment by lecturer.

(It was observed that distribution of teaching and learning resources was mostly done by the lecturer. The implication is that there was less empowerment to learners).

Lecturer ended the lesson.

27th February 2019

Lecturer 6: lesson 3

Time: 10 – 11 am

Topic: Teaching of Animals and Their Environment

Teaching and learning resources: chalkboard, chart showing invertebrates animals

Class size: 25 learners

Lecturer 6: good morning

Learners: good morning sir

Classroom sitting arrangement: group members both linear and circular

Lecturer 6: (Wrote on the chalkboard the subject name). Last time, we looked at plants and today we are going to look at animals. This is from your module page 40. Animals just like plants can be classified based on their characteristics; that is similarities and differences. There have been misconceptions about animals by learners. This time I want you to think of the misconceptions that learners have towards animals not only in primary school learners even us. Write at least one misconception in your notebooks,' (paused for a moment). Can you write them quickly? Compare your work with your friend next to you. Is it a misconception or truth? What is the misconception? Right, what are the misconceptions?.

Learners: quickly wrote the answers in their note books, raised up their hands and shared the answers with the class. Some of the answers were;

Frogs fall from the sky during rainy season

Some eyes of animals produce fire. For instance, cats, lion.

Some animals do not feed. For instance, SNAIL

Some animals for instance an owl foretells bad omen

Some parts of animals are not eaten by children for example offals, chicken claws.

Question and answer method

Certain animals are sacred e.g sheep (lecturer used quick write method of teaching).

Lecturer 6: explained the learners' responses, asked questions to learners to clarify their answers and/or findings. Wrote points on the chalk board as learners explained them.

Wrote both right and wrong examples for learners to either reject or accept them. Lets look at the classifications of animals

Learners: listening and jotting down notes.

Lecturer 6: as you go out there, try to iron out learners' misconceptions. Now there is animal classification. Some animals are not existing because of extinction; others hibernate e.g. frog and cat fish. The process of hibernation helps animals to survive and live for some time.(Lecturer transmitted knowledge, an element of teacher centred teaching).

Lecturer 6: I think we are in groups (he was referring to home groups). There will be four groups. Choose one member to be the secretary who should record the proceedings and finally the secretary will report your findings.Choose a competent secretary to document the points as you discuss the task because in the end there will be presentations. (Lecturer instructed learners to be in groups- their permanent groups. Learners went into groups as instructed. There were four groups of 4-6 members each in total. Lecturer gave a task to each group. Each group was given a different task to work on as follows;

Group 1. Analysing introduction of the topic; animals and their environment

Group 2. Classification of protozoa

Group 3. Characteristics of Mollusks and arthropods

Group 4. Survival mechanisms in animals).

Lecturer 6: Choose a silent participant to take minutes. Dont tell the secreatry what to write, and the secretary should not make any contributions towards the discussions.

(Observation: group 1 and 4 had both boys and girls but groups 2 and 3, there were boys only which means that gender was compromised. Learners worked on their assigned tasks in their groups. Lecturer went around, monitoring the group discussions, assisted those groups with problems, asked questions to group members for clarification of some points).

Lecturer 6: make sure that everyboby in your group is participating in the discussion and contributes to the points raised. (Learners read the text books on the assigned pages).

(Note: In some cases a group had two or more groups within it. Some members discussed between and among themselves the same task).

Lecturer 6: this activity is for 5 minutes. Time up. Can the silent participants for each group come forward to read to the group members what they have written down? After reading the points, each group is supposed to react to the reading. (Silent participants, one by one, read out what theyhad documented while group members listened).

Lecturer 6: Any member from your groups can now present your findings to the whole class.

Learners : one member from a group made a presentation while the rest looked on and listened.

Lecturer 6: explained some terminologies to learners.

Learners: made presentations about classifications of animals with examples and justifications. Learners taught each other. Lecturer gave further explanations where he felt it necessary to do so. All groups made presentations. They gave definitions of terms and adequate examples. Gender was followed.

Lecturer 6: what is the unique feature in reptiles? (follow up questions after some presentations)

Learner 5: they are cold blooded animals

Lecturer 6: what distinguishes mammals, birds from reptiles?

Learner 6: they are warm blooded animals. (lecturer taught with no resources at all. There were no resources available—learners might have used previous knowledge to arrive at a correct answer). After answering the questions then group reporting went on.

Learners: Group 4 secretary presented on survival mechanisms- Some animals change colors to protect themselves e.g. chameleon. Some animals produce poisonous fluid, while others have slippery bodies. Some animals fly or move away from their enemies.

Group 2 secretary presented on invertebrates which are protozoa and worms. (group work although it started like jig saw/bus stop).

Finally the lecturer pasted a chart showing pictures of invertebrates to consolidate work for group 2. He consolidated the learners work by explaining and clarifying some points about the topics under discussions. This marked the end of the lesson

Lesson observation details for lecturer 7

22nd January, 2019

Lecturer 7 Lesson 1

Class B

Time: 8.30 – 9.30

Subject: Science and Technology

Number of learners: 25

Topic: Teaching of plants and their environment

Teaching and learning resources: Primary School Science and Technology learners' books, syllabi and teachers' guide for standard 5-8

Classroom environment:: small fixed groups, chairs in linear arrangement, learners worked in pairs/groups, charts hang around the walls

Lecturer 7 entered the classroom. Hello class.

Learners: hello sir!

Lecturer 7: This is time for Science and Technology . He wrote the day's date, the topic of the day's lesson and the subject name and drew lines on the chalkboard while learners silently looked on. All learners were seated in linear arrangement facing the chalkboard where the lecturer used to sit/stand when teaching. After 3 minutes he started teaching;

Lecturer 7: Right, last time we were looking at the topic resources and we also analysed where we can get these resources. Can someone share with us where can we get teaching learning resources to be used when teaching Science and Technology ? Who can tell us where we can get them? (Teacher paused for a moment to wait for learners' responses. Some learners raised up their hands). Yes, madam!(Pointed at a female learner).

Learner 1: From the local environment (one learner gave a response while the rest listened and looked on).

Lecturer 7: From the local environment. Well done. You can get teaching, learning and learning resources from the local environment. So can you look around which resources can you use to teach learners? Can you look around? (Learners were asked to look around while they were seated in their chairs in the classroom) Which re? Teaching, learning and resources, teaching learning and assessment resources from the local environment which you can use to teach learners any topic in primary schools? (Teacher paused for a moment to wait for learners' response. Some learners raised up their hands). Yes (while pointing at another female learner)

Learner 2: Flowers (learner gave an answer from her memory because there were no flowers in the classroom)

Lecturer 7: Yes, flowers where do we get flowers from? Yes ----- where do we get flowers from? (Paused for few minutes, waiting for some learners to raise hands. Pointed at one learner to give an answer to the question). Yes!

Learner 3 (female): we are getting flowers from the local environment like plants.

Lecturer 7: Yes I understand we get flowers from the local environment but exactly where can we find the flowers? (Pauses to wait for a question).

Learner 3 (same female) raised hand: flowering plants. (As the learner gave the response, the rest of the learners just listened and looked on. The lecturer just talked to one learner until she finished and the lesson continued upon the lecturer being convinced by the learner's responses).

Lecturer 7: Alright, you mean the flower?..... the flowering plants eeeeti? Ooh fine! so today we are going to learn teaching of plants and their environment (paused for 3 minutes while writing on chalk board). Right, as proposed by our friend that we can get teaching, learning and assessment resources such as flowers from the local environment especially from plants we are going to learn how we can teach plants and their environment especially in primary schools especially in primary schools. Can.....(paused for a minute) I have group mem... group leaders to come and collect theeeee reference mat..... I mean the text books that are used in primary schools? Leaders one per group. (Group leaders collected standard 5-8 Science and Technology text books from the lecturer. i.e.

distribution of text books was done by the teacher himself. The text books were brought to class by the lecturer himself).

Right, with you, you have books especially from standard five up to eight teachers' guides aah teachers' guides and learners' books. Also I have a syllabus the teaching syllabus. I want you to analyse topics that are taught in standard five, in standard six, seven and eight. Analyse topics that are taught aah wait in standard five, six, seven and eight especially that covers plants and their environment only topics that covers plants and their environment put them in the table like this one (teacher drew table on chalk board and shown to learners. Learners seated in linear arrangement facing the chalkboard while listening and watching)

Class	Topic

Lecturer 7:Right have the table like the one on the chalkboard and list topics that are taught in primary schools especially concerning plants and their environment.

(Learnersin groups of 4 members each discussed and listed the topics on plants and their environment while lecturer was moving around to check work progress, assisted those with

problems, listened to the ongoing group discussions. Learners organised themselves into group discussions. Each group had a secretary who took main ideas from the discussions).

Some of the statements caught by the researcher as learners were in group discussions:

Learner: Musitandard 5 mwapeza chani (what did you find for standard 5)? ndiye sunapeze? Aise talembani (so you didn't find the answer? Please, write). Ndiyambula nawo zomwe mukulembazo eti? (Can I just copy what you have written??) Learners were heard discussing the task at hand; some learners were seen writing/ taking notes, comparing their work with fellow learners. After 5 minutes the lecturer continued talking;

Lecturer 7: (while standing in front of the class, near the chalkboard): Now stop, stop, stop aah this point at this point I would like a group representative to share to the class what topics are taught in primary school curriculum that topics about plants and their environment. Send a group representative to make a presentation for your group. Tell us what you discussed. Group representatives! Let's start with group number one. A representative from group number one can shhh.... can you share with us topics that are taught?

(The lecturer determined how much time to do an activity, which group to start making presentations, whether learner should make observations/remarks or not. Learners prepared their work on chart papers. Group leaders pasted their chart papers and made presentations to the class. A learner from group one went in front, made a presentation and lead plenary discussions based on the presentation. Later, other members from the

remaining groups did the same. However, the lecturer advised that a point which was mentioned by one group needed not to be repeated)

Learner 4: (female learner rose up and walked to the front to present group 1 work): Topics that are taught in primary schools.

Lecturer 7: Yes

Learner 4: In class five, there is relationship between plants and animals, in standard six ...
(Teacher interrupted presentation)

Lecturer 7: I would rather love if you can mention unit number if possible where we can have that topic.

Learner 4: (rushed to the group members to check the required information) Unit 11 The relationship between plants and animals that's class five. Standard six, the external parts of the plants. (lecturer interrupted again)

Lecturer 7: Unit ?

Learner 4: Unit 10

Lecturer 7: Thank you

Learner 4: Standard seven parts of the plant, unit 12

Lecturer 7: unit 12

Learner 4: Seed germination unit 6 pollination fruit and the seed dispersal
unit 5 that's all .

Lecturer 7: Thank you very much clap hands for the group. Aaamu do we have any group that have different topics? You have come across a different topic from what group one have listed that are taught in primary schools which talks on which talks about plants and their environment?

(Learners raised up hands)

Lecturer 7: That's group number???

Learner 5: four

Lecturer 7: two??

Learner 5: four

Lecturer 7: four yes! Representative, can you come in the front and share with us?

(Female learner from group number 4 went in front of the class to present their work).

Learner 6: In standard seven

Lecturer 7: Listen (lecturer said this after noting that there was some background noise from the other learners)

Learner 6: standard seven, unit four. Flowering and.. flowering and non-flowering plants. Standard eight, unit 12. Technologies for conserving the environment

Lecturer 7: Any question on the last topic?? Don't go, don't go, don't go (teacher told learner/presenter not to go back to her seat-the reason was that she should answer any questions that might have come from fellow learners for clarity sake). Technologies and what?

Learner 6: Technologies for conserving the environment

Lecturer 7: Technologies for conserving the environment. Do you think that topic covers plants and their environment? How does the topic cover? How do you think technologies and their environment covers the plants and their environment?

Learner 6: we are saying that that topic covers plants and animals.....when we are conserving the environment we use technology

Lecturer 7: now can you assist? (lecturer asked another learner from group 2 to assist the presenter in justifying how technologies assist in conserving the environment)

Learner 7: We are saying that when we are conserving the environment we are also conserving plants and animals.

Lecturer 7: Can you read again that topic?

Learner 7: Okay we are saying that we are saying that topic covers plants and their environment when you conserve the environment you will also conserving plants .

Lecturer 7: Can you read again the topic?

Learner 8: technologies for conserving the environment

Lecturer 7: technologies for technologies for conserving the environment. So how can we use that topic, I mean how can we relate that topic as related to plants and their environment, in what way?

Learner 8: technology is there to protect the environment.....they also conserve the environment. (Learner tried to clarify her points by using examples. Lecturer simply said okay after the learner's answers. Gender was observed by lecturer).

Lecturer 7: anyone who wanted to add? Someone wanted to add? (some learners raised up hands), yes! (while pointing at one learner)

Learner 9: Yaaa If you look the meaning of the environment it refers that its the total surrounding of the living things meaning to say that there is including of the vegetation which is which are plants so we put we put that topic under teaching of plants and their environment.

Lecturer 7: Thank you very much. Aaah a big hand to group 4. So this point we will still be using the aaah teachers' guides and the syllabus to analyse knowledge, skills, attitudes and values that are covered when learners are taught the topic plants and their environment in different classes. What I want you is to identify or to explore the knowledge, skills, attitudes and values which you think learners should develop as they learn the topic plants and their environment so as the case with the first activity this one should also put on a table like this one. (Lecturer drew a sample table on chalkboard and divided it into five columns. He wrote the headings for each column. Learners were silent, observing as lecturer drew the table.

Class	Knowledge	Skills	Attitudes	Values
5	How	Observing investigating	curiosity	

6	External parts of plants	Communicating experimenting
7	Types of leaves, stems and roots	Recording classifying
8		

After three minutes, the lecturer continued speaking).

Lecturer 7: The last table you will combine attitudes and values so we are going to have class, knowledge that are taught. What do you think knowledge are taught also skills learners or what sort of knowledge should learners develop when they learn the plants and their environment, also skills learners should develop when they learn the topic plants and their environment especially standard 5, especially standard 6, especially standard 7 and finally especially standard 8 so you need to analyse the knowledge, skills, attitudes and values learners should develop when they learn this topic plants and their environment (lecturer explained the task/activity while facing and pointing at the chalkboard using a ruler).

Lecturer 7: You can begin (learners studied and analysed the teachers' guides, learners' books and the curriculum for standards 5 to 8 in their small groups of 4 to 6 members. They discussed their observations- the lecturer moved around checking and monitoring learners'

work progress, giving them clarity on the task, and assisting the learners. He also made clarifications to some learners who didn't understand the task. He visited each and every group. Learners were allowed to ask questions to the lecturer as he moved around). Figure 7 shows a lecturer assisting learners during group discussions



Lecturer assisting learners during group work

As an example, to show how lecturer assisted learners, he was heard saying, ‘at least two lines for each class. The last activity you have five topics so what sort of knowledge do learners develop which learners should develop as they learn the topic plants and the environment say in this case standard 6 and you will go as far when you are done with the knowledge, go to the skills and you will also go as far as skills attitudes and values. Clear?’
(The discussion went on for over ten minutes)

Learner 10: Yes sir! (Learners of a certain group responding after the lecturer had explained/clarified to them about the task).

Lecturer 7: 2 minutes to go, 2 minutes to go. (Then, he moved around again to check progress on learners’ work).

Lecturer 7: Stop, Stop, stop, attention. I think as a group we have discussed knowledge, skills, attitudes and values that are covered in primary school curriculum especially when in learning area Science and Technology . Can we close the books? Close the books! Close the books! (Lecturer briefly looked on and then said stand up! Learners stood up and listened to lecturer’s instructions). Move around quietly. So we will be moving around after I have clapped a hand, aah hand. Then you are going to stop, form pairs and share the knowledge, the skill, attitudes and values that are covered in primary school curriculum. Clear?

Learners: Yes!

Lecturer 7: So once I clap hands, move around don't move the chairs so that they should make noise but should move around quietly and when I clap hands for the second time, stop and share the knowledge, the skills with a friend close to you (Lecturer clapped hands once, learners moved around. Then he clapped hands twice, learners stopped walking around. Learners were observed discussing in pairs and writing what they had shared).

Lecturer 7: Yes, move around (clapped hands once. Learners did as instructed). Clapped hands twice. Please stop and find a friend and share what each one has. Discuss in pairs. (as learners were exchanging ideas in their pairs lecturer was moving around and supervising. After clapping hands for a number of times and learners made a good number of pairs, the lecturer said); Thank you very much. Go back to your places; go back to your places (Learners went back to their seats). Sit down, sit down, sit down. Right, let's come to sharing (moving the chair aside). What have we shared, the topics covered in standard 5, 6, 7, and 8 especially that covers plants and their environment. (Learners raised hands). Come, yes come and sit in front on the chair which is in front. (One learner moved to the front and sat on the chair)

Learner 10: Aaaah, in standard 6 topic; parts of the plants, knowledge needed external parts of the plants

Lecturer 7: (writing on the chalkboard) No let's begin by topic carried, covered topics first

Learner 10: Class standard 6

Lecturer 7: Standard 5

Learner 10: Okay. class standard 5, aaa knowledge, how plants and animals

Lecturer 7: I thought you were saying parts of the plant as a topic

Yes, Standard 5

Learner 10: The relationship between plants and animals

Lecturer 7: Is the one who is sharing us.

Learner 10: The relationship between plants and animals.

Lecturer 7: The relationship between plants and animals (lecturer repeated what the learner had said while writing on the chalkboard). Standard 6?

Learner 10: Standard 6, Mmmmm topic: Parts of the plants

Lecturer 7: Parts of the plants. As a topic ?

Learner 10: Yaa

Lecturer 7: Not knowledge?

Learner 10: Yaa , as a topic (Lecturer wrote on the chalkboard)

Lecturer 7: Is it true that in std 6 we have parts of a plants as a topic ?

Learner 11: Wwwwhhh!! As a topic? The external part of the plants, as a topic?
Mmmmm.

Lecturer 7: Some are saying no , some are saying yes. Come again, (Wrote the topic on chalkboard)

Learner 10: The external parts of a plant

Lecturer 7: Okay , the topic is the external parts of the plants. So the topic is external parts of the plants. Standard 7?

Learner 10: In std 7, Parts of the plant, Parts of the plants

Lecturer 7: Do we have such topic in standard 7?

Learner 10: Yes

Lecturer 7: Okay, Part of..... (Learner 10: the plants). Parts of the plants (wrote on the chalkboard). Standard 8?

Learner 10: Up to standard 7

Lecturer 7: Okay, thank you. A big hand to the presenter. (Presenter went back to his sit). Right! Yes Sir (pointing at a learner), can you share the topics that are covered in standard 8 especially on plants and their environment? Come in front. Quickly! (Another learner come in front to present and take a seat).

Learner 11: In standard 8, its technologies for conserving the environment

Lecturer 7: Come again!

Learner 11: Technologies for conserving the environment.

Lecturer 7: Technologies is for conserving the environment (writing the topic on chalkboard). Fine. These are some of the topics that are taught in primary school curriculum especially on the topic plants and their environment. In *standard* 5, we have the relationship between plants and animals while in standard 6 we have the external parts of a plant. In standard 7 we have parts of the plants and finally in standard 8, we have technologies for conserving the environment. Now let's come to knowledge, skills, attitudes and values covered in primary school curriculum. (learners raised up hands). Yes,

madam can you come and share with us what sort of knowledge, skills, and values?
(learner moved from her chair to the front). Take us through class by class.

Learner 12: In class 5 : the knowledges, knowledge that primary curriculum covers.....

Lecturer 7: Come again

Learner 12: In class 5, the following are the knowledge, how plants and animals benefits from each other in the environment (lecturer wrote on the chalkboard, asked the learner: how plants and ?). Animals benefit from each other in the environment.

Lecturer 7:Right

Learner 12: Skills ; observing, investigating

Lecturer 7: Skills; observing, what else? Come again.

Learner 12: investigating

.

Lecturer 7:Ahaa

Learner 11: Attitudes and values, curiosity

Lecturer 7: Yes. So curiosity, is it a value. I mean a value or an attitude? Is curiosity a value or an attitude?

Learner 12: an attitude

Lecturer 7: It's an attitude. So once you mention a term, please specify whether it's an attitude or a value. Together? (learner responded: Yaa). So curiosity is an attitude (learner: Yes).

Learner 12: Cooperation

Lecturer 7: Cooperation. What is it?

Learner 12: It's an attitude

Lecturer 7: It's an attitude.

Learner 12: I have reservation

Lecturer 7: You have reservations? You say cooperation is an attitude. You have reservations? (learner: Yes), Yaa, what is it?

Learner 12 : I think that one is a value

Lecturer 7: Cooperation is a value. In what way should we consider cooperation as a value, not an attitude? Yes Madam (lecturer chose a learner to answer).

Learner 13 : Aaa, I think just because cooperating if one is going to cooperate cooperation

Lecturer 7: Come again

Learner 12 : I think cooperation, is a value just because its will.. if the learners are value cooperation They have to choose to be cooperative. Not they are forced to.

Lecturer 7: Okay . So point to become an attitude it should be?

Learner 12 : ha ha ha

Lecturer 7: It can no longer be an attitude . Thank you very much. Can you take us through standard 6?

Learner 12: The knowledge, External parts of a plant. (lecturer wrote on the chalkboard)

Lecturer 7: External parts of a plant. Skill, any skill?

Learner 12 : Communicating

Lecturer 7:Communicating. Any skill

Learners 12: Experimenting

Lecturer 7:Come again

Learner 12 :Experimenting

Lecturer 7:Experimenting, experimenting, any skill?

Learner 12; Investigating

Lecturer 7:Investigating etc. Right, Values

Learner 12: Honesty

Lecturer 7: Attitudes

Learner 12: Resourcefulness.

Lecturer 7:Resourcefulness. What have you?

Learner 12 : That's all

Lecturer 7: That's all. Thank you. Are we together with the presenter?

Learners: Yes.

Lecturer 7: A big hand to her. Standard 7 quickly take us through, knowledge, skills covered in standard 7. (One learner raised his hand). Yes sir, Yes, come in front quickly. (Learner went in front and took his seat).

Learner 13 : Knowledge

Lecturer 7: Yes

Learner 13 : Types of leaves

Lecturer 7: Come again

Learner 13: Types of leaves, stems and roots

Lecturer 7: (wrote on the chalkboard) Types of leaves, stems and roots.

Learner 13: Skills; recording, classifying, and inferring.

Lecturer 7: (wrote on the chalkboard) Skills: recording, classifying and inferring, inferring.

Attitudes or values?

Learner 13: Curiosity, honesty, objectivity, appreciation and cooperation

Lecturer 7: (wrote on the chalkboard) Curiosity, honest, objectivity, appreciation and cooperation. A big hand to the presenter (Learners clapped hands). Finally, standard 8, standard 8. Yes madam at the back. In black jersey. (Learner walked to the front). Get seated. What sort of knowledge do learners develop as they learn in the class and their environment in standard 8?

Learner 14: Activity that can lead to destruction of the environment

Lecturer 7: Activities that can lead to the destruction of the environment. It's the knowledge, Knowledge of the activities that can lead to the destruction of the environment. Any other knowledge?

Learner 14: Technologies for conserving the environment

Lecturer 7: Technologies for conserving the environment. Good, What about skills?

Learner 14: Perseverance, perseverance

Lecturer 7: Perseverance

Learner 14: Curiosity

Lecturer 7: Curiosity, Are these skills or attitudes?

Learners: Attitudes

Lecturer 7: You are sharing us attitudes. Thank you very much.

Learner 14: Skills- Observing, investigating, recording

Lecturer 7: Observing, investigating, and recording. Thank you very much. Go and sit. (Learner got seated). Aah, at this point, a big hand to the presenter. At this point in time may group leaders collect the books and Group leaders quickly please do so (group leaders collected the books). Attention aah next time we are going to learn about classification of plants, that's tomorrow. Tomorrow we are going to learn about classification of plants. Any question from what we have learnt today? Do you have any question from what we have learnt today?

Learner 15: Yes

Lecturer 7: Yes

Learner 15: Between attitude and values, what is perseverance?

Lecturer 7: Between attitudes and values, what is perseverance? Anyone with a quick answer to her question?

Learner 16: Attitude.

Lecturer 7: It's an attitude. Clear, when does it become an ethic? Because values it's about ethics that should that scientist follow when they are working in their field of Science. Are we together there? So the way you have presented perseverance should be an attitude. But when you talk about values you talk of ethics. What deemed to be correct or what deemed to be right when science, when scientists are discharging their duties that's what these are all about. So are you clear madam?

Learner 15: Yes

Lecturer 7: Now you can go for your healthy break.

25th January, 2019

Lecturer 7 Lesson 2

Topic: teaching methods

Time: 8.30 – 9.30

Class size: 25 learners

Lecturer 7: hallo class!

Learners: hello sir

Classroom environment: learners already seated in permanent, small groups of 5-6 members around tables, chalk board used most oftenly, chart papers available.

Lecturer 7: in the last lesson you learnt about teaching methods. Can you remind me about the methods you identified in the previous lesson? Methods which should be used by teachers to teach? (Learners raised up their hands. Lecturer pointed at a learner at a time)

Learner 1: group work, gallery walk, brainstorming, pair work, mix-freeze-pair, think-ink-pair-share). Lecturer used question and answer strategy.

Lecturer 7: So it means teachers use various methods when teaching various learning areas? Among these methods which ones are used to teach Science and Technology ?

Learners gave answers accordingly.

Lecturer 7: So today, we are going to explore methods that we can use when teaching Science and Technology . Last time you were given topics to research on.(Wrote the topic of the day's lesson on the chalk board. Different topics were assigned to different groups in the previous lesson to prepare lessons to be delivered in the current class). Discuss your topics what they are all about.

Learners: in 4 groups of 5-6 members discussed their topics and prepared to teach others.

Lecturer encouraged use of research method in learners. You will be expected to teach others in groups. Then he wrote on the chalk board the methods to use when teaching Science and Technology .

Thereafter he also wrote topics which the learners did a research on before the day's lesson.

Skeleton.

Coordination.

Matter.

Force and pressure.

Mixture.

Lecturer 7: Can you count yourselves from 1-5? Form new groups. The 1s should be in one group, so too with the 2s, 3s, ...5s. Each group will have an expert to teach others from the other groups, i.e. each group has one person who is an expert from a different group. Share what you discussed in your home groups.

Learners formed new groups. The expert groups discussed different topics as assigned by their lecturer, i.e. in the new groups each expert explained what he/she had learnt from his/her home group's discussions. Each learner was observed reporting/ explaining to other group members what they had discussed. The topics were those which the learners had researched on.

Lecturer 7: moved around the groups checking progress of the reporting/discussions, listened to learners leading group discussions. Please stop whatever you are doing.

Learners: mmmmmmm sir, we have not finished yet! Give us more time.

Lecturer 7: i give you 2 more minutes. (after 2 minutes).Can you stop whatever you are doing now? Thank you, can you go back to your original groups? Now share what you have learnt from the expert groups.

Learners went back to their home groups and shared whatever they had discussed in their respective expert groups.

Lecturer 7: thank you very much. Stop!! Stop!! Quickly can you share what you have captured, that is, the information that you got from your assigned topic? Let's begin with the group that was assigned on skeleton. All secretaries for the home groups made presentations in a form of teaching by using LCT methods starting with Group 1, then 2. Etc. The learners practiced teaching using some learner-centred teaching methods.

Lecturer 7: looked on as learners were discussing/reporting what they had learnt from the expert groups. He moved from one group to another to appreciate how the learners conducted the activity. He gave enough time for the discussions.

Lecturer 7: I want group representatives to report to the whole class what you have agreed on. (the topics under discussion were teaching of human skeleton, teaching of states of matter, ...the learners were assigned these topics in their groups during the previous lesson). Let the reportes come in front to report their work to the whole class

Learners: a representative from each group went in front, stood up, taught other learners. The presenter wrote important points on the chalk board. Other learners listened and jotted down points as their fellow learners taught. Some learners brought to class teaching and learning materials eg model of human skeleton- an indication of preparedness.

Learners 2: (Group 1 presented) skeleton is the frame work of the body.

TYPES

Endoskeleton: found inside the body.

Exoskeleton: found outside the body.

The human skeleton

Axial skeleton: skull, rib.

Appendicular skeleton: arms, legs

Functions

It gives shape of the body.

It gives support to the body.

Protect delicate parts of the body.

It assists body movement.

Lecturer 7: any questions that you want your fellow learners to answer?

Learner: why did the presenter about types of skeletons not include the hydrostaic type of skeleton in his explnantion?

Lectuer 7: a presenter from group 2?

Learner 2: a representative of group 2 went forward to teach about teaching of states of matter. He wrote some points on the chalk board as he taught. There was no interference from both the lecturer and the other learners.

Learner 2: Group 2 work

States Of Matter

Matter is anything that occupies spaces, has mass and volume.

States of matter

Solids

Liquid

Gasses

Plasma

Properties

Liquids:

Take the shape of the container.

Solids:

High intermolecular force

Are in fixed position

Have definite shape

Gasses:

Moves randomly.

No intermolecular force.

Plasma

Conduct electricity

Magnetism

Learner 2: Do you have questions from what I have taught you? He asked questions to fellow learners as form of informal assessment. This act ensured that the other learners were following the lesson. The lecturer just looked on as the presenters went on teaching and asking questions. Other learners listened, answered questions and took down important points. All answers given by fellow learners were correct.

Learner 3: can you give an example of a plasma that does not belong to gas, solid or liquid? Some learners answered the question.

Lecturer 7: alright, we have been taught by our fellow learners. From the lessons presented, what are the shortfalls of the two presenters? Were the teaching and learning methods used effectively? Justify your answers. (Lecturer asked this question to the whole class. He

wanted the class to analyse the lesson to come up with shortfalls as the lessons were being presented by fellow learners. Fellow learners gave their opinions on how the lessons should have been taught).

Learners: use of teacher centred, no resources used, no continuity. It was a higher order question, demanded analytical, critical and application skills from learners. The lecturer used question and answer teaching practice.

Lecturer 7: consolidated the lesson. and ended the lesson

Lecturer 7: thank you very much. Remember when teaching use different methods. This is the end of the lesson.

Lecturer 7

5/02/ 19

Lecturer 7: lesson 3

Science and Technology

Time: 8.30-9.30am

Topic: animals and their environment

Teaching and learning resources: primary school text books and teacher's guides for standard 5-8, papers with a description of different tasks on each, chart papers with graphics.

Class size: 25

Lecturer 7: good morning

Learners: good morning sir

Lecturer 7: last time we learnt about classification of plants. (a reminder about the previous lesson). What did you learn about in flowering and non flowering plants?Who can remind us this? (Learners put their hands up).

Learner 1: We classified plants into flowering and non-flowering plants. Lecturer 7 repeated the learners' responses. He explained the points learners raised in order to clarify the points.

Lecturer 7: today we are going to do a similar thing but differently apart from plants, what is it? (Learners put their hands up).

Learners: Animals and their environment

Lecturer 7: today you are going to learn about animals and their environment (wrote the topic on the chalk board). Explained some facts about animals.....Think of challenges faced when learning about the topic animals and their environment in primary schools.Good. Have you ever heard it or experienced it? What were the challenges when learning this topic? And what are the solutions of these challenges as a teacher? Just think and write. Individually write the answers on paper and then share your answers with a partner next to you.

Learners: individually wrote about the challenges faced when learning about animals, then shared their points in pairs

Lecturer 7: Can the pairs share their points with the whole class?let's hear what you have discussed

Learners: pairs shared with the class as per lecturer's instruction

Learner 2: Lack of resources, e.g. elephants are scarce that cannot be used clearly as a resource

Learner 3: Some animals are dangerous to touch them e.g. a lion, a tiger, etc.

Learner 3: Solutions

- Use video clip

- Using locally available resources or improvisation

- Organize a trip to the places where learners can see these animals

Note: after the learners gave their views, the lecturer explained the concepts to clarify misconceptions, ie to build on what learners said in class. Very good, thanks, hand clapping were some of the reinforcement given to learners who did well in answering oral questions as one way of encouraging them.

At times lecturer entertained chorus answers. Learners were encouraged and allowed to ask questions for clarification. Lecturer asked individual learners to answer questions from fellow learners. He then added or subtracted some information from the learners answers as one way of fine tuning the answers

Lecturer 7: There have been misconceptions when learning this topic. For example;

1. Frogs drop from the sky
2. Meeting snakes is a bad omen
3. Animals like owl if found in our roofs is bad omen and because of these misconceptions, learners fear when learning about them

Lecturer 7: (Shared primary school learners' books and teachers' guides to learners). Let's look into the books and find the topics which are related or linked to this topic "animals and their environment".

Lecturer 7: study the primary school text books to see which topics are related to the topic under study today. The aim was to see if topics in TTCs were similar to primary school topics. (Lecturer used bus stop method of teaching)

Learners studied and analysed the primary school learners' books and the teachers' guides to check on topics linked or related to animals and their environment. For example, learners reported the following:

Standard 5 unit 8: classification of animals

Standard 6: none

Standard 7: invertebrates, vertebrates and livestock in our community

Lecturer 7: let's close the books and send them in front. (Learners sent/returned the books to the lecturer's desk)

Lecturer 7: count yourselves from one up to four. All ones must form one group, the twos in one group, so too with the threes and the fours. May all the ones occupy this stage, twos this stage while pointing to such stages. (Learners did as instructed. Lecturer distributed 4 questions on a paper, one to each group. He gave instructions about how the tasks would be done. He advised the groups how they would work on the tasks in their working stations. Each group had a different task). I give you 2 minutes for the task. (Each group had 6-7 members)

Lecturer 7: stop! Leave your work where you are and move from your work station to another to see or look at what your colleagues have done. Look at your colleagues answers. Discuss the possible answers to the question, then add or subtract answers to question. If you are subtracting a point from your friends work, you should just why your action.

Lecturer 7: explained about bus stop procedures to learners. When reaching to the stages, let's work on what is at the stage. Let's work! (Lecturer instructed learners to work on their assigned tasks; she started moving around to groups one at a time while giving instructions.

After a few minutes, lecturer instructed to leave their work station and go to another station). Alright let's go to another stage! (Clapped hands). May buses start moving please?

Lecturer 7: can you move to the third work station? After that please, go to the fourth station and do likewise. The activities in these stages are of different nature but pertaining to the same topic. Remember to read what other learners have done and just add yours

Learners: wuummmmmiii, wuuuuu.....(going to another stage).

Note: when learners visited a work station they read their colleagues' work first, made their observations about the colleagues work, edited or removed any points they considered wrong or incomplete with justification. There after they added their own points to their colleagues' work.

Lecturer 7: buses to move to the next stage (stage means work station). I hope that is the last stage. Work for 3 minutes and get prepared for reporting. prepare for presentations. I am giving you 3 minutes for that. You will report about work of the last work station which you finished with. (Each work station had been visited with each group. Lecturer moved around the work stations to monitor and supervise the activities).

Lecturer used the following teaching and learning methods: group work, think pair share, bus stop, explanations

Lecturer 7: can you start making the presentations now? Alright, let's begin from stage 1, start by telling activity and what information is there.

(Group leaders presented their work while others listened and jotted down important points. They reported what was there by mentioning the activity and what information was there). Can you verify if what has been reported is a correct version of your work? Please confirm if the points given are correct. (Lecturer asked the presenters and/or group members to clarify or justify some of the points raised. All groups were given the chance to present their work to the class. Later the lecturer explained or clarified some points).

Note: interaction with content was through reading text books, question and answer technique, discussions between and among learners, discussion with the lecturer, group discussions in groups of 6-7 members.

Lecturer 7: put up chart on the chalk board to show animal classification to learners. He explained to learners what was on the chart paper. He read what was on the chart papers and explained to learners about the concepts. Lecturer asked learners to differentiate cold blooded from warm blooded animals.

Learners: were listening, answered questions and reading about animal classification from the chart paper. All learners were in one big group seated in their chairs/desks

Lecturer 7: explained how they can grow a culture (it was an explanation only but no sample culture was shown). We can grow grasshoppers, houseflies, etc.

Hand clapping was used as reinforcement

Lecturer 7: explained about complete and incomplete metamorphosis and continued to ask learners as to what is the difference between complete and incomplete metamorphosis?

Learners: Gave their responses to the question

Lecturer 7: Ask your partner, what you have learnt today. One learner was chosen as resource person to answer questions from friends (use of resource person).

Lecturer 7: explained what will be taught in the next lesson. She advised learners to read about the topic from their module.

Note: Used explanation skill where charts as resources were used. Charts were effectively used and they were very clearly seen even at the back.

8 February, 2019

Lecturer 7: lesson 4

Subject: Science and Technology

Topic: Light Energy

Time: 10:00 – 11:00 am

Class size: 25

Teaching and learning resources:

Station 1: board and cards and sources of light.

Station 2: 1 beaker with soapy water

1 beaker with clear water

A straw.

Station 3: mirror

Station 4: trapezium grass.

Lecturer 7: We are going to share with our friends about light and its properties while in a circle. can you form a circle?

Learners: formed a circle as instructed by the lecturer

Lecturer 7: what are the properties of light? Think of the answer and share it with your friend close to you.

Learners; sharing the answer in pairs

Lecturer 7: change a partner and go for a new one.

Learners: changed partners and shared answers which they discussed with the first partner

Lecturer 7: please give properties of light based on your discussions in the pairs. Speak to all of us what you were discussing.

Learner 1: -light can be deflected.

-light has speed.

-light can form shadow when it is blocked.

Learner 2: -light can be refracted.

-light can be dispersed in different colours.

(both lecturer and learners participated in the discussions)

Lecturer 7: let's sit down and list properties of light. What are the properties of light?

(Learners sat down. Each learner wrote down what they thought were properties of light.

Later they reported to the class about light properties).

Learner 3: Light travels in a straight line

Light can be reflected

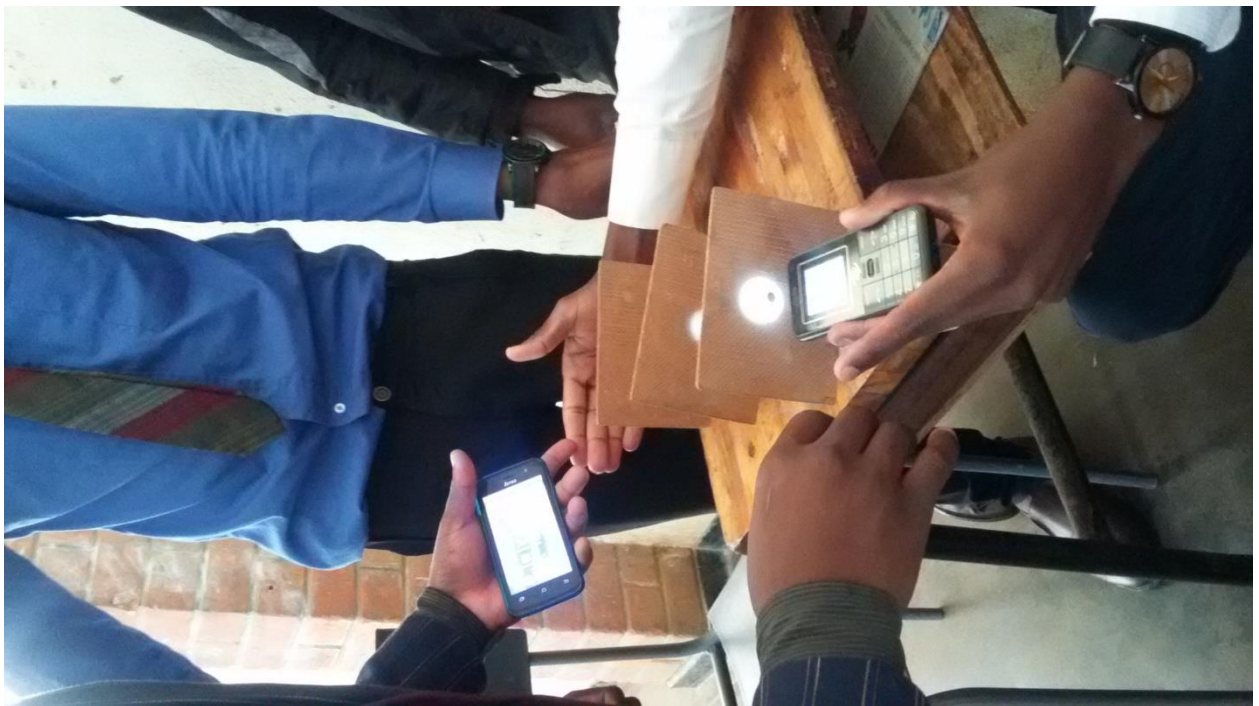
White colour can be dispersed.

Lecturer 7: we are going to be in 4 groups by counting 1 to 4. You are going to investigate some properties of light (she wrote on the chalk board the properties of light). Count yourselves from 1 to 4. (Learners counted themselves from 1 to 4).

Lecturer 7: All the ones will form a group and should come here going to the left then others at the center.

Lecturer 7 distributed triangular prisms, card boards, torch to learners through group leaders. I give you 3 minutes to investigate the properties of light mentioned above. Two groups will go outside and two groups will remain here. We will use the 'one stays three astray method' method of teaching. Make sure you investigate each property in your group. (Learners formed groups and occupied the spaces as instructed by the lecturer).

Group 1 was given apparatus of a beam of wood with card boards with holes at the middle and a candle to test if light travels in a straight line- see figure 8:



Second group was given a straw, two tumblers with clear water and the other with a mixture using a torch to investigate whether light can be refracted.



Figure 8: learners doing an investigation on properties of light

Group 3 was given a mirror to investigate change of direction of light. Finally, group 4 was given a trapezium glass to investigate if white light can be split into different colours – red, yellow green, etc. The experiments were done to investigate the properties of light).

Learners: discussed and performed the investigation/experiment about the properties of light with the lecturer's guidance. Groups kept changing working stations and type of task until each group visited all the work stations and did all the four tasks. Lecturer 9 monitored the activity. After sometime, the lecturer stopped the groups tasks.

Lecturer 7: moved around, checked and assessed learners work, explained to learners what was happening to light as it travelled from one point to another. You can now disperse but leave one member behind so that he/she can explain to visitors about what you have found during the investigation. (the learner left behind was an expert to explain to others how the experiment was conducted and the findings).

Lecturer 7: Alright, go back to your places. 20 minutes have elapsed. Can you disband your groups? (explained concepts about light like normal, reflected ray, incident ray, refracted ray, demonstrated how light travels from one point to another. Lecturer did not ask learners to report their findings about their investigations). Can you explain the procedures you can follow to investigate refraction? (learners used memory from their discussions).

Lecturer 7: The rule says the incident angle is equal to reflected angle. Why does this happen? Group 2, in your experiment the straw looked bent in the water and it looked as bigger as well as it passed through the water. Explain why a straw looked bent when put in water (Lecturer wrote on the chalk board by the aid of diagrams. Diagrams were drawn).

Learner 2: This is because water has higher density than air outside the beaker. it is because of refraction

Lecturer 7: how do we use this knowledge (properties of light) to everyday life? how do we use light travels in straight lines and refraction in real life situations?

Learner 2: application

Light travels in straight line.

A car travelling at night uses lights to see where it is going.

Photographers use the same with their cameras.

Lecturer 7: is what your friend said correct?

Learners: yes

Learner 3: Light can be reflected or refracted.

Cars use mirrors to see what is coming.

Microscope magnifies things to look bigger _ refraction.

Germs, bacteria can be enlarged and be able to be seen.

Lecturer 7: can you explain how reflection and refraction properties of light can be used in real life situations?

Learner 4: refraction and light travels in straight lines can be used by photographers when taking photos. Drivers are able to see pedestrians because the light is reflected to him/her so that they know what is coming ahead or behind him/her.

Lecturer 7: Can anybody explain what happens during photographing?

Learner 5: explained something

Lecturer 7: gave an explanation of the same after the learner's explanation as a way of emphasising the point. Later the lecturer led a class discussion of the same.

Lecturer 7: explained how refraction and reflection of light can be used in real life situations more especially with cars as mentioned by the learner. Then she gave the

following assessment questions where learners had to give aural answers; Reaching there, what are sources of light?

Learners: Sun and moon.

Lecturer 7: can you identify properties of light?

Learners: light travels in straight lines.

Light can be refracted

Lecturer 7: How can you investigate with your learners how light travels in straight lines?

Learners: raised hands up and gave answers to the question. One learner wanted to know if the moon was also a source of light.

Lecturer 7: she said yes the moon was a non luminous body- source of light. She also gave an example of luminous bodies of light like the sun, stars

Learner 6: is a torch a luminous or non luminous source of light? Another learner explained the answer to the question. Other learners also joined to give views on the question.

Lecturer 7: Lets stop here, the questions will be answered in the next lesson, we will continue tomorrow

Thus the end of the lesson; 11:02

Lecturer 7: lesson 5

Topic: properties of light

Time: 14.00- 15.00

Number of learners: 24

(Researcher arrived in class a bit late.....and therefore, missed the introductory part)

Lecturer 7: Angle one and from where that ray is directed from the mirror to somewhere else, it has also formed a ray, it is called the??

Learners: the reflected ray.

Lecturer 7: So the more you say it as an incident angle is equal to a reflected angle because this one has formed an angle which is the rightfull way you can speak again, and that one is also another angle. So this one is a reflected angle. So incident angle is equal to reflected angle (Lecturer drew diagrams on the chalk board which he constantly referred to illustrate her points) Lecturer 7: Alright then we have also observed that light can be refracted, how is that possible? Learner 1: this happens when light travels from one medium into another of different densities.

Lecturer 7: I hope you remember the ah the activity that we did to investigate that, may be with a traditional one which normally in primary schools we use that one of having a transparent bottle or a beaker that ah which you have filled with what?

Learners: Water

Lecturer 7: Water, and then you take anything in our books they use straw. You may use a ruler, you may use a ballpoint cover, anything that if you show it to the learners, like the way I do with this one am showing you (shows a straight object to learners), it is straight, not so? (Learners said yes). But now after deeping it into water you observed what happened? So what happens to the straw?

Learners: It bends

Lecturer 7: it bends like this (demonstrated to learners what it looked like when put in water).

Hey, so as we were saying here we have filled the straw in different media and what are you filling?

Learners: air and water.

Lecturer 7: The way you have filled the whole part of the straw you are filling into what?

Learners: air

Lecturer 7: air. Light passing through air. While here you are able to see the ruler which is now you are seeing as light is passing through?

Learners: water

Lecturer 7: water. Now water and air do they have the same density?

Learners: no

Lecturer 7: no. Now in science we are checking that the media with low density will make something to look small where as the media with higher density will make something look

bigger or an object to look bigger. That is why we are able to see this straw up there since we are seeing it as light is passing through air to be like small but now from the straw it has deeped into water since light is passing through the water the same straw is looking as if bigger. And because of that size it is making it to look as if it is bent.

Learner 2: what makes things look bigger when put in water?

Lecturer 7: Okay, anyone to give clarity for that question? You will just begin, someone will proceed, so begin

Learner 3: this happens when light travels through two mediums of different densities

Lecturer 7: Okay can someone continue?

learner 4: If density is higher than the other media. Water has higher density than air it is making the what to also to have to make that thing to be bigger

Lecturer 7: Making since it is if density is higher than the other media. In this case the water has higher density than air it is making the object to also to have to make that thing to be bigger. And because of making that object to be bigger you will look at it as if it has been bent. So refraction is related to maginification. It's like you have maginified the ruler as you are seeing it passing through the media of higher density, of higher density than the other one. In this case water as compared to air. Right, then let's look at the knowledge of this of these properties. How do we use this knowledge? The knowledge of these properties. Let's start within a set time. Can you think of an object with that property. If no object. No object. Any object with that property or we apply that knowledge. Alright!

Learner 7: cars

Lecturer 7: umh

Learner 8: bulbs

Lecturer 7: Okay you are talking of the car (learners: yes) and a car has got what?

Learner 7: bulbs

Lecturer 7: bulbs, umh do we have a scientific name for those bulbs?

Learner 8: Yes

Lecturer 7: What is that?

Learner 8: Head lights

Lecturer 7: umh, headlights. The car that you know they have headlights in front of them such that when it is dark or at night they assist or they give light. They enable the driver to see well where to go, not so?

Learners: yes

Lecturer 7: Have you ever travelled at night in a car?

Learners: yes

Lecturer 7: That one

Learner 9: yes.

Lecturer 7: Right. Ah if you were very observant because at night I don't know whether it's new or only me I don't know you because am very focused I just want to see my house, at

night, I just want to see my house any time. So whatever happens on the way I am very very attentive to see what is happening. So if you are in vehicle as already said when you are travelling, let's say may be a car is coming from our turn off there, it is coming here with the lights on, when it reaches at the gate before the driver changes ah the what the car, where do you see the light? Ah simukhala chidwi? Inutu mudzapanga ngozi usiku inu. Tikuti ukuchokera uku ndi galimoto usiku, ikutionetsa kumene tikupita eti? Ikuyenda mseu wake uli straight komano tafika kuti tizikhota tikupita ku gate, timakhala ngati tikukhota pang'ono, sichoncho?

Learners: ee (Yes)

Lecturer 7: komano driver uja sanakhotetse, ndiyeno ikhala ikuyang'ana kuti?

Learners: kutsogolo kwa msewu komwe ikupita

Lecturer 7: ikupita kuti?

Learners: pa gate

Lecturer 7: in that case pagetipo kutsogolo kwake ndi kuti?

Learners: kumunsi kuja komwe

Lecturer 7: kumunsi kuja komwe ndi ku college. Are you following?

Learners: yes

Lecturer 7: Ehe, there the light is straight because it is travelling in a straight path. But once you change the position of the car it is now when you can change the what? the light. You are changing the position now and it will follow where you are going now because of the light bend. Are we together?

Learners: Yes

Lecturer 7: Sindikutanthauza kuti bending ndi chani ndikutanthauza kuti light until dead iyayi but we are making the headlights to turn where we are going so that the lights should be shown to where we are actually going even though ku malo a straight koma tikukhota when we are turning our back the light will be changed to where we have directed that path. That shows that light travels in a straight line. Where else do we use that same property? Umh!

Learner 10: in photography

Lecturer 7: Good. A photographer uses the same property. Sichoncho?

Learners: yes

Lecturer 7: Are you agreeing? If you are agreeing how? How does a photographer, they use camera. How do they use this property? Light travels in a straight line. Please apa tisachedwepo, mumajambulitsa zithunzi ten patsiku inu ndipo inu, what happens? Do we have a camera artist this side while we are there (learners laugh) eh is that the way your photo is taken? The camera man is taking this what ah are you saying smile, smile. What happens, tell me.

Learner 11: some cameras have flashes

Lecturer 7: Right. In some cameras we have a flash, am I right?

Learners: yes

Lecturer 7: That produces light the time your picture is being taken. So the camera man make sure that that light should be in straight line with you so that your image should be really captured. That's why sometimes if it is a group photo others are told move, move closer to your friends. Have you ever been in such a situation?

Learners: yes

Lecturer 7: Umh that camera man is trying to say that if I flash, you will not be focused. You are not in a straight line. That one is a real camera man, a professional one. Unprofessional ones are the ones that when you take a group picture with you it's only the arm that has been taken (learners laugh) and even the unprofessional ones or if single one, you are there alone but you will find that in front of you things show, that one does not focus well. In this property, light travels in a straight line. What about light can be reflected as well as refracted? Where do you use this property? Yah

Learner 12: reflectors

Lecturer 7: umh, how?

Learner 12: light can be reflected on somebody's back

Lecturer 7: on his or her back, is it true?

Learners: yes

Lecturer 7: do we know these reflectors?

Learners: no

Lecturer 7: Muzikhala ndi chidwi abale inu, kukwera galimoto uwone kuti kodi icho ndi chani? Atleast zikhala zodziwikako.

Learner speaks

Lecturer 7: Timakhala tikuyang'ana kuti

Learner speaks

Lecturer 7: eti, kena kamakhala pa windo la driver. Driver'yo ali apa, ngati apa koma kunja kwa galimoto eti, kena kamakhala mkati momwemo mwina simmakayang'ana chifukwa simmakhala nchidwi. You have to be carefull nowadays. You have to be curious, kena kamakhala mkati momwemo, but both take the path and the aim is what has been made will make the driver able to see what is coming behind him or her. When the car is coming over there, light will focus it and then will reflect it to where the driver is and the driver will see what is coming behind him or her. More especially at night that light from the back if there's no may be moving vehicle which has also lost lights or headlights those we are saying the property light travels in a straight line.

Lecturer 7: It is directing where the car is and the driver cannot see from the back but that light will be reflected on the (mirror) mirror and that light will be seen by the driver because from the lights of the back it will reflect light to the driver and the driver will know there's something coming behind me and I should know what to do, reflection.

Lecturer 7: What about refraction? umh

Learner 13: Microscope

Lectuer 7: eh, stop there. Just mentioning of the microscope. Do you know microscopes?

Learner 13: Yes

Lecturer 7: What do they do? how do we use it?

Learner : to modify things to see small things look bigger.

Lecturer 7: So that is refraction. To make an object look bigger. The ones that we cannot be able to see with our eyes more especially, you will use at the hospital they are able to take out blood samples and other samples and they look at ah looking through the microscope they are able to identify germs or whatever they call them which might be found in our specimen and they will tell us you have plasmodium, muli ndi malungo eti. But for the plasmodium, they could not see it with their naked eyes. I hope you understand with naked eyes

Learners : Yes

Lecturer 7: not that doctors want to see have to undress. (learners laugh) But when using the microscope you are using that science that light arrows bend back because on that microscope on that microscope that specimen is put on a certain media so the way you have explained here that media can be of density that can enable that thing to look bigger and that's how the laboratories, laboratory people are able to see small change from other things. Correct ah because of time we can stop today we can meet tomorrow thinking of these other properties and how they are used in our everyday life but reaching there, let me know what are the sources of light?

Learner 14: sun, fire, moon

Lecturer 7: umh ,another source of light, another source of light

Learner 15: candle

Lecturer 7: alright. Then can you identify the properties of light, what are they?

Learner 16: light travels in straight lines

Lecturer 7: right, and there?

Learner 17: light can be refracted

Lecturer 7 : right, how can you investigate with your learners that light travels in a straight line? How can you investigate with your learners that light travels in a straight line?

Learner 18: explains how the investigation can be done

Lecturer 7: first thing is mention of the holes that is very important. It must have holes and if you put them in a straight line and have a source of light one end you will be able to see the light the other end. If you try to block the holes one ah one hole should be blocked then you have blocked the light. You will not be able to see the light at the end. That is how we have shared science today till we meet again tomorrow, that is the end of our lesson.

Learner 19 : is the moon the source of light?

Lecturer 7: aah what?

Learner 20: is the moon the source of light?

Lecturer 7: yah, the moon is a source of light. On sources of light there are two groups, luminous and non luminous. Those that are able to produce light on their own are called (luminous) luminous. You can mention them on sources of light, can you give examples

Learner 20: the sun

Lecturer 7: the sun, okay non luminants are those objects that do not produce light on their own but they depend on su on light from another source, in other words indirect source of light, example?

Learner 21: the moon, the mirror umh.

Lecturer 7: The mirror right here is not producing any light but when connected to another source of light it can produce that light. Have I answered your question?

Learner 22: yes

Lecturer 7: right what else?

Learner 22: said something

Lecturer 7: and another one? this side

Learner 23: explained something

Lecturer 7: okay, umh, in how many seconds?

Learners 24: said something

19/02/19

Lecturer 7: lesson 6

Subject: Science and Technology

Topic: Forces And Pressure

Time: 13:30- 14.30

Class size: 25

Lecturer 9: good afternoon

Learners: Good afternoon sir

Lecturer 7: today, we are going to look at forces and pressure. May I know how do we use forces and pressure?

Learner 1: When opening a door, when playing football

Learner 2: when riding a bicycle, when walking.

Lecturer 7: you will be exploring books to see if there are topics concerning forces. But because of the shortage of books, I will take you to standard 7 work where we can see the topic force. Find relationships between forces and pressure.

Learner 7: used the chalk board and said pressure is measured in square millimeter.

Learner 3: pressure is a measure of how a force is applied.

Lecturer 7: brought in correct responses as how force is related to pressure

Liquid pressure increases with depth

Liquid pressure increases with depth at the same level

Liquid pressure acts in all directions

Lecturer 7: one should come and show us with an aid of a diagram the relationship between pressure and forces (One learner did as instructed).

Lecturer 7: Good. Then can you think and design any experiment to show that air pressure acts in all directions? Explain how are you going to design an experiment? Please form two groups for this activity.

Learners: Formed two groups. Group 1 worked on-air pressure acts equally in all directions. Group 2- strong air pressure acts in the direction of low air pressure. Each group designed an experiment to explain their activity.

Lecturer 7: moved around supervising learners assisting them as to provide directions. (After 20 minutes of group discussions the lecturer instructed the learners to stop discussions). Can you display your charts? One member to explain what is on the chart.

Learners:reported their work- group 1 drew a wind sock that explained the direction of air pressure from high to low. Group 2 explained about air that moves in all directions with a balloon full of air and tied on the top. It gets inflated showing that air acts equally in all directions.

Lecturer 7: thanked the learners for the design of experiments. Then came in with his own experiment on activity 2: strong air pressure acts in the direction of low air pressure. A bottle with a hole at the bottom, filled with water and closed a bottle top tightly. He then asked the following questions: Why do you think that the water was not coming out of the bottle? Why when opening the lid water start flowing?

Learner 3: Explained- there is high air pressure outside the bottle that moves towards low pressure area which is a bottle. This makes water in the bottle fail to come out.

Lecturer 7: think of how we can apply the knowledge of air pressure in everyday life.

Learners: responded:

The tank of water is raised up on top to let water coming with pressure for supply

System of toilets

Then the lesson was interrupted by a visitor from DTED. What was remaining was conclusion.

Lesson observation details for lecturer 8

18/01/19

Lecturer 8, Lesson 1

Time: 10.00- 11.00

Class size: 20 learners

Topic: Teaching of plants and their environment

Teaching and learning resources: lecturers' guides. Syllabi, learners' books, chart papers, markers

Lecturer 8 enters the classroom and greets her learners.

Lecturer 8: Good morning class

Learners: good morning madam

Lecturer 8: Ah, Science and Technology (talked to herself and wrote subject name on the chalk board and then started talking). Last time we were looking at the teaching of teaching and resources for Science and Technology . Last time we were looking at the teaching and learning resources for Science and Technology . Now when we are making the teaching and learning resources for Science and Technology you get the materials from.....?? Where do you get the resources?Where can you get materials to be used when teaching Science and Technology ? (Learners raised up hands) Yes! (Pointing at one learner).

Learner 1: You can buy

Lecturer 8: yes you can buy, okay. Where else? (Most learners raised up hands) Yes (pointing at a learner)

Learner 2: You can get the materials for making the resources from the environment.

Lecturer 8: Okay. That's where you can get the materials for making the resources. From the local environment. What are some of things that you can find from the environment? Some of the things that you can find from the environment? When you go into the environment, what are some of the things? Can you mention things eh? Yes can you think of this from the environment or what can you find from the environment?

Learners: (only male learners raised up their hands, and the lecturer mentioned ladies to encourage them to participate in the task).

Lecturer 8: Ladies! (Some ladies joined male learners to raise up their hands. She then pointed at one female learner). Yes Agnes!

Learner 3: You can find trees

Lecturer 8: You can find trees, what else? You can find trees in the environment, (another learner raised up a hand. Lecturer asked him to give an answer) yes!

Learner 4: Specimen

Lecturer 8: Specimen like what? Like what? (Pointed at a learner who raised up a hand) yes! Learner 5: insects

Lecturer 8: Insects, okay. Today's lesson is on the teaching of plants and their environment. Someone said we can find trees in the environment. Today's lesson we are going to ah the topic is teaching, teaching of plants. Teaching of plants and their environment. Teaching of plants and their environment. You have been learning about plants and their environment. You have been learning about plants and their environment from primary school and secondary school you have been learning about plants and their environment.

Lecturer 8: Can you tell me some of the misconceptions about plants and their environment that learners or your selves had at first? I want you to think about misconceptions that you as learners ah students you had when you were learning plants and their environment at primary school and also misconceptions that your learners might have when they ah learn about this topic plants and the environment? I want each of you to think of the misconceptions. Think of the misconceptions. I will give you 2 minutes.

Lecturer 8: Davie is it okay? (she mentioned a learner's name to ensure everybody was listening to the instructions) (After 3 minutes the lecturer asked the learners to share what they thought of as misconceptions)

Lecturer 8: Can you share the misconceptions that you have with a partner? Have a partner. Dora, can you be there? Be there..... and share the misconceptions with that one.

Learners: (paired, discussed and shared with each other about the misconceptions).

Lecturer 8: (went around, checking pairs, how they were sharing the issues). Okay, I think you have discussed in pairs. I want a pair to give us one misconception. A pair to give us one misconception. (Some learners raised their hands up, lecturer pointed at a learner to say something. Lecturer pointed at a learner for an answer to the question). Yes!

Learner 6: One of the misconceptions is that plants are not living things. Most of the learners think that plants are not living things.

Lecturer 8: Yes, this is a misconception. Plants are not living things. Most of the learners out there believe that plants are not living things. Another misconception? Another pair. Yes! (pointed at another learner)

Learner 7: Seeds are produced in factories.

Lecturer: Seeds are produced in factories. Learners think of think that seeds are produced in factories. Okay. Another misconception?

Learner 8: The other one misconception is that plants get their food from the soil through roots, from the soil through roots.

Lecturer 8: So these are some of the misconceptions. Any? Any other? (Some learners raised their hands up. Lecturer pointed at one learner) Okay, yes.

Learner 9: Plants move to search for food.

Lecturer 8: Ah some learners think that plants move to search for food. So we are saying that these are some of the misconceptions that learners have about plants and their environment, about plants and their environment? Now when we are teaching the topic plants and their environment, we need to ah remove these misconceptions from learners so that when you are teaching there learners ah your learners they should not have these misconceptions. You have to emphasise on this so that learners do not have these misconceptions. (One learner raised a hand up to ask a question. Lecturer recognized him). Yes!

Learner 10: Do plants get food from the soil

Lecturer 8: What do you think? Do plants get food from the soil? (Lecturer sent back the question to the learners to have their views first).

Learners: We want to hear from him (some learners responded in chorus. Other learners responded that it's a misconception).

Lecturer 8: What is it now you know about the process of photosynthesis?

Learner 11: Photosynthesis takes place from the air.

Lecturer 8: From the air? Okay. Ah what do you think? Let us throw this question to the class. Yah, what do you think?

Learner 12: For food formation

Lecturer 8: For what? For food formation. It's the raw material, it's the raw material. Okay ah. Now after looking at the misconceptions we want to analyse ah the concepts that learners should get from the books, from the books. What will ah learners, eh the knowledge that learners will gain after learning the topic plants and their environment? So we are going to identify topics ah at primary school level. We are going to identify topics at primary school level. Which topics for this plant and environment will learners learn at primary school? So we are going to ah identify these topics from standard five up to standard eight from the teachers' guides, from the teachers' guides. So we just want to see the topics that these learners will learn from different ah classes. From different classes. So I want you to be in the four groups, the four groups.

Lecturer 8: I have four groups. The four groups you are going to use a rope and three ladies the third lady in that group One from each group come and collect the lecturer's guide. One from each group come and collect the lecturer's guide. Take all this, take all this for your group. (group leaders went to the front to collect the items). Okay. About an activity to have I've given each group one class. So you are going to ah draw a table like that one. (lecturer drew sample table on the chalkboard).

standard

Topic

Lecturer 8: Write standard then topic then you browse in those lecturer's guides. Check any topic that is under plants and their environment in that class. You are going to write this on the charts. I will give you five minutes for that. Check in the books find topics that are under plants and their environment in each class. (learners discussed and worked in their groups -group work).

Lecturer 8: (lecturer moved around to check learners' progress, to assist those with problems. After 5 minutes, lecturer reminded learners about time). A minute. A minute, can you write something? (Some groups had not written anything yet on their chat papers. Lecturer encouraged them to write something. After 2 minutes, he stopped the group discussions). Okay through?

Learners: Yah

Lecturer 8: Okay, ah we are going to paste the charts. The other group should paste the chart here. The other group should paste the chart there. The other group should paste the chart here, and the other one can you paste the chart here. Seal tape is there. Quickly. (Learners were seen pasting their work).

Lecturer 8: Last group! The last group, can you paste it here? Ah, so you have looked at the lecturer's guides, you have checked the topics and you have identified the topics that fall under plants and their environment? Now ah we have got four groups. This group,

which group was looking at ah standard five? Okay, that's the first group. Can you come? Now here we are going to use ah gallery tour. The class is going to move from each station, see what your friends have written. Check the topics that they have written under ah from each class, from each class. So first of all just go to your station before we start moving around the stations. It will be a gallery tour; there will be nobody at the station. Which group was doing standard six? Standard six. We want to move. Ok so we are going to move clockwise. Just move to the next station and see the topics which your friends have written. Can you do that now? Just ah ah indicate the topic.

(Learners in their groups visited a work station at a time to appreciate what their colleagues had done)

Lecturer 8: If you have questions, you will ask. (after few minutes, there was clapping of hands by the lecturer to inform learners to go to another work station). Please move to the next station (hand clap) Okay, move to the next station (hand clap) Okay, go back to your places, go back to your places.

Lecturer 8: In our groups we were looking at topics that fall under plants and their environment. Now after doing the gallery walk, do you have any observations? Do you have any observations? (Learners responded by saying yes- meaning that they had some questions to ask for clarification and additional points). Okay, what are the observations? (Some learners raised hands up). The first one, yes!

Learner 13: standard eight, mhhh, can the group clarify more on the family size, income and food supply?

Lecturer 8: okay, yah, can the group clarify more on the family size, income and food supply? We are looking at the topic plants and their environment. Learners will go into the environment and identify the plants and what so ever. What do you why did you put it there? Should it fall under plants and their environment, standard 8?

Learner 14: (explained something)

Lecturer 8: on food supply is that concept there in the book?

Learner 14: (explained something)

Lecturer 8: Okay, what does the activity say?

Learner 14: (explained something)

Lecturer 8: Okay. Are they going to dwell much on plants and their environment on this topic? (Learner responded). Will they go in the environment and look for this, when you are talking about this topic?

Learner 15: (explained something)

Lecturer 8: For you, class what are your observations. For them, they are saying that, for the class? We are talking about plants and their environment. For the class. We want that observation. Should we put this topic under plants and their environment? (Learner spoke about something in response). Can they discuss, can you discuss? Umhh

Learner 16: no

Lecturer 8: Okay, yes

Learner 17: no, we cannot put it under that topic

Lecturer 8: Okay, they are rejecting the topic because ah information here on food supply. We are just describing okay the relationship among income, food supplier and food size. Okay, that's the information here. So we are not including it, we are not including it under plants and their environment. We are not putting it on this, okay?

Learners: Yes!

Lecturer 8: Okay, another observation? (Pointed at a learner). Yes.

Learner 18: Nutrition and health, nutrition and health, Standard five nutrition and health!

Lecturer 8: Good nutrients. You just thought it wise to put it there? (Learner answered yes). Okay, kkkkkk but our topic is on plants we are just looking at plants not the nutrients that we get from the plants and the environment. The plants and their environment. We are not looking at nutrients that are found in the plants. So our topic should dwell much on plants, on plants.

Lecturer 8: So? (Learner said something). Okay (learner said something). On what? On the environment and see the plants. Can you see the nutrients in the environment? No we cannot, because the topic we are going to learn we will be going out and see the environment and what plants. So when you are looking at this topic, we are not going deep but we are just going out and look at the environment and at the plants. So on the topic; we are looking at what, plants and the environment not going deep to the nutrients that we are going to find in the plants.

Learner 18: So we are taking out this nutrient.

Lecturer 8: Okay from standard 5 did we accept this? Did we accept this one?

Learners: No

Lecturer 8: Okay we are not there (noise from learners) Then the question. Any other observation?

Learner 19: Can you tell us looking at scientific investigation?

Lecturer 8: yah scientific investigation?

Learner 19: about standard 8?

Lecturer 8: Yes standard 8 can clarify on this. (Learner explained something) Standard 8 again. (Learner explained about plant topics in standard 8) Okay, can we remove it?

Learner 20: No, to be there,

Lecturer 8: Okay, umhh, about plants. Now under scientific investigation, is there any ah concept talking about plants and their environment? We are looking at that, plants and their environment. May be we are going to investigate when you are looking at the topic plants, we want to find the parts of the what the plants. Then we are going there to investigate. Now it will fall under which topic? May be this topic, external parts and ah external parts of the what (plants) of the plants. That's the topic that we are going to look at. Okay?

Learners: Yes sir

Lecturer 8: Now we are not looking at the investigation, we are not looking at whatever. We are looking at the what we are looking at the topics that fall under plants and their environment. That is what we are looking at. We are just identifying topics in the what in the books. We are just identifying.

Lecturer 8: When we go out there, which topics are we going to teach under this plants and their environment. In standard 5, what are the topics? So you were looking at the topics say in standard 5, where is standard 5? Standard 5 it will be the what, the relationship between plants animals. Okay, under this topic. So in standard 5 you are going to look at this topic. The relationship between plants and their animals. What about in standard 6?

Learner 20: about external parts of plants and....

Lecturer 8: No, I haven't concluded. In standard 6, external parts of the plants, external parts of the plants. So in standard 6 you are going to look at the external parts of the plants. You have to you need to have this knowledge that in standard 6. I will be teaching this under ah plants and their environment.

Lecturer 8: In standard 7 what are you looking at, flowering and non flowering plants, pollination, fruits and seed dispersal and seed germination parts of the plant under plants and ah their environment, then we will be looking at these ah these concepts. Then we will be going out searching for that, getting this ah the information. For standard 8 for standard 8 you have said under plants and environment, technology is for sa ah conserving the

environment. Technology is for conserving the environment. Particularly we are looking at plants and their environment. Okay, under ah scientific investigation we are looking at may be the stages that we are going to the steps or the procedures that you are going to ah follow when you are ah teaching a certain concept.

Lecturer 8: Okay. You are looking at the stages. What are the stages or what are the steps that am going to follow? That's the scientific investigation. So you can do a scientific investigation under the topic which is on plants and environment. Are we together?

Learners: yes, sir!

Lecturer 8: So here mainly we are looking at the topics that will ah be under plants and their environment. So we are I think we have to do

Learners: Plants

Lecturer 8: Okay, not all of them but there's a concept there. Yah there's a concept there. So after looking at these topics, next you have to identify the Next you have to identify the scientific knowledge, scientific skills and scientific attitudes and values from the books. What are the ah ah knowledge that learners will get after learning that topic? So we are looking at the topics that you have agreed in each class. So this has been passed, this has passed and this.

Lecturer 8: Now from the books that I've given now identify the scientific knowledge, skills, attitudes and values from the books that learners will gain after learning these concepts from each class. Therefore, you are going to identify the scientific knowledge, the scientific skills and the scientific attitudes and values. Okay, we have already discussed about what scientific skills are, what scientific attitudes and values are last time. So you just identify these from the books write this on another chart. Can group representatives come and take another chart.

Lecturer 8: Okay. The chart will look like that, write topic, the topics that you have in each class, and write scientific knowledge, scientific skills and scientific attitudes and values. So you have to identify these from the books. They are there in the books. Just check for them. Okay, can you do that class?

Lecturer drew table like the one shown below for learners to put their answers in

Topic	Scientific knowledge	skills	Attitudes values

Learners were in group discussions. Lecturer walked around to check learners' work progress, to assist those with problems, to clarify the task).

Lecturer 8: Okay, I will give you half a minute. Can you leave the charts to your fellow learners? They are going to crowd looking at what you have written under the topic scientific knowledge, skills and values that learners will get from ah each topic. Each group should move from one station to another and check what your friends have written. Leave the charts (each group started moving away from their work station to another).

Lecturer 8: Wait! Wait! Wait! How are you going to move? This group will see what their friends there have written, that group will move there, that group will come here. If you have an observation you can write.

Lecturer 8: Okay (hand clap, clsp), move to the next paper, move to the next paper. If you have an observation you can write. Okay, move to the next paper. (Lecturer clapped hands and said, move to the next station. The lecturer did this until learners visited all stations. Learners moved from one station to another until each group visited a station.). Okay, go back to your places. Go back to your places. Okay, any observations? You have moved round looking at the knowledge, the attitudes the skills that learners will get after learning the topics that are identified. Any observation? (Learners raised hands up. Lecturer pointed at one learner for his observation or question). Yes!

Learner 21: added a point about experimenting to the discussions

Lecturer 8: umh, which group added that point, experimenting? Another group? We have experimenting in this group. This one which group? (Learners responded). You did not consider the challenge, you just added so it's a mistake; we have to remove it (learners

laughed). You wanted to add, another group? Umhh. Another group added recording on this topic. Flowering and non flowering plants they added recording. It should be there.

Lecturer 8: Okay, recording is correct they did not include recording under the topic flowering and non flowering plants but learners will require this skill of recording, the skill of recording. Ah, so these are some of the skills that learners will be ah acquire the skills they will be acquiring under each topic. For example ah the skills under flowering and non flowering plants. What are the skills that learners will be acquiring? Yes!

Learner 22: There is also recording.

Lecturer 8: These are some of the skills that learners will be acquiring. So when you are teaching your learners make sure that the learners have to acquire these skills these skills. You have also listed the knowledge listed the attitudes that ah learners will get from the topics.

Lecturer 8: So today we were looking at ah the concepts some of the concepts for teaching plants and the environment. We were looking at the topics from the teachers' guides. What are the attitudes that learners will get what are the skills that learners will acquire from the topics under plants and their environment. When you go there when you will be teaching the learners, make sure that these to be applied by the learners and also we looked at the misconceptions that learners have and how to remove those misconceptions. Ah can you tell me the topics, mention topics that learners will acquire at primary school level? Not to acquire. Learners will learn at primary school level. What are the topics that will come

under the topic plants and their environment? (Learners raised hands up. Lecturer asked one learner to respond) Yes!

Learner 23: flowering plants (lecturer pointed at another learner for a response).

Lecturer 8: Yes!

Learner 24: seed germination (lecturer pointed at another learner)

Lecturer 8: Yes

Learner 25: relationship between plants and animals

Lecturer 8: last? (pointing at another learner)

Learner 26: flowering and non flowering plants.

Lecturer 8: What are some of the skills that learners will acquire by the end of the topic.

Some of the skills, Man?

Learner 27: Communication

Lecturer 8: Okay, yes!

Learner 28: Observing

Lecturer 8: umhh

Learner 28: critical thinking.

Lecturer 8: These are some of the skills. Now when we meet, we are going to look at the success criteria under each topic. We are going to look at the success criteria under each topic. Okay, can I have my books?

23/01/19

Lecturer 8: lesson 2

Subject: Science and Technology

Time: 10:00-11.00

Topic: animals and their environment

Class size: 20 learners

Teaching and learning resources: pieces of papers and chart papers

Lecturer 8: (enters classroom, greets learners). Good morning class.

Learners: Good morning madam

Lecturer 8: it's time for Science and Technology . Can I Can you get some these pieces of papers.....one each..one each.....one each (The lecturer brought pieces of papers as teaching and learning resources. She gave the pieces of papers to some learners for distribution). I want you to write any animal.....any animal on that piece of paper and after writing that aah come and paste it on the chalkboard. Just write any animal that you know and come and paste it on the chalkboard. If you are through come and paste whatever you want your.....(Learners wrote names of animals and pasted the papers on the chalk board).

Lecturer 8: Can I have two volunteers to come in front? a gentleman can you cluster these animals cluster them the way you want to cluster them. You can ask your friends to help you. Can you cluster these animals the way you want. You can ask your friends to help you and you have to read the animal so that your friends know the animal where the clustering. (Learners read the animal's name and asked the class to help in clustering them).

Learner 1: Yah it help hyena

Lecturer 8: You can start with that hyena, okey anyway..... what is that? What is that?

Learner 1: snake, fish, ... (learner read names of animals from the pieces of papers)

Lecturer 8: Other side..... other side.... (lecturer was referring to other learners from another side to assist in clustering the animals) Okey, can you go to friends?

Learners: gave responses on how the animals could be clustered

Lecturer 8: Clap hands for them for clustering the animals. (lecturer wanted the class to clap hands for the two learners who were leading the clustering exercise/discussion). Now can you tell me why you have clustered these animals there and we only have one animal there? What criteria have you taken to cluster these animals? (learners raised up hands)

Yes!

Learner 2: vertebrates and invertebrates animals

Lecturer 8: Okay, considering vertebrate and invertebrate animals. We have got vertebrate animals ah and invertebrate animals. What are vertebrate animals?..... What are vertebrate animals?..... (Learners raised up hands. Lecturer pointed at one learner) Yes...

Learner 3: animals with backbone

Lecturer 8: Yes... invertebrate animals? inverte.. yes

Learner 4: Animals without backbone.

Lecturer 8: So, you say that you can use this method (referring to clustering) ah when you are talking about ah when you are teaching about animals. You are still on animals.

So you can use this method when you are ah you want to classify animals. You classify animals into two broad ah two groups: vertebrates and invertebrates. So you can use this method. Now we are continuing with our topic and today we are going to explore ah challenges learners face ah to understand the concept of metamorphosis and survival mechanisms. Metamorphosis and survival ah mechanisms. Yesterday we looked at some of the survival mechanisms of animals. We looked at ah survival mechanisms of animals. Ah can you give me exa... some of the survival mechanisms that we discussed yesterday? (many learners raised hands and lecturer pointed at one learner). Yes!

Learner 4: locomotion

Lecturer 8: Locomotion, locomotion (pointed at another learner for another answer/opinion) Yes!

Learner 5: Feeling.

Lecturer 10: Feeling, Okey. Yes (pointing to another learner).

Learner 6: changing of a colour

Lecturer 8: Changing of a colour, which is called what?

Learners in chorus response: camouflage

Lecturer 8: Camouflage, Okey. Ah now today we are going to look ah we are continuing then we have to ah define what is ah metamorphosis. Okey. Can you think of the meaning

of metamorphosis? Think of the meaning of metamorphosis? What is metamorphosis? That line, that line, share the meaning (pointing to one middle line of learners). Again..... What is the point? We start with the ah the pair at the back, the pair at the back (pointing at a pair at the back). Can you give the meaning of metamorphosis?.....

Learner 7: The process of change of from grapher to an act (according to that pair).

Lecturer 8: What is the meaning of metamorphosis?.....Ah...okey..... Gloria...

Learner 8: The process of change that take place in the development of animals.

Lecturer 8: Any other pair with different answers from the two pairs?

Learner 9: metamorphosis is the the developmental changes in the animals

Lecturer 8: Come again (learner repeated the answer) Oh! Okay. Any other?

Ah...metamorphosis is the the developmental changes in the animals. It is the developmental changes in the animals. Probably different changes, stages of development in animals. That's metamorphosis. Okay. Give me types of metamorphosis. Types. How many are types?

Learners (responded in chorus): Two.

Lecturer 8: The first one?

Learner (responded in chorus): Complete metamorphosis.

Lecturer 8: And the other one?

Learner 10: Incomplete metamorphosis.

Lecturer 8: So we have got complete metamorphosis and incomplete metamorphosis. Ah, what is the difference between complete and incomplete metamorphosis? What is the difference between complete and incomplete metamorphosis? (Pointing at a learner) Yes.

Learner 11: Ok.....Complete.....consists of three stages

Lecturer 8: Yes. Incomplete?

Learner 11: three stages

Lecturer 8: complete?

Learner 11: All stages

Lecturer 8: complete?

Learner 12: Four

Lecturer 8: incomplete?

Learner 13: three

Lecturer 8: Can we hear from others? What is complete? What is the difference between complete and incomplete?

Learner 14: complete metamorphosis has four stages while incomplete has three.

Lecturer 8: This is right. Ah okay under complete ah metamorphosis you go four different stages, you have got different stages. You have ah eggs then you go to larvae then pupae then.....

Learners: (in unison) adults.

Lecturer 8: Its a complete metamorphosis. From eggs then larvae then pupae then adults. Then in incomplete metamorphosis its where we ah we don't undergo the two stages. Incomplete metamorphosis two stages are not undergone, the larvae and the pupae. We don't have the larvae and pupae in the in incomplete. In the incomplete metamorphosis. ah this is the concept that you already know from primary schools and secondary schools, you know this. If you have forgotten you have to search in the books about metamorphosis.

Now ah today, we want to explore challenges. What are some of the challenges learners will face, will face to understand these concepts, the concept of metamorphosis? What are some of the challenges? And you have to come up with solutions how you can teach your learners these concepts. You are looking at metamorphosis and survival ah mechanisms. Survival mechanisms. The challenges that learners will face when you are teaching ah these concepts under animals. What are some of the challenges ah learners will face under the concept of metamorphosis and survival mechanisms concept? Now you will be in your groups. Go to your groups. Now in groups, group one. Group one to to five. Can you do just that?

Group one! Where is group one? Group two! (Learners responded by raising up their hands) Okay. Group three! (Learners raised up their hands).

Group one, two and three, you discuss the challenges learners to face when they are learning the concept metamorphosis. Group one, two and three you do ah ah challenges

learners face to understand the concept metamorphosis. Group four and five, challenges learners face to understand the concept survival mechanisms, survival mechanisms. (Wrote on the chalk board: Challenges learners face to understand the concept of Metamorphosis, Survival mechanisms. She then shared chart papers, allocated the tasks to learners in their groups. Learners discussed about possible solutions to the tasks in their groups. 3 groups worked on challenges and 2 groups on survival mechanism).

Lecturer 8: I will give you three minutes to do that. Discuss in your groups what are some of the challenges that learners can face when they are learning these concepts under animals, metamorphosis and survival mechanisms. What are some of the challenges that learners will face when you are teaching them these concepts? This group has got only males? Where are females? (After three minutes, the lecturer continued talking) Is it okay? Are you through? Are you through?

Learners: No.

Lecturer 8: I will give you a minute. A minute can ah conclude. Write what you have now.(Learners continued with small group discussions). Okay, it's okay! Now, stop discussing. Let us now present what we have discussed. We are going to present by writing on the chalkboard. No, don't write on the chalkboard. Just come and paste the paper on the chalkboard. Those that were under metamorphosis, can you just paste them. One group. What is the other group? Which group?

Learner 15: group 1 work-challenges to understand metamorphosis

Lack of knowledge by the teachers.

Lack of interest by the teachers.

Inadequate teaching and learning resources

Poor planning.

Lecturer 8: Okay now one we will just read what you have written for the challenges that learners ah face to understand the concept of what metamorphosis. What are some of the challenges learners will face to understand the concept metamorphosis? So you have come up with some of the challenges. You will read to us. (Learner read about the challenges) Can you just read all of them from other groups as well? (Learner did as instructed) Read what you can see. Okay, group two. (Learner read) Okay. Read for the others.

Learner 16: group 2 work-

Challenges to understand

Challenges to understand Survival mechanism to children.

Improper use of methods.

Some animals produce poisonous fluids and this might be dangerous

Lecturer 8: Now we are looking at challenges ah learners face to understand the concept and the concept of metamorphosis. And these are some of the challenges that you have ah come up with. The challenges that you have come up with you are saying that ah lack of inadequate, inadequate knowledge of teachers. May be teachers do not have adequate

knowledge about the concept and they will fail to deliver this to learners. So learners will have challenges in understanding the topic metamorphosis. Some of us have also some challenges here. Now if you have got challenges, you cannot deliver this concept to the learners well and learners will have problems to understand the concept. So you as student teachers, you need to have adequate knowledge. Enough knowledge so that you can deliver the concept to your learners, to the learners. We have already seen, some of us don't know ah what complete and incomplete metamorphosis is. What is metamorphosis? So you need to have the knowledge here so that you can deliver this knowledge to your learners. Because some of the learners will have challenges in these concepts. (lecturer continued)

Lecturer 8: Lack of interest in learners. You said that lack of interest in learners to learn the concept. Some of the times learners will not have interest because of ah the what the teacher. How they deliver the concept can also make the learner not to have interest. You need to change the mindset, you need to love the ah the subject, then you can deliver the subject well.

The other thing you said inadequate teaching and learning resources. Inadequate teaching and learning resources will also ah make will also ah contribute to the challenges learners face to understand the concept. For any teaching you need to have a lot of recourses so that learners can understand the concept.

There is also poor planning, ah poor planning by the teachers. Some of the times if ah the teacher plans ah do not prepare his or her lesson, you cannot deliver that well and in so

doing learners cannot understand the concept. Hence there will be challenges. Ah yet some of these concerns appear. (Lecturer continued explaining)

The process of metamorphosis is abstract hence learners do not ah do not quickly understand because they do not see with their naked eyes, the process. May be sometimes metamorphosis ah looking at metamorphosis as the life cycle, life cycle of animals. Now when you are teaching they may not see the complete cycle with their naked eyes. So in so doing, there might be some challenges, because some of the topics are difficult. Seeing you cannot see the whole process when you are teaching, but you can change this one because the abstract you can use now use what you can use resources, you can use resources. You can draw the life cycle so that learners can understand.

So these are some of the challenges learners ah face under this process, hence you have to be prepared, you need to have the knowledge, you need to know some of the methods you need to teach the learner so that you can overcome these challenges, to overcome these challenges. Yes.... group one to present.. What are some of the challenges learners face to understand the concept, survival mechanisms? Yes... (Learner responded by reading out their group's answers)

Lecturer 8: Any observations? Any comments? Any response from the groups? Challenges which learners will face mhhhh to understand this concept, survival mechanisms?

Learner 16: Lack of knowledge in learners and to understand how other animals survive.
Lack of knowledge in learners.

Lecturer 8: You are saying lack of knowledge in learners and to understand how other animals survive. Lack of knowledge in learners' lack of knowledge. That was a good idea.
Group two!

Learner 16: Lack of knowledge. Through the process of

Lecturer 8: Okay. Survival mechanisms, madam. Yes!

Learner 16: lack of knowledge by the teacher.

Lecturer 8: La.... ah teachers may fail to teach learners the survival mechanisms as they do not have the knowledge in ah or you can say inadequate knowledge about the survival mechanisms. So just wait, at the end class think there the survival mechanisms without ah adequate knowledge. So in so doing learners cannot understand the concept.(Learner speaks). Or it can be lack of knowledge tikunenayo.(Learner speaks) Can you explain?

Learner 17: Lack of preliquisite knowledge in learners

Lecturer 8: eehee Lack of preliquisite knowledge in learners

Learner 17: umhh, umhhh okay

Lecturer 8: So they will have problems to understand the concept because they don't know some of these animals. They are not in their locality. Inadequate time for the learners to study other animals? Can you take this one? We have adequate time for other learners to learn. Can this be a challenge class?

Learners (in unison): No.

Lecturer 10: No. Okay so we are removing this (lecturer removed the point). It is not a challenge.

Learner 17: Lack of knowledge, we have already said, lack of resources okay. Poor use of methodologies, poor use of methodologies.

Lecturer 8: Meaning what? Poor use. Is it poor use of methodologies or what? Is it poor use of methodologies?

Learner 17: improper use.

Lecturer 8: ah improper use? Then ah when we are teaching we need to use different methods, different methods. Don't just use one method because sometimes learners may be bored. So if you are just teaching using one method they will be bored and they will not understand what you are ah talking about. So they will have challenges, they will not understand the concept, they will not understand the concept because of the ah ah the methods that the methods you use. So these are some of the challenges that learners may face when you are teaching these concepts under the topic animals, under the topic animals.

And also under the survival mechanisms learners, it is difficult to observe some of the survival mechanisms. Because some of the most of the time you need ah to teach new things. So learners will need to have realia. But when we are looking at the survival mechanisms you will see that it is difficult ah to observe some of the survival mechanisms ah of animals. For example ah, one of the survival mechanisms is to produce poisonous what food. So it can be risky for the learners to observe this ah survival mechanism.

Observing an producing poisonous food. So yes.....

Learner 18: (interrupted) Can't we include inadequate time?

Lecturer 8: Okay. Inadequate time for the learners to study other animals? So you are saying that we can include inadequate time ah to study the other animals, do you want ah here they are saying the other animals. If you can phrase this one to be inadequate time for teachers to teach. When you are teaching survival mechanisms, now you have been given thirty five minutes to teach this topic. Now you think this time is not enough for you to teach learners survival mechanisms. Therefore, learners will not understand the concept because of the time that you have been what given, then you can put that point like that. But note that maybe the period for teaching the concept may be short, may will not be enough for the learners to understand the concept, to understand the concept Okay. So these are some of the problems these are some of the challenges learners will face and you need to know that you may meet some of these problems when you go there and you need to plan well, to have enough resources and to use different methods in order ah for you to

deliver these concepts to learners so that they understand these concepts. You need to have also adequate knowledge on these concepts on these concepts.

Okay, let's we are going to look at ways of assessing learners considering large classes under the same topic, animals. How can you assess your learners when you are teaching the topic animals? You have got a large class; you have got a large class. What are some of the ways of assessing learners? You have got large classes. If you have got large class how can you assess your learners? Yes (pointing at one of the learners who raised a hand up)

Learner 19: You can use groups to assess your learners.

Lecturer 8: Yes, how?

Learner 19: umhhh check and assess as aah what as a group.

Lecturer 8: You can assess as a group. Good what about others?

Learner 20: umhh, you can assess learners by asking some questions, by asking some questions in the process of teaching.

Lecturer 8: When you are teaching you can assess learners by asking them some questions. That is a large class. So you sport few ques,,,,, ah a few students in your class, ah! Another way? (some learners raised hands up) Yes (pointing at one learner)

Learner 21: You can use different types different methods to assess your learners

Lecturer 8: The teacher can use the what?

Learner 21: Different types methods to assess your learners

Lecturer 8: Oh! You can use different types ah different methods to assess your learners.

Ah, in Science and Technology will debate assess learners?

Learners (in chorus): Yes.

Lecturer 8: The teacher will assess learners while they are debating, while they are debating. Learners: Yes

Lecturer 8: So debate is a method this debate can be used to assess learners?

Learners: Yes

Lecturer 8: You are agreeing ?

Learners: Yes!

Lecturer 8: Ok fine

Learner 21: Its time consuming.

Lecturer 8: It is time consuming?

Learners: Yes

Lecturer 8: Okay, you have to assist the learners. Any other way we can ah assist learners.

We are now considering the large classes. How? That side, yes! (pointing at one of the learners who raised a hand up)

Learner 22: Give them weekend test or assessment.

Lecturer 8: Give them weekend test or assessment. Okay. Yes (pointed at another learner)

Learner 23: give them assignments

Lecturer 8: Okay. Types of assessment. What are the types of assessment?

Learner 23: Formative and summative assessment.

Lecturer 8: Formative and summative assessment. So you can assess your learners while you are teaching in class. You can assess learners while you are teaching in class. Now others were giving methods that can be used to assess learners while they are in class. Fine ah ah Evelyn, you said by doing what?

Learner 19: by doing group work. While learners are working in their groups you can assess the learners. You can assess the learners while they are working in their groups

Lecturer 8: Using group work. Someone said using debate you can assess your learners while they are still in class. You can assess when you are asking the questions in the process of ah teaching, you can ask then you can assess the learners. You can know where they are and what you should do ah to help the learners. Those that are not doing well you can know how to help them. Okay so you can use ah formative and summative assessment. You can assess them while you are teaching or you can give them a test after you have taught them. After you have taught them. So these are some of the ways, you can also use peer assessment, learners assessing themselves. You can use observation to assess your learners. While you are teaching, you can observe your learners what they are doing. So these are some of the ways ah you can assess your learners in large classes, in large classes.

Lecturer 8: Okay. Next, you are going to develop assessment items on the teaching of animals. This, you are going to do it on your own time. I will give you some tasks so that you can assess, you can develop, you can write some of the assessment items that you can give your learners either when you are teaching or you have finished teaching. You can gi.... ah give this assessment. So you can give this assessment I will give you this and you can do this at your own time. So today we are looking some of the challenges learners face to understand the topic ah the concept of metamorphosis and survival mechanisms and some of the ways of assessing ah learners considering large classes, considering large

classes. This marks the end of the lesson. We will meet on Friday to continue the topic.
Thank you.

1st February, 2019

Lecturer 8 lesson 3

Topic: States of Matter

Time: 11.00-12.00

Learners in class:18

Teaching, learning and assessment resources: chalk board, chart papers, pentel pens

Lecturer 8: what is matter?

Learners: gave answers as lecturer was writing on chalkboard

Lecturer 8: think of any two examples of matter

Learner 1: volume, and

Lecturer 8: mmmmmmm volume?? No its not. Volume is not necessarily an example of matter. The correct answers are; banana, air, water, plus many more. (She then listed on the chalk board a number of items: carbon dioxide, soot, smoke, ice-cream, etc. She asked the learners in their groups to classify the substances according to their characteristics/features. She walked around as learners were discussing the task. The reason for walking around was to monitor the progress of learners' discussions, but didn't assist them in any way).

Lecturer 8: (after 5 minutes) are you done? I hope you have finished your task.

Learners: Yes!

Lecturer 8: its time for presentations! Come leaders, please come forward to present your work (presentations done by group secreatries while lecturer wrote the points on the chalk board, lecturer also asked questions for clarity sakeand learners answered questions from fellow learners).

Lecturer 8: can you come up with the topic for the day's lesson based on my question?

Learner 2: (many learners raised up their hands. Lecturer pointed at one of them). Teaching of states of matter

Lecturer 8: what are the three states of matter?

Learner 3: solids, liquids and gases

Lecturer 8: why do we teach our learners in primary schools about‘states of matter’? do it in pairs please.You have 5 minutes for the activity.

Learners: discussing the possible answers to the question in pairs.

Lecturer 8: (walked around the classroom to listen to, check progress of the discussions). Stop the discussions. Can pairs report their work to the class by simply reading out their answers?

Learners: read out their answers (lecturer wrote down on chalk board learners' answers-called learners by name). She consolidated learners answers by giving more examples,

reasons and justifications for teaching the topic 'states of matter' to primary school learners.

Lecturer 8: what are the misconceptions that learners may have about states of matter?
(learners raised their hands up. Lecturer pointed at who should answer)

Learner 4: air has no mass

Learner 5: solids do not have molecules in motion, etc.

Lecturer 8: clarified some misconceptions amongst learners

Learner 5: (asked a question). What is the difference between a gas and air?

Lecturer 8: (The lecturer answered the question before giving chance to fellow learners to attempt it? Distributed chart papers to learners, then wrote the properties of matter on the chalk board, eg compressibility, shape, volume, etc.? your task it to associate each property with either a solid, a liquid or a gas (could have done better if learners were allowed to investigate the properties- learners used previous knowledge as learnt in secondary schools).

Lecturer 8: (distributed the above 3 tasks to three different groups to do them). I give you 10 minutes for the activity.

Learners: Did the tasks in groups of 6 members as lecturer moved around to check progress of work.

Lecturer 8: (after 10 minutes). Stop doing the activity. Please stop! Paste your work on the chalkboard or walls

Learners: pasted their work as advised by the lecturer

Lecturer 8: can group leaders to present their work by reading out to the whole class?

Learners: group leaders made the presentations

Lecturer 8: (Consolidated the learners work after the presentations). Please correct your work. Some of your answers are wrong. Any questions from today's lesson?.

Learners: corrected their work (evidence- they were taking points as the lecturer was consolidating the learners' presentations). Two learners asked questions for the lecturer to clarify some points.

13th February, 2019

Lesson 4

Subject: Science and Technology

Topic: coordination

Time: 13.30- 14.30

Number of learners = 30

Classroom arrangement: chairs in rows, all learners seated facing the teacher in front of them, classroom (laboratory) empty with no teaching, learning and assessment resources, no Science equipment, adequate chairs

Teaching, learning and assessment resources: chalk board, chart papers, primary school text books for standards 5 to 8, ball

Teaching, learning and assessment methods used by teacher during the lesson: question pause and name then answer, explanation, think pair share, group work, presentation by group leaders.

Lecturer 8: Good afternoon class.

Learners: Good afternoon madam!

Lecturer 8: We are having some visitors amongst us. They have come to observe how we learn. So feel free. Don't mind them. Okay ah, this time we have an activity. This activity, we are going to play. It involves playing. I want you to play throwing and catching a ball. I need 2 learners to come here. Any volunteer? (two learners volunteered. Lecturer called them upfront).

Lecturer 8: Okay, let's turn and face there. Okay, fine. Go,go,go (Lecturer and the 2 learners did throwing and catching of a ball without saying any words.. After 2 minutes, the lecturer instructed them to stop). Fine. Okay fine. Another activity, the second one. The second one. I need boys, three boys and two girls (three male and two female learners volunteered and went in front as requested by the lecturer).

Lecturer 8: Can you, a lady here. Yah. Kick the ball to each other, kick the ball. Pass it to the first one. Pass it okay, fine (kicked the ball to the five learners one at a time then the

learners kicked it to each other while the rest looked on). Let's go back. Okay, fine. Now feedback, as our friends were playing, which game did you play? What is the type of the game?

Learner 1: football and netball

Lecturer 8: Yes!

Learner 2: Throwing a ball

Lecturer 8: As you were playing, as they were playing, what was happening, how possible was it that they were able to catch the ball or throw the ball to each other? I say as they were playing, isn't it, for them to be able to kick the ball or catch the ball or whatever game, what was that?

Learner 3: Seeing.

Lecturer 8: Yes, thank you. Yes (Pointed at another learner).

Learner 4: Holding the ball in the hands

Lecturer 8: Yes, let's imagine that friend; the one who was kicking the ball, the other friend was tied on the face. What will happen, will he be able to kick it or to throw the ball? Why was it possible that they could throw or kick the ball? (Learners raised up hands. Lecturer pointed at one learner).

Lecturer 8: Yes

Learner 5: because of sense organs

Lecturer 8: But, I want an explanation not just because of the sense organs. I want an explanation. How can you explain for somebody to be able to catch, throw it to a friend and catch again the ball? (Some learners raised hands up).

Lecturer 8: Yes (Pointing at a learner)

Learner 6: There was that coordination.

Lecturer 8: For somebody to be able to throw a ball to a friend there is need to be coordination. Isn't it? For somebody to catch the ball there should be coordination between the body parts. Our topic today is teaching of teaching of human coordination (wrote the topic on the chalk board). Now my question is, what is coordination? Get a piece of paper, write what is coordination? How can you define the term coordination? Get a piece of paper, write points (Each learner was busy writing the definition of coordination. Lecturer went around while checking learners work. After some minutes, he instructed the learners to share their work in pairs).

Lecturer 8: I think you have have written eti

Learners: Yes madam

Lecturer 8: Now you can share with your friend. Now can you share with your friend? A partner that is close to you. Now who can start? (Learners raised hands up). Yes madam! (Each learner talking with a friend. Lecturer instructed each pair to stop discussions). Right, let one representative tell us. Yes (pointed a pair)

Learner 5: It is when body activities are well coordinated (whole class laughs hihihhi!!!!!!)

Lecturer 8: Okay, this side (Pointed at another pair)

Learner 6: coordination all body parts work as one.

Lecturer 8: Anyone to help, who can help? Who can tell us what she said? Yes at the back, what did she say?

Learner 7: Said something in very low voice

Lecturer 8: and what did she say? I didn't hear what she said. Listen, can you be attentive?
(Lecturer pointed at another learner who volunteered by raising a hand up)

Learner 8: linking up of body activities

Lecturer 8: what about you? Yes sir, go on, go on.

Learner 9: the body doing activities as one.

Lecturer 8: Okay, fine. That is what she has said. Another pair. Yes sir. Can you tell us what you discussed

Learner 10: The linking together of various processes

Lecturer 8: Where?

Learner 10: In the body.

Lecturer 8: Okay. According to my definition, the ordinary definition, the definition I have the definition. Okay, can we define coordination? They are not different from yours. Okay (put up a chart paper on the wall on which the definition was written-learners looked on), that is how I have defined. Who can read number one?

Note: A learner by the name Simbeya, failed to read because the graphics on the chart were small and could not be read well from the back.

Learner 7: It is the process of organising different elements in the body or an activity work together

Lecturer 8: (explained to learners the definition of coordination to remove any misconceptions of coordination that might have existed in the learners. He then told learners to compare their definitions of coordination with each other). That is from where?

Learner 7 IPTE module

Lecturer 8: it is derived from where?

Learner 7: IPTE module

Lecturer 8: IPTE module what?

Learner 7: One of Science and Technology

Lecturer 8: Definition number two, what did they say? Alright, yes (pointed at another volunteer)

Learner 11: It is the process through which different activities in animals are working together in one way or another. That is what we learn in Science and Technology . This is from Kalibwanji, Chanco book of Science. They are saying that it is the process through which different activities in animals are linked together in one way or another.

Lecturer 8: That is what?

Learner 11: Coordination.

Lecturer 8: That is the definition of what?

Learner 11: Coordination. They are all talking about what?

Learner 12: Linkage.

Lecturer 8: To link means what? What does it mean to link?

Learner 13: To connect.

Lecturer 8: Okay, how does this process, how does this process take place? Can you think how this process takes place?

Learner 13: Raised a question; what is the difference between coordination and human coordination? (The lecturer threw the question to the fellow learners and finally it was elaborated by the lecturer).

Lecturer 8: Coordination and human coordination and coordination itself (a learner raised hands up). Yes madam!

Learner 14: Said something

Lecturer 8: Yes, anyone?

Learner 17: Cooperation

Lecturer 8: They are saying coordination in general, that is when certain activities for them to be carried out properly, there is a need for some sort of cooperation. Let us say for example here at the TTC institution for activities to be carried effectively, where do they start from?

Learner 15: From the principal

Lecturer 8: After the principal?

Learner 15: the deputy principal

Lecturer 8: from the deputy principal?

Learner 18: heads of section

Lecturer 8: from there?

Learner 18: after the lecturers

Lecturer 8: after the lecturers? From the lecturers we go to where? I think to the students union, it can go to the SRC, not so? From the SRC to then the students. That is coordination, that passing on of that information or activity, they are referred to as what? A challenge. There is a challenge. For example you have got a burning issue, can you just go straight to principal? You yourself (pointed at a learner). What are you going to do?

Learner 18: You are going to go to the SRC.

Lecturer 8: what?

Learner 18: I will go to the president first

Lecturer 8: President and then from there you are going to the student advisor. That is how it goes on. If you go straight to the principal, what is he going to say?

Learners: go and see the advisor

Lecturer 8: Go and?

Learners: Go and see student advisor.

Lecturer 8: There is coordination, for something to be handled properly, there is need for what?

Learner 19: a coordination

Lecturer 8: Okay, we are talking of the teaching of coordination in the teaching of human?

Learners: coordination

Lecturer 8: That is the topic there. See the topic then you will get it. Do you see the topic there?

Learners: Yes!

Lecturer 8: We know there are a lot of coordination but the focus is on what?

Learners: Human coordination.

Lecturer 8: Now for this human coordination to be there, for the coordination to be there, there is some processes which take place and the human coordination works with certain parts of the body. You know that, can you name? Name parts of the body which are involved in human coordination (wrote on the chalk board the following sentence, “name the parts of the body that are involved in human coordination”).

Lecturer 8: Let's be in 4 groups. Discuss parts of the body that are involved in coordination.

I give you two minutes

Learners: went into groups to discuss about the question while in their groups (Lecturer moved around as learners discussed the task. Later she stopped the discussions).

Lecturer 8: can you tell what you have discussed?

Learners: each presented their work through a group leader

Learner 19: Spinal cord

Learner 20: the brain

Learner 21: the skin

Learner 22: the eye

Note: when a learner gave an answer to a question, the teacher asked other learners to find out if they were convinced with the response.

Lecturer 8: You have mentioned them, not so? The eye, brain, skin, spinal cord. What is the composition of this? What is their composition? What does human coordination compose of or comprise of? What does it comprise of? Discuss (learners engaged in group discussions. Later lecturer asked them to report). Alright can you report to us what you have agreed. Can report to the class what you have discussed. Mr President Sir.

Learner 23: nervous system

Lecturer 8: what?

Learner 23: central nervous system.

Lecturer 8: Okay, fine, yes (Pointed a learner volunteer who raised up a hand).

Learner 24: the brain and the five senses.

Lecturer 8: Yes(pointed at another volunteer)

Learner 25: brain, sense organs and the the alimentary canal.

Lecturer 8: What do we have? One we are saying the sense organs. The sense organs comprise of what?

Learners: the skin, the tongue.....(Lecturer interrupted)

Lecturer 8: I don't need a choir. That's a choir. Yes! (Pointed at a learner)

Learner 25: the skin, the tongue, central nervous system

Lecturer 8: okay, fine. And then we have the human nervous system. The human nervous system comprises of the brain, which comprises of the brain, spinal cord and what you have mentioned, nerves. That is what?

Learners: The human nervous system.

Lecturer 8: On the human nervous system we have plenty of them. The third one is what?

Learner 26: named the body.

Lecturer 8: Repeated the learner's answer. He asked for further explanation

Learner 27: blood circulation and digestion.

Lecturer 8: Blood circulation and digestion. Anha, I can hear that, meaning that there is blood circulation. Yah, what about digestion?

Learner 27: its part of the system. (Then asked a question).

Lecturer 8: Yes, are you just asking? Not that, okay are you able to get this? Okay. You are asleep, automatically digestion takes place. When you are asleep the brain is not working, digestion what?

Learner 28: Does the brain control digestion? How about blood circulation?

Lecturer 8: blood circulation is the circulation of the blood. It is controlled by the heart. The function of the heart and the whole process is okay, fine. Ah, we have all learnt about coordination. Isn't it?

Learners: Yes

Lecturer 8: flapped out a chart paper and went through the work with learners. Okay, we all had learnt about coordination in primary schools. Didn't we?

Learners: Yes

Lecturer 8: What challenges did you face when learning coordination at primary school? The topics are talking about what?

Learners: coordination

Lecturer 8: Stand up! Walk around to mix, then pair with anybody upon hearing a hand clap. Then discuss in pairs the challenges that learners may face when learning about coordination. Move around to mix again and then form new pairs upon hearing a second hand clap- to discuss the same question

Learners: did as instructed by their lecturer

Lecturer 8: Can pairs report their findings to class?

Learners: Came up with challenges as follow:

Negative attitude

Misconception about the term coordination

Lecturer 8: what could be way forward as teachers?

Learners: responded

Vary teaching methods

Teachers to master the concept coordination

Lecturer 8: Go back to your seats. (Learners were allowed to ask questions while in their original groups. Pasted second chart paper which was faint as well. On the chart paper were challenges and solutions eg, Nervous system is difficult to understand and the solution was that use teaching/lesson resources)

Lecturer 8: I have standard 6-8 books here, can you be in groups of 3 and analyze a topic which is talking about coordination? So can one member come and collect the books? I don't have standard 5 books. Analyse the topics. Read the topics and analyse the topics. There are some topics in these books. You are having standard 6 books

Learner 29: should we analyse the books?

Lecturer 8: Yes, analyse the topics. You are having standard 7 books. Yes analyse the books. Have time to analyse the topics. (Learners got engaged in group discussions. All groups had the same task. Lecturer moved around. However, the lecturer did not assist learners but insisted that they needed to find the answers. Later she announced time remaining). Two minutes. Okay, can you stop? Okay. Secretary for this group. Who is your secretary? Come here, standard?

Learners: 7.

Lecturer 8: Okay, tell us. Let's listen to standard 7 (Called group secretaries to present their findings using hot seat method -secretary sat on a chair in front).)

Learner 30: Reported on behalf of his group

Lecturer 8: Let us give them a hand. Yes! (Pointed at a learner from another group for a presentation).

Learner 31: Made a presentation on behalf of her group

Lecturer 8: Okay, fine. A hand (Hand clap). Let us listen please, that is standard?

Learner 32: 8. Started reporting

Lecturer 8: Can you speak up? Do we all hear what he is saying?

Learners: No

Lecturer 8: Okay, speak up

Learner 32: reported about their group findings for standard 8

Lecturer 8: Thank you, fine ah I had these (displayed a chart paper with pictures on it), are you able to see?

Learners: Yes

Lecturer 8: Okay, fine. Can you read this for us?

Learner 33: Read out what was on the chart paper

Lecturer 8: Okay, fine. This is what we are supposed to be analysing what?

Learners: A book.

Lecturer 8: This is what it is supposed to be done. For example, we are saying that how does muscles and joints enable movement in human beings? What will it be? It will need some explanation, it will be what? We are going to what?

Learners: To explain.

Lecturer 8: How does the bone, how do human bones move, how do bones, muscles and joints move? What coordination is there? You need to explain, demonstrate and role play. That is what is there. Not so?

Learners: yes

Lecturer 8: Yah, we are trying to analyse the what?

Learners: The book.

Lecturer 8: Draw muscles, bones and joints of a bent arm and a bent what?

Learners: Leg.

Lecturer 8: They are going to do an activity of what drawing activity. They are going to have a drawing activity. (the lecturer had his work on chart papers. No consolidation of the learners' work. as a conclusion, the lecturer asked one learner to go upfront to explain to the class what they had learnt on the day). Okay, fine. From what we have learnt, tell us what we have learnt today in our lesson. Tell us what we have learnt today in our lesson (Learners raised hands up).

Lecturer 8: Yes, madam

Learner 34: explained what she had learnt in the day's lesson

Lecturer 8: Okay, fine. Let us give her a big hand (Hand clap). This madam has said what we have learnt. When we go, let us read more. This marks the end. Can you collect the books?.

18/02/19

Lecturer 8: lesson 5

Time: 11.00- 12.00

Number of learners: 28

Subject: Science and Technology

Topic: Making of Resources for Teaching and Learning

Teaching and learning resources: both commercial and artificial resources- ear-commercial, skeleton- artificial.

Lecturer 8: Good morning class

Learners: good morning madam

Lecturer 8: It is time for Science and Technology . Aah last time we were learning about coordination. We learnt about the importance of coordination, challenges which teachers and learners face in teaching coordination and many more. Today we are going to learn about resources but before we do that can you get a piece of paper and answer this. (She wrote the following questions on the chalk board); what is coordination? Learners in standard 5 had challenges in sense organs . Explain two ways how you as a teacher could help the learners to overcome these challenges.

Lecturer 8: Write the answers to these questions on a piece of paper. (Each learner was writing on his or her piece of paper while the lecturer observed. She went around the groups to mark/ check the learners responses, assist individual learners on how best to answer the questions). Those who have finished put your hands up (learners raised hands up and lecturer pointed at a learner to respond). Each learner must share his/her answers with a friend seated next to him/her

Lecturer 8: Number what?

Learner 1: number one

Lecturer 8: Okay, fine. Number one, challenge on coordination? Yes

Learner 1: sense organs

Lecturer 8: Yes, okay, fine. Number two yes

Learner 2: Learners in standard five with challenges with sense organs, explained points teachers has to do to overcome these challenges. Use of teaching, learning and assessment resources.

Lecturer 8: Yes, use of teaching, learning and assessment resources. That's what you are saying, not so?

Learner 2: Using different teaching, learning and assessment strategies.

Lecturer 8: Okay, that's about justification. Now stand up, come here (called learners to go at the back of the class for an activity). Can you make two circles? One circle inside and the other outside. How many are you?

Learners: 30

Lecturer 8: Almost 30? Okay, fifteen both sides. Okay, fourteen outside, fourteen inside (learners did as instructed). The inner circle turn facing the outer circle.

Lecturer 8: Okay, hold hands, hold hands. Okay, as you are holding hands, as you are holding hands, turn this side. Can you leave your hands? Okay those who are inside, can you turn (lecturer meant that learners forming the inside circle should turn to face their colleagues on the outside circle). See to it that you have a pair. Now can you share what you thought about the teaching strategies and teaching learners who have challenges in sense organs? You should discuss at least three. Give at least three to each other.

Lecturer 8: One (learners shared a point) two (learners shared a second point) three (learners shared a third point) Okay. Now can you stop, stop (pairs stopped sharing notes upon the lecturer's instruction).

Lecturer 8: Those who are inside, hold hands, hold hands, move two steps to your right (inside circle did as expected). Okay, now face the other pair, the other friend of yours (Each learner from inside circle formed pairs with learners from outside circle). Thank you, can you stop. Let us go back to your places.

Lecturer 8: Okay, I think you have discussed in your groups and according to your pairs which you had. I want a boy to come in front and write at least four, four methods, and so,

a girl. Ah, fine (a female and male learners went to the chalk board and wrote four point each while the other learners and the lecturer were observing).

Learners: Female learner wrote- pens in the middle, think in pair share, T. Chart, bus stop while male learner wrote- ball bearing, gallery walk, talk around walk around, think pair share.

Lecturer 8: Let us clap hands for them. Okay, we have learnt that in order for us to help learners who have challenges in the topic of sense organs, we need to use various teaching, learning and assessment resources. What is the different teaching, learning methods that you can use when teaching? As a teacher, what are the various methods you can use? There, how many are they?

Learner 3: (raising up a hand) four

Lecturer 8: four. What are they? Yes (pointing at a learner)

Learner 4: think pair share, gallery walk, silent participant

Lecturer 8: okay, we have seen that there are so many. These are some. Then I have table, and finally think of the methods which you can use. Any topic on what

Learner 5: coordination.

Lecturer 8: I have books here, go through the books and find the topic. Then think of the method you can use. Please be in four groups (Learners formed groups and started working

on the task). You are going to tell us the topics which you have chosen and then prepare resources you are going to use. I give you three minutes only. The topic should be coordination (lecturer went round the groups while giving instructions and advice). Three minutes only. The topic should be on coordination. We are talking about coordination. Find a topic on coordination. There are several topics. We learnt the topics already. Are you in that group? (Lecturer was asking a learner who was sitting by himself) Can you come and sit here? (Learners doing the task in groups. After a few minutes, the lecturer stopped the activity).

Lecturer 8: Okay, fine can you stop what you are doing? Stop please. Stop what you are doing. Stop (some groups were seen discussing and writing the task). Okay, let us hear from the group representatives what you have written. Tell us what you have written. Let's start with that group

Learner 6: group work, pair work

Lecturer 8: okay, fine, thank you for that. This group

Learner 7: think pair share, brainstorming, individual work.

Lecturer 8: Yes (pointing at a learner)

Learner 8: one remains three astray, lecturing, pair work

Lecturer 8: umhu

Learner 9: lecturing, group discussion, question and answer.

Lecturer 8: How many do you have?

Learner 9: five

Lecturer 8: okay, fine. At least from what we have discussed, you will see that there are so many methods we can use in teaching different topics. Unfortunately, when we go to the field you will find that you are not using the methods.

Learners: we will use them.

Lecturer 8: You are going to be using them?

Learners: yes sir, we will use them

Lecturer 8: You will use them?

Learners: Yes

Lecturer 8: (explained to learners each point/method that was raised. This should have been left to the learners to find out how they understood the method). Okay, can you go back to your places? (Learners disbanded their groups and went back to their seats). Yah, in one of the groups you said: one of the ways of overcoming you said; use of variety of methods, use of variety of teaching resources?

Learner 8: The teacher has to use different teaching, learning and assessment

Lecturer 8: The teacher has to use different teaching, learning and assessment resources.

Two, using different teaching, learning methods which we have done, not so?

Learners: Yes!

Lecturer 8: Now on resources, ah, you have more resources here. I have different resources. In front of me I have different resources. I have got this (showed ear (commercial), eye (commercial), digestive system (commercial), locally available resources eg. cartons, knives). What is this? Now look at this, showing the resources while learners observed and mentioning them.

Learner 11: an eye

Lecturer 8: but this one has been commercially made, this is a commercial what??

Learners: resource.

Lecturer 8: Isn't it?

Learners: Yes!

Lecturer 8: Okay, I have this, what is it?

Learners: circulatory and digestive systems.

Lecturer 8: Isn't it?

Learners: yes

Lecturer 8: When I have this, ah eye, all these are commercially resources but where we are going, these are not there. There are just very few schools if there is any. If there is any may be if there are any. Yah, that school is fine maybe I can think of one may be because was of funding so the constructor funded and it was donated to the government of Malawi. But all the schools we go, there is none. So as teachers what do we need to do? There are commercial resources but as teachers what do we have to do?

Learners: We need to improvise. We need to borrow.

Lecturer 8: I have here a model. What is this? (Showed learners an artificially made digestive system)

Learners: (in unison) the digestive system!

Lecturer 8: Okay, fine. Now, I want you, in your groups, to make or model artificial resources which you can use to teach sense organs. (lecturer provided raw materials. Learners received them and started making the teaching and learning resources). One in each group (one learner from each group received a sample digestive system). Let us go to our groups (learners went into home groups). Use the books and model an organ as assigned to your group.

Lecturer 8: We have our tools. Group 1, group 2, group 3, group 4. I think I have got the resources. I gave you work, go to your groups (learners formed groups). What did I say? Yah, you have got books, share with friends (learners shared text books and teachers' guides).

Learners: (learners in groups of 4-5 started working/ making teaching and learning resources based on printed pictures from the books. 3 groups were using hard papers from carton. 1 group using clay and another group using wires as sketches for their models of different parts of the body. Group with clay made an ear. Group with wires made an eye. The three groups with hard papers made human brain, digestive system and human nose)

Lecturer 8: (stood beside one group, and just watching for a long time. She was watching the learners as they were modelling/ making- improvising human sense organs that could be used to teach about coordination. However, at times she went round checking with learners' work in the groups. She also checked the resources which were being made/modelled by the learners). Are you through?

Learners: No

Lecturer 8: I will give you 5 more minutes because I have observed that some are far from finishing the task. (Assisted some learner who had problems with the modelling/ making of the resources).

Lecturer 8: Can we be fast please? We have only three minutes. Can you be fast? We are remaining with a minute. Okay, can we stop, please what we were doing? What are you doing? Let us leave what we were doing. Let us stop what we were doing. Let us leave whatever we were doing, what we have done, where it is.

Lecturer 8: Now I see that all groups have finished the task. Please display your work by hanging it on the walls. Arrange it in such a way that, that group can you place it can you make sure that can you put it somewhere here, put somewhere here. Can you make sure that. Okay, fine. I think we have produced some resources, and you, can you put here? Go, go, go. Fine, can you stand up? This is what we are going to do. Members from that group should come here. And members of this group to go to this place and then you come there. Leave the resources at an open place. Let's stand up and go to another place to appreciate

what your friends have produced. Then from place to another place to appreciate the work of your friends. Can you comment on what resource has been made?

Lecturer 8: Yah, appreciate what your friends have produced. Okay, after appreciation, go around, go around, go around (learners looking at what their colleagues have produced, asking questions). Appreciate what your friends have produced. Now, you go back and sit down. Sit down. Okay from what you have seen, you have observed, isn't it? What comment can you give?

Learners: some groups have produced nice models

Lecturer 8: Therefore, this group has produced a nice model?

Learners: Yes

Lecturer 8: Okay fine, anyone? I want you to comment on what you have seen.

Learner 12: the teaching and learning resources look very beautiful

Lecturer 8: Okay, and finally? (Learners raised up hands) yes!

Learner13: made a comment about the resources made

Lecturer 8: Okay, fine. What I wanted you was to just have a feel of what you will be doing in the field. You have to be producing using locally available what resources. The resources should be locallymade. We can't manage with that in a classroom what setting. This is a classroom setting, we have produced. Why not you? When we go out, let's try to do it so that learners should be able to feel what it is, they are going to enjoy and they are going to learn.

Lecturer 8: Okay, fine. What have you learnt so far?

Learners: the sense organs, parts of the body,

Lecturer 8: is it? What else?

Learner 14: the best methods which you can use when teaching, coordination.

Lecturer 8: Not that here how should it be done but you have done it yourselves Okay, this marks the end. Bring the books, leave the models there.

APPENDIX 11: General procedures followed by the lecturers during lesson delivery to make their lessons learner-centred

Class brainstorming

- 1.A lecturer asked a question to the class
- 2.He/she appointed individual learners to give answers (after the learner had raised their hands)
- 3.The lecturer recorded all ideas generated by the learners on the chalkboard/chart paper (Recorded all responses regardless of whether they were right or wrong).
- 4.He/she discussed with the learners all the ideas generated (accepted correct responses and eliminated incorrect ones).
- 5.the lecturer then consolidated by emphasising on correct responses

2.Group brainstorming

- 1.A lecturer asked a question to the class
- 2.He/she asked the learners to be in groups to brainstorm a given concept e.g. procedure for testing presence of starch in leaves.
- 3.The lecturer asked the learners to record suggested responses raised in their groups.
- 4.He/she asked a representative from each group to present their work and record on the chalkboard/chart paper
5. He/she then discussed with the class responses from various groups.
6. the lecturer then consolidated by emphasising on correct responses

Jig-saw

- 1.The lecturer selected a topic with a number of sub topics/sub headings.
- 2.He/she asked the learners to be in groups (number of groups depended on number of subheadings/tasks to be discussed/worked on). These were called home groups or Jig saw groups.
- 3.He/she asked each learner give themselves a number; e.g.1,2,3,4 etc
4. The lecturer asked all the number ones to form their own group, likewise with numbers 2-6 (expert groups).
- 5.He/she gave each expert group a task prepared in advance (each expert group had a different task but from the same topic)
6. He/she let each expert group discuss/work out the assigned task and ensured that each participant was actively taking part and recording agreed points (He/she allocated time for the discussion).
- 7.The lecturer asked learners to go back to their home groups and report their findings, beginning with number 1 up to number 6 (He/she assigned time)
8. He/she asked the learners from selected groups to share their responses with the class.
9. The lecturer consolidated the lesson by highlighting the correct responses.

Note: Where the learners were struggling, the lecturer provided information to aid discussion

Gallery walk

- 1.The lecturer introduced a topic with a number of subtopics/subcategories.
2. He/she divided the learners into groups (the number of groups depended on number of tasks or subheadings)
3. He/she assigned each group a different task to do

4. The lecturer asked each group to record their responses on a chart paper or any piece of paper.
5. He/she let each group display their work on the wall or any other suitable place (gallery)
6. He/she asked each group to choose a presenter who would stay at each gallery ready to present to the visiting groups.
7. The lecturer asked the groups to go around visiting the other galleries in clock or anticlockwise direction, listening to the presentations by the presenters, commenting, asking questions and where necessary making additions.
8. He/she asked the presenters to form their own group and present to each other as the rest of the learners visit any gallery or join the group of presenters to gather more information.
9. He/she consolidated the lessons by highlighting correct answers and clear misconceptions.

Walk around-talk around.

1. The lecturer asked the learners to create space in the classroom.
2. He/she presented a problem and asked the learners to think about solutions to it
3. He/she asked the learners walk around upon hearing a hand clap from the lecturer,
4. The lecturer asked them to stop and pair upon hearing a double hand clap,
5. He/she asked them to share their responses in the pairs, ensure that they were discussing on each point.
6. Procedures 3-5 were repeated two to three times

7. The lecturer asked selected individual learners to share with the rest of the class and recorded the correct responses on the chalkboard/chart

8. He/she consolidated by confirming correct responses

Note: The question was one that could generate several responses. The lecturer asked one question only, used signals such as hand clap or desk banging not words for learners to walk or stop

Mix-Freeze-Pair

1. The lecturer created space in the classroom

2. He asked the learners to move around the class when he/she shouted “mix!”

3. He/she asked them to stop when he/she shouted “freeze!” and be in pairs.

4. The lecturer asked the learners a question each time they froze (stopped) and let them discuss in their pairs to find a solution.

5. Procedures 2 to 4 were repeated but changing the question each time learners froze (stopped)

6. The lecturer asked some pairs to share their responses with the class and recorded the correct responses on the chalkboard/chart paper.

7. He/she consolidated by emphasising on correct responses

One Stay-Three Stray

1. The lecturer asked the learners to be in groups of 4 (home groups) and give themselves numbers 1-4.

2. He/she arranged the groups in a circular format and number them.

3. He/she asked each group to work out/discuss a given task
4. The lecturer asked all number ones to stand up and move to the next group; all number twos to move two groups away; all number threes to move three groups away; and all number fours should not move.
5. He/she asked the visitors (one to three-the guests) to interview the hosts (number fours) to find out what they had discussed in their group. It's only the host who share information.
6. He/she ensured that the visitors were recording only new information from the hosts.
7. The lecturer asked the visitors to go back to their home groups and present new information gathered from the visits beginning from number one to three.
8. He/she asked some learners from selected groups to summarize the discussions.
9. He/she consolidated the lesson by emphasising on correct responses.

Think-Pair-Share

1. The lecturer asked a question to the whole class:
2. He/she asked each learner to think through the question for a minute.
3. He/she asked each learner to choose a partner (preferably one who is close) and share their responses and come up with a consolidated answer.
4. The lecturer asked some learners to share their responses with the class and record the responses on the chalkboard.
5. He/she consolidated the lesson by emphasising on the correct responses

Ball game

- 1.The lecturer asked the learners to form a circle.
- 2.He/she asked them a question
- 3.He/she started the game by throwing a focus ball to both volunteers and non-volunteers to answer the question.
- 4.The lecturer let the learners continue with the game by throwing the ball to each other for more responses.
5. He/she called back the focus ball whenever misconceptions arose for clarification.
6. He/she consolidated the lesson by emphasising on correct responses