

AN ASSESSMENT OF IN-SERVICE TRAINING NEEDS AND PREFERENCES OF
SECONDARY PHYSICAL SCIENCE TEACHERS IN CENTRAL WEST
EDUCATION DIVISION IN MALAWI

A Thesis

By

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DECLARATION

I hereby declare that the text of this dissertation entitled: AN ASSESSMENT OF IN-SERVICE TRAINING NEEDS AND PREFERENCES OF SECONDARY PHYSICAL SCIENCE TEACHERS IN CENTRAL WEST EDUCATION DIVISION IN MALAWI is substantially my own work.

ALNORD LEVEISON DAVE MWANZA

SIGNATURE

MAY 2008

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DEDICATION

This research study is dedicated to my children Philip, Edwin and Anne for their unbounded patience and eagerness to continue with this journey.

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This dissertation is the result of two years of classroom and research work with assistance in many forms from many people and organisations. I would like therefore to deeply thank the various people and organisations that, during the two years in which this endeavour lasted, provided me with useful and helpful financial, moral and material support. Without their patience, understanding, expertise, care and consideration, this thesis would likely not have matured.

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ABSTRACT

In this mixed model and methods study, I assessed the self-perceived in-service training needs of Physical Science teachers in public secondary schools in Central West Education Division in Malawi. I also assessed their preferences for in-service education models, organisation and management. A cross sectional census survey of 60 teachers was employed with purposively sampled 30 teachers of them participating in a face-to-face follow up interviews. Quantitative data was analysed by using Borich Needs Assessment model and descriptive statistics. Qualitative data was analysed using the thematic approach.

The results of the study indicate that the different categories of degree and diploma Physical Science teachers (by experience) in CWED indicated high in-service training needs in varying competencies in the seven broad dimensions of management of instructions, diagnosing and evaluating students, pedagogical knowledge and skills, knowledge and skills in the subject, administering laboratory equipment, integrating multi media technology in lessons and use of Information Communication Technology. Additionally, the degree teachers indicated common in-service training needs in such competencies and teaching special needs students while the common in-service training needs indicated by the diploma teachers included, teaching special needs students and repairing laboratory equipment. Diploma teachers also indicated more needs in cognitive competencies than degree teachers.

The results also indicate that the in-service training needs of the different categories of teachers from Chancellor College, Polytechnic, Mzuzu University and Domasi College of Education were in all the seven broad dimensions tested and varied with their years of teaching experience. However, all teachers from Chancellor College indicated common needs included teaching special needs students and repairing laboratory equipment; from Polytechnic, common needs included teaching special needs students and using computers in classroom and laboratory; from Mzuzu University, common needs included repairing lab equipment, using multimedia equipment and using computers; from Domasi College of Education their common in-service training needs were in teaching special needs students and repairing lab equipment. Despite few common in-service training needs among teachers from different institutions, the results indicate that Physical Science teachers' in-service training needs were a factor of the teacher training institutions.

Physical Science teachers preferred the voluntary and traditional face-to-face in-service workshops held per education division at teacher training institutions with certificates of attendance and stipend as the best form of recognition and incentives respectively. The results have implications on the design of INSET content and formulation of INSET policy. The results also confirmed the need to regard in-service education of teachers as a seamless component of the teacher education and development.

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ACRONYMS AND ABBREVIATIONS

AIDS	Acquired Immune Deficiency Syndrome
CDSS	Community Day Secondary School
CEED	Central East Education Division
CIDA	Canadian International Development Agency
CPD	Continuing Professional Development
CPE	Continuing Professional Education
CWED	Central West Education Division
DCE	Domasi College of Education
EDP	Education Development Plan
FPE	Free Primary Education
GDP	Gross Domestic Product
GER	Gross Enrolment Ratio
GoM	Government of Malawi
HIV	Human Immunodeficiency Virus
ICPD	In-Career Professional Development
ICT	Information, Communication and Technology
ILO	International Labour Organisation
INSET	In-service Education and Training
JCE	Junior Certificate of Education
JICA	Japanese International Development Agency
MAMSTIP	Malawi Mathematics and Science Teacher Improvement Project
MANEB	Malawi National Examination Board

MIE	Malawi Institute of Education
MLS	Malawi Library Services
MoE	Ministry of Education
MoE&VT	Ministry of Education and Vocational Training
MPRSP	Malawi Poverty Reduction Strategy Paper
MSCE	Malawi School Certificate of Education
MWDS	Mean Weight Discrepancy Scores
NA	Needs Assessment
NED	Northern Education Division
NLS	National Library Service
NSO	National Statistical Office
NSTED	National Strategy for Teacher Education and Development
PIF	Policy Investment Framework
PSLCE	Primary School Leaving Certificate of Education
SEED	South East Education Division
SEP	Secondary Education Project
SHED	Shire Highlands Education Division
SMASSE	Strengthening Mathematics and Science in Secondary Education
SPSS	Statistical Package for Social Sciences
SSTEP	Secondary School Teacher Education Project
SSTIP	Secondary Science Teacher Improvement Project
SWED	South West Education Division
UCE	University Certificate of Education

UN	United Nations
UNDP	United Nations Development Programme
UNESCO	United Nation Scientific and Cultural Organisation
USD	United States Dollar
WHO	World Health Organisation

CHAPTER 1

INTRODUCTION TO THE PROBLEM

Chapter Overview

This chapter describes the problem that led to this research study on In-Service Teacher education (INSET) of practicing qualified secondary Physical Science teachers in Malawi. It begins by discussing the socio-economic, political, and educational contexts in which the problem is situated. Then, the chapter defines and describes the nature, scope, and severity of the problem. The next sections give the purpose, objectives, research questions, significance, assumptions, limitations and delimitations of the study. The chapter ends by giving definitions of the key terms used in this study.

1.1 The Socio-Economic context

According to UNDP (2003), Malawi is one of the poorest countries in the world with a GNP per capita of US\$570. As such, the UN and World Bank rate Malawi as one of the Least Developed Countries, Highly Indebted countries and Least Scientifically Developed countries in the world. The Integrated Household Survey 2004/05 reports that 52.4 percent of the population (6.3 million) lives below the poverty line (NSO, 2003). Thus, poverty in Malawi indeed remains significant, widespread, deep and severe in both rural and urban areas. However, the Poverty Vulnerability Assessment for 2006 indicates that low quality education is one of the major factors affecting the level of household

poverty in Malawi. Strategies of improving quality of education, and quality of science education in particular, consequently become some of the necessary vehicles which would avail opportunities to citizens to break the poverty cycle.

In the NSO (2003) projections, the population of Malawi is estimated at 11.9 million with an annual population growth estimated at 3.32% and an average population density of 105 per square kilometre. In addition, 30% of the total population lives in urban areas. Ministry of Education (MoE) (2005) also reports that there is a high level of adult illiteracy of 39.1% due to, among other factors, poor quality supply of education. This high illiteracy rate acts not only as an obstacle to the democratization process in Malawi but also to sustainable economic growth.

Malawi, like many other countries in the world, continues to experience the devastating effects of HIV and AIDS. According to Government of Malawi (GoM) (2006), the national adult HIV prevalence in the reproductive age group of 15-49 years is at 14 % in 2005. As pointed out by the Malawi National Commission for UNESCO (2006), HIV and AIDS hamper the supply of education, reduce the demand for education and consequently negatively impacts on the quality of education. Thus, GoM's long-term goal is to prevent further spread of HIV and AIDS and mitigate its impact on the socio-economic and psychosocial status of the general population and high-risk groups (GoM, 2006:xvii). While education has been regarded by GoM as a social vaccine to the fight against the pandemic, World Bank (2005) also singles out quality secondary science education as an equally important tool. The provision of In-service education to secondary science teachers therefore remains one of the vehicles to prevent further spread

of HIV and AIDS among teachers, students and communities around educational institutions.

1.2 The Political context

Malawi transitioned herself from a one party system of government to a multiparty-democratic system of government in 1994. A democratic Constitution was consequently implemented in the same year. Among other principles, democracy entails that government represents the governed such that policies of government and/or its subsidiary organisations must be sourced and informed from the governed. Thus, participation of Malawians, including teachers, in policies that affect them is a prerequisite for effective and lasting democracy. However, it is noted that educational policies in Malawi tend to be more of pronouncements (top down policies) expressed at the Ministry level with very limited or no inputs from the governed (teachers).

The Constitution of the Republic of Malawi, 13 f (iv), stipulates that it is the responsibility of the state to provide adequate resources to education sector and devise programmes in order to, among other things, offer greater access to *continuing education* (GoM, 1999:14). It is therefore a constitutional right for teachers in Malawi to access and participate in continuing education or in-service teacher education.

The vision of the present Government of Malawi, under the leadership of His Excellency, Dr Bingu wa Muntharika, is “Poverty reduction through economic growth and development” (GoM, 2006: ii). Therefore, the Malawi Growth and Development Strategy (MGDS) of 2006 were developed as essential tool to assist in turning this vision

into reality. The MGDS identifies social development as one of the five thematic areas in which progress must be made if poverty reduction overall strategies are to be successful. Education, a sub-theme under social development, is considered a catalyst for socio-economic development, industrial growth and an instrument for empowering the poor, weak and voiceless (GoM, 2006:50). The MGDS, therefore, identifies the provision of in-service education to secondary teachers as one of the strategies to improve the quality of education including secondary education and achieve the broad policy of poverty reduction.

1.3 The Education context

1.3.1 The policy on Education in Malawi

GoM (2006) points out that education is a key for attaining prosperity, a catalyst for socioeconomic and industrial growth and an instrument for empowering the poor, weak and voiceless. MoE (2001) also points out that the expansion of scientific knowledge and technologies that are necessary for socioeconomic development depend on education. Hence, the GoM's broad policy on education is to develop an efficient and *high quality system of education* of a type and size appropriate both to the available resources and to the political, social and economic aspirations of the nation (MoE, 2004:10). MoE further points out that the general objectives of education in Malawi is to equip students with skills and the desire for self employment and entrepreneurship rather than conventional wage employment. The achievement of both the broad policy and objective, however, call for at least a competent teaching force capable of causing effective learning in the classroom.

1.3.2 The Main challenges facing Education in Malawi

Malawi's educational system faces a number of challenges in quality. According to GoM (2006) and World Bank (2005), the quality of education in Malawi is low. According to GoM (2006), indicators of low quality of education in Malawi include internal inefficiencies such as high repetition, dropout, and completion rates, as well as low national examination pass rates and transition rates. This low quality of education has been attributed to a number of factors including weak teaching force (shortage of qualified teachers and use of untrained teachers) (Oki, 2004). Oki further points out that the lack of in-service opportunities to secondary science teachers partly contributes to a weak science teaching force for Malawi. As argued by Ogunniyi (1967) unless in-service education is provided to teachers, hopes of improving the quality of education cannot be realised. Hence, In-service education and training of teachers has remained one of the key strategies to improve the quality of education at all levels (GoM, 2006).

1.3.3 Organisation and administration of Education in Malawi

Education in Malawi is administratively demarcated into thirty-three Education Districts and six Education Divisions (a group of at least 4 Education Districts). One of the Education Divisions is Central West Education Division comprising Ntchewu, Dedza, Lilongwe and Mchinji Education districts. The Ministry of Education headquarters remains the central policy making institution. And the majority of the secondary schools in the Education Divisions are cost centres as a result of devolution of budgeting and financial responsibilities from MoE headquarters.

1.3.4 The structure of Education system in Malawi

The formal education system in Malawi is a three tier, 8-4-4, system consisting of 8 years at primary level, 4 years at secondary and an average of 4 years at university level. The first two tiers are terminated by public examinations: Primary School Leaving Certificate of Education (PSLCE) and Malawi School Certificate of Education (MSCE) set by Malawi National Examination Board (MANEB). These national examinations also act as selection tool for further education. Appendix I give full details of the structure of the public education system in Malawi.

The goal of Malawi's free Primary education is to equip its recipients with basic knowledge and skills to allow them to function as competent and productive citizens in a free society (MoE, 2001:14) and GoM (2006). According to MoE, (2004:12), the fundamental objective of primary education is, therefore, to instil basic literacy, numeracy and life skills to over 90% of school going age population by 2012. Generally the quality of primary education in Malawi is low (MoE, 2001 and GoM, 2006) as indicated by low internal efficiencies such as high repetition and dropout rates of 16% and 20% respectively (MoE, 2005). GoM (2006) cites shortage of qualified teachers as one of the contributing factors to low quality primary education. Hence, GoM, among other strategies strives to improve the quality of the primary teaching force by training more teachers and providing systematic in-service education (MoE, 2001). Unless primary teachers, who are graduates of the secondary sub-sector, received quality secondary education, efforts to improve the quality of primary education through the training of such teachers could be futile. Hence, GoM aims at improving the quality of

secondary education as one of the ingredients of improving the quality of primary education.

Secondary education in Malawi lasts 4 years (forms 1 to 4) with Junior Certificate of Education (JCE) and the Malawi School Certificate of Examinations (MSCE) being administered at forms 2 and 4 respectively as national examinations. According to GoM (2006: 50), the goal of secondary education is to provide the academic basis for gainful employment in the informal, private and public sectors. According to MoE (2005), there are 6 categories of public secondary schools in Malawi. Provision of secondary education is a responsibility of both government and private secondary schools. Public secondary schools are however categories into Community Day Secondary Schools (CDSSs), Government Day and Boarding Secondary Schools, Open Schools, and Grant Aided secondary schools. MoE (2006) reports that the public secondary schools enrol over 166,000 and has a teaching force of 10368, 3168 (31%) of them are qualified (minimum of Diploma qualification). It is also estimated that the shortage of teachers at this sub sector stands at about 11,000.

The secondary education curriculum of 2002 identifies Mathematics, Biology and Physical Science as core science subjects. The Ministry of Education adopted a cascade model of orienting the science teachers into this curriculum with all categories of science teachers (qualified, unqualified and under-qualified) treated to the same content. However, the majority of the science teachers have to date remained not oriented as the activity ended prematurely. A study by Strengthening of Mathematics and Science in

Secondary Education (SMASSE) Malawi in 2002 revealed that both teachers (qualified and unqualified) and pupils had difficulties in teaching and learning some of the new topics in core science subjects. Thus, while some of teachers have struggled to teach the new science curriculum others have resorted to simply skip teaching some of the new topics in the core subjects, consequently negatively affecting performance of students. Table 1.1 gives a summary of the MSCE results in three core MSCE science subjects (Mathematics, Physical Science and Biology) in the past 5 years.

Table 1.1: Pass rates of MSCE candidates in core science subjects

	Mathematics		Biology		Physical Science	
Year	Total enrolled	Pass %	Total enrolled	Pass %	Total enrolled	Pass %
2000	54657	19.3	54501	35.8	8332	57.9
2001	55232	15.0	55565	28.1	8687	52.9
2002	54994	43.3	57690	56.3	10475	60.1
2005	62806	47.4	66503	73.3	20808	56.6

Source MoE (2005b)

In general, the quality of secondary science education (particularly in Mathematics and Physical Science) in Malawi is low as indicated by the low pass rates in Table 1.1. Surprisingly, Physical Science with the lowest enrolments among the three core subjects and being taught by mostly qualified teachers and offered in well-established secondary schools has been registering low pass rates. The causes of the poor abilities of students in Physical Science have been attributed to a number of factors including the lack of professional development (In-service) support given to practicing and qualified science teachers (Kumwenda-Phiri, 2001 and Oki, 2004). Thus, improving the quality of Physical Science education therefore still remains distant unless a regular

and systematic intervention to improve the quality of the teaching force is put in place. Eshiwani (1993) advises that the most important of the many interdependent factors in establishing good quality of education is the quality of the teachers, Therefore, Ogunniyi (1967) points out that , where INSET opportunities for qualified science teachers are lacking, chances of improving the performance of learners in the subjects are very minimal. Hence Malawi must aim at providing systematic in-service support to practicing Physical Science teachers to improve the quality of teaching and learning of Physical Science (MoE, 1999 and 2001).

The term tertiary education in Malawi embraces primary and secondary teacher training, technical and vocational training, university education and other post-secondary professional courses (MoE, 2001:13). According to GoM (2006:51), the goal of tertiary education is to produce high quality professionals with relevant knowledge and skills in relevant fields. Tertiary education therefore provides the country with middle and high-level manpower requirements for the management and development of economy and for the teaching and managing of the national educational institutions (MoE, 2001). Pre-service teacher education forms a component of tertiary education.

1.3.5 Teacher Education in Malawi

The Teacher Education system in Malawi comprises two categories: the primary teacher training which focuses on the preparation of teachers for the primary sub sector and the secondary school teacher education whose focus is on training and education of secondary teachers. The broad policy for teacher education in Malawi is to provide teachers with adequate *pre-service* training and *systematic in-service and refresher*

training (MoE, 1998:17). As highlighted by the National Strategy for Teacher Education and Development (NSTED) (2003:18), the overall goal of teacher education and development in Malawi is; therefore, to educate and *continually develop the professionalism of teachers*. Thus, one of MoE's objectives in this policy is to provide professional and continuing education to improve academic and professional qualifications of teachers (NSTED, 2003:18). In-service education is regarded as a key means of developing the professionalism of teachers (NSTED, 2003).

1.3.5.1 Pre-service secondary teacher education in Malawi

Public and private institutions offer pre-service training of secondary teachers in Malawi leading to either a diploma or degree in education qualification. These public institutions include Chancellor College, the Polytechnic, Domasi College of Education and Mzuzu University. African Bible College, Catholic University and Livingstonia University are the only private institutions and the last two are new comers in the business of training secondary teachers. Secondary teachers trained from Catholic and Livingstonia Universities are yet to be absorbed in the public secondary schools (at the time of the study). Approximately, a total of 400 secondary teachers graduate and join the sub-sector annually (NSTED, 2003). These teachers are assigned to teach any form or level of the secondary system irrespective of qualifications. However, it is not established whether the teachers from the different institutions enter the teaching profession with similar teaching competencies since there are apparent variations in philosophies and focus among training institutions. The absence of national standards for teacher education seems to give institutions flexibility in designing curriculum for teachers in Malawi.

1.3.5.2 In-service teacher education in Malawi.

GoM is committed to providing opportunities for *ongoing professional development (in-service education) to practicing teachers* as one of the strategies of improving quality of education in Malawi (GoM, 2006). The players in the provision of In-service education and training to teachers in Malawi include MoE Headquarter, Education Divisions, MANEB and Secondary teacher training institutions (Chancellor College, the Polytechnic, Domasi College of Education and Mzuzu University). Table 1.3 gives the details of in-service programmes, purposes and their target groups in Malawi

Table 1.2 Status of INSET provision in Malawi since 2000

Institution	Target Group	Name of qualification awarded	Purpose of INSET
DCE	Primary teachers teaching in CDSSs.	Diploma in Education	Upgrading to a higher qualification
Polytechnic	Diploma teachers	Bachelors degree	Upgrading to a higher qualification
Chancellor College	Diploma teachers	Bachelor of Education degree	Upgrading to a higher qualification
	Unqualified teachers (holders of degrees/diploma other than in education)	UCE	Certification of teachers
	1 st Degree teachers	Master of Education	Upgrading to a higher qualification
	2 nd degree holders	Doctor of Philosophy	Upgrading to a higher qualification
MoE	All secondary teachers	-	Update and upkeep teachers with appropriate competencies
Education Divisions	All secondary teachers	-	Update and upkeep teachers with appropriate competencies
MANEB	Secondary teachers	-	setting and marking national examinations
Mzuzu University	Mathematics and Science under qualified secondary teachers	Bachelors and certificate	Acquisition of content and methods of science subjects
MIE	Selected secondary teachers	-	Orientation into new curriculum and new teacher-roles

Table 1.3 indicates that there are broad ranges of institution providing INSETs to secondary teachers in Malawi. Notable absence from this list is Livingstonia and Catholic Universities, probably because they mostly admit school leavers in their programmes. Additionally, Table 1.3 shows that there are broad ranges of INSETs offered to teachers. However, the majority of them focus on upgrading the teachers' qualifications. INSETs aimed at updating and refreshing the teachers once they have graduated from the institutions (update and competence models of INSETs (Nasseh, 1996) have been minimal and benefiting a handful of teachers. As pointed out by NSTED (2003), current teacher education programmes in Malawi mainly concentrates on initial teacher education, although structures such as Cluster centers had been established as venues of INSETs. NSTED further points out that challenges in secondary INSETs include irregularity of procedures for recognising and rewarding those who have attended INSETs, little cost sharing in INSETs and reluctance of MoE to release teachers for long periods.

1.4 Statement of the problem

Malawi is one of the poorest countries in the world (UNDP, 2003). According to Integrated Household Survey 2004/05, the current status of poverty in Malawi shows that 52.4 percent of the population live below the poverty line. Realising that economic growth is instrumental to the fight against poverty, GoM's overall broad policy is to reduce poverty through sustained economic growth and infrastructure development (MGDS, 2006). Additionally, realising that quality education at all levels contributes to economic growth, GoM identifies the improvement of quality of education as one of the sub-themes under social development to achieve sustainable economic growth.

GoM's policy documents such as PIF (2001), MoE (2001), NSTED (2006), NESP (2006), MGDS (2006) single out the provision of systematic In-service Education and training to teachers as one of the strategies of improving the quality of education. However, In-service Education and Training is not in the best health. PIF (2001) and MoE (2005) report that INSET for teachers in Malawi is not only adhoc but also unsystematic. ***In particular, there is a lack of systematic In-service Education and Training programmes for qualified and practicing secondary science teachers including Physical Science teachers*** (Kumwenda-Phiri, 2003; and Lungu, 2005).

This state of lack of systematic INSETs to strengthen and upgrade Physical Science teachers' competencies, compelled Physical Science to continue teaching using the competencies they acquired during the pre-service programme despite rapid explosion, decay and obsolesce of subject content and pedagogical content knowledge. Consequently, leading to a poor quality qualified teaching force; poor teaching and learning; poor performance of learners; poor quality science education and retarded economic growth (Oki, 2004). This state was, therefore, retrogressive to GoM's agenda of using economic growth as a weapon for poverty reduction.

While it was appreciated that broad policy statements on INSETs have been made in government documents such as the 1994 Constitution of Malawi, PIF (1999, 2001), MPRSP, MGDS (2006), NSTED (2006) and NESP (2006), the implementation of such policy statements have remained marginal. Firstly, INSETs had mostly focussed on under-qualified teachers aimed improving their competencies as well as upgrading the qualifications. Secondly, INSETs for qualified and practicing teachers had mostly aimed

at upgrading their academic qualifications, despite the many functions INSETs could play for such teachers in the system. The challenges faced by qualified Physical Science teachers while in the classroom have therefore remained unattended to. The INSETs policy was therefore not a failed one but rather stakeholders have not fully maximized its presence. It had remained an under-utilized policy.

Waters and Haskell (1998), Swanepoel and Erasmus (2000) and Good (2003) contend that a needs assessment phase is the early first step in establishing a systematic INSET model. Loucks-Horsley, Stiles and Hewson (1996) concur that effective science professional development programmes are sensitive to the diverse learning needs of individuals. In addition, Lee (2005:41) advises that professional growth is possible when professional development programme responds to teachers' personal needs. A systematic INSET ought to meet teachers at their points of need. Thus, as a prerequisite to establishing systematic and effective INSETs for the teachers, research was therefore needed to assess the In-service training needs and preferences of the different categories of qualified Physical Science teachers in Malawi.

However, several studies repeatedly point out that different categories of teachers possess different in-service needs (Kahler, 1974; Halim, Osman and Meerah, 2000; Layfield and Dobbins, 2002; Washburn et al, 2001). In addition, the Stage theories (Huberman, 1995; Pang, 2001) imply that teachers at different stages of their career tend to possess different strengths and competencies, consequently different In-service training needs. According to Reimers (2001) and Glatthorn and Fox (1996), In-service training needs of teachers also vary with teacher's level of cognitive development.

1.5 The purpose of the study.

The purpose of this concurrent mixed method research study was to ***assess the most self-perceived In-service training needs and preferences of secondary Physical Science teachers in Central West Education Division in Malawi.*** While the teachers' In-service training needs were assessed with respect to their academic qualifications, teaching experience and institutions from where they received their highest qualifications, their preferences for INSET models, organisation and management were assessed as preferences of Physical Science teachers as a group.

1.6 Research Questions

In this study, answers to the following two grand tour questions were sought:

- (a) What were the self-perceived in-service training needs of secondary Physical Science teachers in CWED?
- (b) What were the preferences of Physical Science teachers in CWED for in-service education programmes?

1.7 Significance of the study

This research assessed the in-service training needs and preferences of practicing Physical science teachers in CWED in Malawi by their teaching experiences, qualifications and training institution. The results from this survey may have both practical and theoretical implications for pre-service and in-service education of Physical Science teachers in Malawi as well as for INSET policy formulation. Thus, INSET providers such as secondary teacher training institutions, CWED and MoEVT could use

the results as a guide to the design of a framework of a curriculum for INSET programmes for each of the categories of teachers thereby enhancing the provision of quality INSETs.

MoEVT as a policy formulation body would use the results to review and formulate INSET policies based on teachers' needs. Policies informed from this study would therefore meet very little resistance from the teachers during the implementation phase thereby increasing the likelihood of achieving the appropriate outputs and outcomes of INSET programmes (Waters and Haskell, 1989).

The results from this study also indicated weaknesses and gaps in the teachers' pre-service programmes. Hence, secondary teacher education institutions such as Chancellor College, Polytechnic, Mzuzu University and Domasi College of Education may use the results to review and re-design their Physical Science courses so as to produce a more competent Physical Science teacher. Finally, this study was the first in-service needs assessment on Physical Science teachers in Malawi. As such, the study generated a database, which simply expanded the literature on In-service training needs of teachers nationally, regionally and globally.

1.8 Assumption in the study

The study was conducted on the assumption that the Physical Science teachers in CWED were knowledgeable about the term in-service education hence they would be open and sincere with the information they would provide.

1.9 Definition of key terms

This section gives definitions of four key words in the dissertation. These are in-service education and Training, Need, Needs Assessment and Physical Science teachers.

1.9.1 In-service Education and Training (INSET)

The term In-service Education and Training (INSET) has been defined differently by many scholars. For instance, Ravhudzulo (2001:18) defines INSET as all forms of continuing education and training for educators, whether formal or non formal; whether accredited or non accredited; and whether personal or professional purposes. Mothata, et al. (2000:85) point out that in South Africa, the term INSET for teachers refer to ongoing professional development of the teaching profession. Bolam (1982:3) defines In-service Education and Training (INSET) as *“those education and training activities engaged in by primary and secondary school teachers and principals, following their initial professional certification, and intended mainly or exclusively to improve their professional knowledge, skills and attitudes in order that they can educate children more effectively.* It is clear from the above definitions that INSET encompasses a range of training opportunities inside or outside school, formal or informal, which address both the personal and professional needs of educators. For the purpose of this study, I endorsed the view expressed by Bolam (1982) because the target population in this study were the qualified Physical Science teachers. However, terms such as Continuing Professional Development (CPD) (Craft, 1996); In-career Professional Development (ICPD) (Garavan, 1998); and Continuing Professional Education (CPE) (Weingand, 1999) are used loosely and interchangeably with INSET in this study.

1.9.1 Need

Witkins and Altschuld (1995) point out that the term need may be used as a noun and as a verb. When used a noun, a need is synonymous to problem or concern while when used a verb it refers to a solution. As a noun, a need is defined more specifically as a gap or discrepancy between a present state (what is) and a desired end state, future state, or condition (what should be) (Witkins and Altschuld, 1995:9). In this study, the concept need was used as a noun. As such it refers to the gap or discrepancy between the present state (*what is*) and the desired end state (*what should be*) (Borich, 1980; Witkins and Altschuld, 1995). A need in this study is therefore a *discrepancy between the desired teacher competency and the teachers' performance levels in relation to this competency*. Researchers, such as Layfield and Dobbins (2002), Garton and Chung (1995), Edwards and Briers (1999), have also used this definition to identify in-service training needs of science teachers.

1.9.3 Needs Assessment (NA)

Witkins and Altschuld (1995:4) defines a needs assessment as a systematic set of procedures undertaken for the purpose of setting priorities and making decisions about a programme or organisational improvement and allocation of resources with the priorities based on identified needs. This means it involves two broad steps: identifying needs and ranking the identified needs in order of priorities. In this study, this definition is endorsed. Hence, needs assessment refers to the process of assessing needs and preferences of teachers in INSET programmes and then ranking them in order or

priorities. As a process, this Needs Assessment identified needs and decided upon priorities among them.

1.9.4 Physical Science teachers

In the Malawian context, Physical Science refers to a composite subject made up of two natural science subjects: Physics and Chemistry. It is offered mostly in the secondary level of the education system. In this study, secondary Physical Science teachers, therefore, refer to those qualified secondary school teachers trained and employed to teach Physical Science in secondary schools in CWED.

Chapter summary

This chapter has provided the background information to the problem that was investigated. More specifically, the chapter has discussed the socio-economic, political and educational contexts in which the problem of absence of any systematic In-service Education and Training (INSET) for Physical Science teachers in CWED in Malawi existed. The research problem; the purpose of study; the objectives of the study; the research questions; the importance or significance of the study; the limitations and delimitations in the study have also been discussed. The chapter has finally provided definitions of key terms used in the study so that the readers are at the same wavelength with the writer. The next chapter provides the literature review on in-service teacher education and development, which exists nationally, regionally and globally.

CHAPTER 2

REVIEW OF RELATED LITERATURE AND RESEARCH

Chapter overview

This chapter discusses the literature related to the assessment of in-service needs and preferences of science teachers in INSETS nationally, regionally and globally. The chapter is divided into two broad sections. The first section presents the conceptual framework, which discusses the concepts and theories of teacher professional development, human motivation and in-service teacher education. The second section discusses what has been written on in-service needs and preferences of teachers nationally, regionally and globally. In addition, the second section identifies the gap in the literature on the topic and describes the place of this research study in the literature.

2.1 Teacher Professional Development

In the literature, the concept teacher professional development has been defined in a variety of ways. Evans (2002:131) defines teacher professional development as the process whereby *teachers* ' professionalism and /or professionalism is enhanced. In the Maltese context, the concept of teacher professional development equates with ongoing learning opportunities that all *educators* pursue in order to grow individually and collectively (Bezzina and Carmilleri (2001:158). According to Ling and Mackenzie (2001:88), in the Australian context, teacher professional development equates with what may be referred to in some other settings, in-service teacher education. In all these

definitions, teacher professional development is designed to contribute to learning of teachers who have completed their initial training. In the Malawian context, teacher professional development means those opportunities aimed at improving the competencies of practicing teachers, whether qualified, unqualified or under-qualified. Thus, terms such as In-Career Professional Development (Garavan, 1998), Continuing Professional Development (Craft, 1996) and In-service education and training (INSET) are used nationally and globally interchangeably with Teacher Professional Development.

2.2 Huberman (1989) stage theory of Teacher Professional Development

The literature is rich on the stage theories of teacher professional development (Huberman, 1989; Dreyfus and Dreyfus, 1986; Moyer and Husman, 2000; and Pang, 2001). According to Fok, et al. (2005), the stage theories imply that teachers at different stages of their career may possess different strengths and competencies and may have different training needs. It may also imply that for the successful delivery of Insets, it is most desirable to identify the training needs of each category of teachers and provide each category with INSETs, which address their needs.

The Huberman's (1989) teacher professional theory informed this study in categorizing teachers according to years of teaching experience. According to Huberman (1989), there are five stages of teacher professional development, demarcated by years of teaching experience. The stages are (i) career entry (1-3 years); (ii) stabilization (4-6 years); (iii) divergent (7-18 years); (iv) second divergent (19-30 years) and (v) disengagement (31-40 years). Glatthorn and Fox (1996) point out that each of these

stages has characteristic professional development (in-service) needs. That is, teachers with different years of teaching experience possess different in-service training needs. These stages ought to be considered when designing in-service education programmes. Table 3.1 describes Huberman's stages of career development with their characteristic professional development needs or in-service training needs.

Table 2.1: Huberman (1989) - 5 stage theory of teacher professional development.

Career stage	Years in the profession (experience)	Characteristics of the teachers	Professional development (INSET) needs
1. Career entry	1-3 years	-time of survival and discovery; prefer assistance from mentors on the site;-equipped with new content and methodologies	-technical needs in management and working special needs students
2. Stabilization	4-6 years	-instructional mastery -commitment to the career	-prefer technical assistance from colleagues and supervisors -interested in trying out new instructional techniques
3. Divergent period	7-18 years	-period of experimentation and activism; -period of self doubt and reassessment -highest levels of frustrations -more resignations due to disenchantment with the system	prefer non-directive, problem solving and supervision -turn to external sources (workshops and conferences) for assistance
4. Second Divergent period	19-30years	-period of self assessment, relaxation -critical of the system, administration and profession -period of conservatism	-wants the opportunities to design their own staff development programmes, -prefer self-directed approaches to professional growth
5. Disengagement	41-50 years	-gradual separation from the profession -time of reflection and serenity -time of bitterness. --move their minds away from professional growth	-supervision is unwanted intrusion

Although there are limitations of the stage theories of professional development, such as individual differences of the teachers as they enter the profession (Glatthorn and Fox, 1996), the theory suggests that to provide the teachers with valuable INSET programmes there is need to identify the training needs of each category of teachers since

different categories of teachers call for different in-service content. In this study, the in-service training needs of the Physical Science teachers were therefore investigated and categorized according teachers' years of experience within the Huberman's (1989) teacher development theory.

2.3 The Human Needs theories

Teacher motivation levels for INSETs were critical in reducing absenteeism and no-show rates hence rendering INSETs effective. It was therefore important to identify and understand factors that would ensure that teachers were motivated to attend INSETs. Two broad human motivation theories guided the assessment of the teachers' preferences for INSET programmes in this study. These were Maslow's Hierarchy of needs theory and Hezerberg's Two-factor theory. These theories guided the identification and explanation/interpretation of the teachers' preferences in INSETs as the bases for designing effective incentives in INSETs programmes.

2.3.1 Maslow's Hierarchy of Needs theory

Maslow's Hierarchy of needs theory is based on the premise that people are motivated by the desire to fulfil their needs. According to Maslow (1943), employees have five levels of needs, which form a hierarchy: physiological, safety, social, self-esteem, and self-actualisation needs. Each of these levels of needs has unique characteristics as detailed in Table 2.2.

Table 2.2. Maslow's Hierarchy of Needs

Level of need	Name of need	Description	Examples	Organisation's response
5 (highest)	Self-actualisation needs	need to grow and use abilities to the fullest;	creative expressions,	Assigning tasks that challenge employees minds
4 (high)	Esteem needs	personal sense of competence	need for respect, prestige, and recognition, confidence, achievement	Matching skills and abilities of employees to the job
3 (low)	Social needs	need to feel a part of a group.- need to belong (needs for love, affection and belongingness)	need for love, affection, and belongingness in one's relationships with others, sexual intimacy	Sports teams, parties and celebrations
2 (lower)	Safety needs	Need for security, protection and financial stability in an environment	security of body, employment, morality, resources, property	Benefits, pension packages/schemes
1 (lowest)	Physiological needs (biological needs)	most basic of human needs-body needs	food, water, sex and sustenance, clothing, sleep.	Pay-pecks such salary, allowances

Table 2.2 shows that the physiological needs and self-actualisation needs are the lowest and highest category of needs respectively. Maslow contends that the lowest level needs must generally be satisfied first before the next level of need will emerge. Accordingly, teacher preferences in INSET programmes may therefore lie in this continuum. Maslow's Hierarchy of needs theory is arguably the root of developing effective incentive programmes.

This study therefore investigated teachers' preferences as regards to the five categories of needs: physiological, safety, social, esteem and self-actualisation. The

identification of such needs was required to facilitate the design of effective organisation and management of INSETs.

2.3.2 The Herzberg's Two factor theory

Herzberg identified two separate groups of factors that had a strong bearing on motivation: *the hygiene factors* and *motivation factors* (Herzberg, Mausner, & Snyderman, 1959). The hygiene factors, such as working conditions, pay, organisational policy, and job security strongly influenced feelings of dissatisfaction amongst employees. These factors do not motivate employees as such, but their absence adversely affects job performance. The motivation factors, such as achievement, career progression, responsibility and learning have a role in positively influencing performance. Their presence causes satisfaction among workers. Thus, the theory describes human needs in terms of satisfaction and dissatisfaction with the presence of motivator factors causing satisfaction (these are intrinsic or job content) while the absence of the hygiene factors cause dissatisfaction. The motivators are intrinsic factors to the job (job content factors) and the hygiene factors, on the other hand, are extrinsic factors to the job.

Herzberg's Dual factor theory assisted in this study in identifying the context of in-service education that motivates teachers to participate in INSET activities. Using this theory, this study investigated both the inhibiting (hygiene) and determining (motivation) factors for the teachers' participation in INSET. Both the factors were important for INSET organisation and management.

2.4 Pre-service teacher education

Pre-service teacher education simply refers to the initial education and training that teachers receive before being certified to teach. Reimers (2001) contends that teachers must know subject matter, general knowledge of pedagogy, pedagogical content knowledge, knowledge of student context, psychology of human development, clinical skills, skills to use and teach technology, assessment skills, knowledge of school, community and society and management and administrative skills just to mention but a few in the pre-service training. Ware (1992) contends that science teachers, in particular, need to have developed knowledge and skills in three basic areas: science content knowledge, educational theory and practice and general education including humanities (communication skills), although in different balances. However, as science is often taught in laboratory settings, science teachers need also to have laboratory teaching skills and competencies involving planning, preparing, and carrying out laboratory activities including managing students' laboratory work. In Malawi, the entry-level competencies of Physical science teachers consists of at least seven broad dimensions of management of Physical Science instruction; diagnosing and evaluating students; generic pedagogical knowledge and skills; knowledge and skills in Physical Science subject; administering Physical Science instructional facilities and equipment; planning activities of Physical Science instruction; integrating multimedia technology in Physical Science instruction.

2.5 In-service Teacher Education

The concept In-service Education and Training (INSET) refers to a broad range of activities designed for teachers who have completed their initial training to contribute to the development of their knowledge, skills and understanding in order to improve the quality of teaching in the classroom (Craft, 1996; Glover and Law, 1995). Bolam (1992:3), provides another definition of INSET as the education and training activities engaged by primary and secondary teachers and principals following their initial professional certification and intended mainly or exclusively to improve their professional knowledge, skills and attitudes in that they educate children more effectively. As such, in-service education targets qualified teachers beyond their pre-service education through such vehicles as short courses, conferences and workshops, largely focussed on practice and skills, longer courses focused on theory research based knowledge and job embedded arrangements or procedures (Glover and Law, 1996). However, pre-service education and in-service education are seamless components of teacher education and professional development and function to compliment each other.

2.5.1 Rationale for Science teachers' INSETs

Science is one such subject area in which there are rapidly changing knowledge base and expanding relevance to societal issues. Science teachers therefore need to update skills and knowledge in such continuously evolving science discipline areas as Physical Science, Physics, Biology, Chemistry. Wood (1983) contends that the knowledge or know-how acquired by teachers during the pre-service training decreases appreciably after qualification due to some things learned in basic training becoming

irrelevant, some things needed to be known are never taught such as solutions, some things become forgotten and changes in job environments.

Sikes and Troyna (1991) cited in Good (2003:14) also indicate that most teaching learned through initial teacher education programmes is negated once a teacher enters the classroom. Hence, pre-service training is never conclusive in all the information, skills and attitudes for objective practices. Consequently initial licensure of professionals is no guarantee of continued competent performance (Lowethaw, 1980). In-service education is therefore a vehicle through which science teachers renew, revisit and understand the knowledge, skills and attitudes to become effective professionals. Teachers, therefore, need to improve their knowledge and competency on the job beyond what was acquired for initial certification in order to become effective professionals (Abolaji and Reneau, 1988). Hence, the central goal of in-service education is the elaboration and expansion of a teachers “knowledge base” (Burko and Putman, 1995:58 and Eraut, 1994:25).

2.5.2 Purposes of in-service education

Craft (1996) identifies five purposes for undertaking in-service education of teachers. The purposes are (i) to improve the job performance skills of whole staff and individuals; (ii) to develop the professional knowledge and understanding of an individual teacher; (iii) to extend the personal or general education of an individual; (iv) to make staff feel valued; and (v) promote job satisfaction among staff; (vi) prepare teachers for change. These purposes, however, accrue more to the individual teacher. But as highlighted by Eraut (1995), in-service education raises the cultural and professional

standard of the teaching force as a whole. Therefore, in-service education is also an indicator of the health of an education system.

2.5.3 Methods of providing in-service education

Craft (1996) gives a range of vehicles through which in-service education is provided. Such vehicles include action research, self directed study, distance learning materials, receiving on job training, school based and off-site courses of various lengths, job shadowing and rotation, teacher placement and personal learning. However, the traditional vehicles of providing in-service education have been the off-site courses in the form of short courses, workshops, conferences and seminars. But, as pointed out by Craft (1996), the strategy now is to provide in-service education in which teachers assume more responsibility over it. Hence the move towards providing school based or focussed INSETs.

2.5.4 The models of in-service teacher education

Literature is also voluminous on the models of in-service education. But as highlighted by Craft (1996) the models are a factor of (i) *purposes* (such as update model, and expansion model collectively called the Bolam Model), (ii) *location* (such as school based, school focussed and off-site models). Implicitly, the models determined by location are in two broad categories: off-sites models and school based models. The off-sites model also known as institutional model uses training institutions at national, regional and district level employing a face-to-face methodology. Advantages of offsite model include availability of resources and direct interaction between participants and

resource persons although they dislodge the teachers from their workplace. Thirdly, INSET models are also classified based on *methods* (as described above-The Joyce and Shower Model) and *level of impact of the programme* (whole staff, individual teacher, an individual teacher's professional knowledge, or personal education or growth, and learner levels). Reimers (2001) extends the list by including professional development schools and teachers networks. However, Guskey (1995) argues against the notion that there is a best model of in-service education or professional development, asserting that issues of context are critical in determining which approach to take. Perhaps a mixture of the models would be practical for an education system. Models of in-service education also appear to differ between countries and the level of development of the countries with developing countries focussing more on short off-site courses approach such as Kenya, while developed countries such as Britain and United States of America focus more on school based INSETs.

2.5.5 Factors influencing in-service education

According to Reimers (2001), there are at least 7 critical factors affecting the planning, implementation and assessment of in-service education or professional development programmes. These factors are the teachers' stage in their careers, teachers' cognitive development stage, stage of the school in their institutional development, characteristics of students and communities, context (social, cultural, economic and political factors, time to engage in professional development and financial support. The factors however belong to two broad categories (i) personal factors (teachers' stage in their careers, teachers' cognitive development stage), and (ii) contextual factors stage of

the school in their institutional development, characteristics of students and communities, context (social, cultural, economic and political factors, time to engage in professional development and financial support).

Glatthorn and Fox (1996) concurs that the personal factors include the cognitive development, their level of motivation and the stage of career development. Accordingly, the higher the cognitive level the more adaptable and flexible in teaching style. The greater their levels of motivation (due to supportive environment, meaningful work and type and frequency of feedback) the more receptive and more value they attach to in-service education.

Reimers (2001) points out that there are also contextual factors affecting the planning, implementation and assessment of professional development of teachers. These include a culture of support- a learning –collaborative school culture (values and norms of behaviour) and school leadership, national and international associations; the education system-INSET policies and also on teacher supervision and assessment; and time and financial resources-timing and allocation of funds for INSETs. The importance of these contextual factors need not be over emphasized. Without a culture of support for in-service education from school level up to employer's level, teachers may be presented with obstacles to participate and benefit from INSETs. In addition, guidelines on INSET policies are needed to regulate its provision.

Davis (1976) in Good (2003) contends that hindrances to in-service programme participation include scheduling of the programme, programme site, topics involved and variety of learning experiences employed. Other factors include hours offered, topics and formats (Reynolds and Kummerow (1978) in Good (2003). Good (2003) further contends that potential deterrents for participation in CPD were the leadership within the education system, lack of marketing of CPD programmes and lack of emphasis on the importance of attending CPD sessions once the participants had been registered. The contextual factors and personal factors are therefore critical to the provision of an effective INSET.

2.6 Practice of In-service Education of Science teachers in African countries

2.61 Lesotho

Open Society Initiative for Africa (OSISA) (2006) reports that Lesotho's education system mirrors the one inherited from British colonial rule in 1966. Inherent problems in the system include poor facilities, an inadequate and poorly organised in-service teacher programme, and high pupil-to-teacher ratios, coupled with overcrowded classrooms. Additionally, Lesotho's education system is plagued by a lack of qualified maths and science teachers and a dearth of equipment and infrastructure for science and other practical subjects. According to Kingdom of Lesotho (1978:13), teaching science must form a core curriculum for every child in Lesotho. To meet this objective, the Lesotho Government has embarked on activities, such as INSETs, aimed at increasing the proportion and quality of mathematics and science teachers in the overall teaching force (Kingdom of Lesotho, 1978). Maqutu (2003) points out that in Lesotho, the main providers of INSETs for Physical Science teachers are the Centre for In-service Education for Mathematics and Science Teachers (CIEMST), Ministry of Education and

Lesotho Science and mathematics associations. Maqutu further points out that INSETs for mathematics and science teachers are mostly delivered in the form of workshops.

2.62 Zambia

The mission of education in Zambia is to guide the provision of education for all Zambians so that they are able to pursue knowledge and skills manifest excellence in performance and moral uprightness, defend democratic ideals, and accept and value other persons on the basis of their personal wealth and dignity, irrespective of gender, religion, ethnic origin, or any other discriminatory characteristics (Tindi, et al. 2001). World Bank (2006) reports that Zambia subscribes to the philosophy that the quality and effectiveness of any education system largely depends on the quality of its teachers. Teachers are therefore regarded as the single most important factor in determining success in meeting the system's goals. Additionally, the educational and personal well-being of children hinges crucially on their competence, commitment and resourcefulness. Hence, the two pillars on which the professional competence of Zambian teachers rests are initial training and on-going in-career professional or INSETs and personal development.

Tindi, et al. (2001) reports that Zambia's national policy on Teacher Education states that Teacher education is a continuing process that must be extended throughout the individual's years of actual teaching. That is pre-service and in-career professional developments are regarded as two sides of the same coin. The responsibility to deepen knowledge, extend professional skills and keep up-to-date is however in the hands of the teachers themselves. Strategic approaches to provision of INSETs include demand

driven programmes, school focused programmes held in schools or Resource centers, cascade models to special subjects, cost effective programmes,

While the Ministry formulates broad guidelines and strategic approaches for the in-service education and training of teachers and exercises a coordinating role in respect of such training, In-Service Training (CPD) is of two types: Long up-grading or professional courses for school teachers offered by the National In-service Training College (NISTCOL), the Zambia Institute of Special Education and The University of Zambia. However, short term courses to improve the professional/class room practice of School Teachers are mostly school-based or in Teachers' Resource Centres. INSETs are also used for new interventions in the Education System such as New Materials (HIV/AIDS), and Science Kits.

World Bank (2006) further reports that coupled with a shortage of qualified teachers and teacher educators at all levels of the system especially in the fields of Mathematics, Science and Technology there are also limited opportunities for In-service and where INSETs exists, most In-service courses are full-time, expensive and do not take account of existing qualifications and experience of the teachers. Tindi et al. (2001) also reports of a string of problems faced in the field of mathematics and science such as that lack of systematic in-service training to make the teachers catch up with the changing world; poor teaching methodologies and poor background of mathematics and science teachers at lower levels.

2.63 Kenya

Mutahi (2006) reports that Kenya embarks on INSETs of teachers for two main reasons: to build capacity for improved quality of education, particularly in the poorly-performed areas of Mathematics and science subjects; and in response to such emerging issues as HIV and AIDS and Gender responsive teaching. Hence, Ministry of Education and JICA, launched the Strengthening of Mathematics and Science in Secondary Education (SMASSE) project in 1998 targeting Mathematics and Science secondary teachers aimed at strengthening serving teacher's teaching competences, against a background of poor performance of students in the subjects. The project adopted a cascade system of INSETs (national, district, and cluster) with the national training being held at Kenya. The project has been focusing on attitude, pedagogy, and mastery of content, developing teaching and learning materials. The project uses the Activity, Student, Experiments and Improvisation (ASEI) movement as a working philosophy. That is, maths and science lessons have these four elements for them to be regarded as effective. On the part of the teachers, the project advocates the Plan, Do, See and Improve approach to ensure that they teach and reflect on their lessons.

2.64 Tanzania

In-service Training of Mathematics and Science Teachers have concentrated on the use and demonstration of innovative approaches in the teaching and learning of SMT with the resources available in schools. However, emphasis has been placed on the use of locally available materials, analysing the time and material cost of the activities, and designing practical activity lessons using local materials on given topics. Most INSETs are provided in the form of workshops aimed to promote the identification and

preparation of various interesting experiments in Biology, Physics, Chemistry and Mathematics; preparations of the required equipment, chemicals and specimens; demonstration of the use of games and riddles in the learning of mathematics, and the uses of mathematics in construction, cooking and commerce, and its importance for girls, training teachers on the use of gender sensitive teaching methodologies that emphasizes relating lessons to the everyday experiences of girls; analysis of Mathematics and Science textbooks, syllabuses and past examination papers, and training teachers on the use of gender sensitive teaching methodologies, that will emphasise relating lessons to relevant everyday experiences of girls, just to mention but a few.

2.7 Past studies on assessment of in-service needs and preferences of science teachers.

Several studies have assessed the in-service training needs and their preferences of science teachers for in-service education programmes. Rhea (2002) evaluated the science, mathematics and technological in-service training needs of teachers who have served as Professional Development Liaisons (PDL) Eastern North Carolina, USA and also established how to best serve their professional development needs. Rhea found that the top three professional development needs identified by the teachers were in the areas of educational technology, curriculum development and inquiry. The teachers also indicated that the topic and location of professional development were the main deciding factors for their participation in professional development courses.. Finally, the teachers also indicated that the best time for them to attend professional development workshops was only during professional development days. It was therefore necessary in this study

to find out the teachers competency levels on the use of technology in their work and in particular the use of computers, which had just been introduced in the secondary schools. While MOEST emphasises on cluster and school based INSETs, it was important to investigate the teachers' preferences on location of INSETs, determining factor for their participation as well as the best time for INSETs. This would ensure that INSETs elements were effective and congruent with the teachers' preferences

Baker (2000) assessed and prioritised the present in-service needs and evaluated the past in-service needs for agricultural education instructors in the state of Illinois, in the USA. Baker found that the instructors indicated greater in-service training need in the areas of motivating students to learn and knowing computer technology. Motivating students is one of the core competencies of teachers irrespective of where teaching is taking place. In this study, it was necessary to find out whether Physical Science teachers in Malawi experienced challenges in motivating student so that appropriate remedies were put in place accordingly.

. Halim, Osman and Meerah (2005) identified the most prevalent in-service needs as perceived by the secondary science teachers in Malaysia in keeping abreast with current demands in science teaching and learning and in meeting the challenges of globalisation. The findings indicated that the top needs of the teachers were mainly in the areas of science teacher self improvement, the use of ICT in science instruction, and the use of English in Science teaching. The results informed this study in investigation teachers' competencies in using ICT in Physical Science instruction to enhance teaching

and learning so that quality teaching and learning were achieved accordingly. In particular, teachers' competencies levels on use of multimedia equipment were assessed.

Garton and Chung (1996) identified and prioritised the in-service needs of beginning agriculture teachers (N=37), members of the Joint staff in Agricultural Education (N=16) in the state of Missouri, in US during the 1994-95 academic year. The results of the study were that the teachers indicated a greater need for in-service in twelve of the fifty professional competencies. These twelve competencies included motivating students to learn, using computers in a classroom, teaching using experiments as perceived by the teachers, their supervisors and teacher educators. The study also found that professional competencies such as planning and conducting student field trips, and using multimedia equipment in the classroom were rated very lowly as requiring in-service education. The beginning agriculture teachers also preferred to receive in-service through the traditional methods of two-hour workshops, sessions at the summer vocation teacher conferences and district in-service courses. The Joint staff in Agricultural Education placed a high in-service for the beginning agriculture teachers on six of the 50 competencies. Generally the study found that there was no correspondence in the rankings of the items by the teachers and Joint staff in Agricultural Education. This study adopted the items: teaching using experiments, planning and conducting field trips and teachers' preferences on models of INSET in identifying the teachers' needs and preferences for INSET as they were also critical for the effectiveness of the Physical Science teachers in Malawi.

Abolaji and Reneau (1988) identified the agricultural science teachers self-perceived in-service education needs and the problems those teachers encountered while teaching agricultural science in secondary schools in Kwara State, Nigeria. The results of the study were that teachers indicated that increasing knowledge was the most popular reason why the teachers needed in-service education. The teachers also preferred one week long courses and workshops at either a university campus, college of education or Ministry of agriculture. The teachers also indicated that lack of funds; poor information and unsuitable times were identified as factors inhibiting their participation in in-service activities. Teaching methods and techniques and selection and use of teaching and learning materials were identified as the topics most preferred in in-service courses in this study. The findings in this study implied that teachers' perception on the importance of INSETs, duration of INSETs, location of INSETs and factors that would inhibit their participation in INSETs were critical to successful INSETs. Hence, the inclusion of such items in the study.

The purpose of a study by Layfield and Dobbins (2002) was to determine current in-service needs of beginning and experienced agriculture teachers in South Carolina, US. The target population in the study were all the secondary agriculture teachers (N=105) during the 1999-2000 academic year. The top five competencies with high in-service needs by experienced teachers included using computers in classroom teaching, using multimedia equipment while beginning teachers indicated high in-service needs in such competencies as organising fund raising activities. The top five competencies identified by beginning teachers included developing adult programmes. However, 5 of

the top ten competencies for the two categories of teachers were found to be the same. These included developing local adult programmes and preparing proficiency award applications. Thus there were some similarities in in-service needs of the experienced and beginning agriculture teachers. The study showed that teachers' needs varied with experience. Hence in this study, the teachers' In-service training needs were investigated according to the teachers' years of experience, using Huberman's Theory of teacher development.

A study by Roberts and Dyer (2004) identified in-service needs of traditionally and alternately certified agriculture teachers. The findings of the study were that traditionally certified teachers had high in-service needs in the areas of professional development and programme planning and management. The alternately certified teachers indicated that they had high in-service needs in the area of writing grant proposal for external funding. The findings also indicated the traditionally certified teachers had greater in-service needs than alternately certified teachers in such areas as instruction and curriculum and programme proposal writing. However, the two categories indicated high in-service needs in using computer technology and computer applications, motivating students to learn, changing the curriculum in order to meet changes in technology and teaching in laboratory settings. This study thus investigating whether there were any common in-service training needs among different categories of Physical Science teachers. Additionally the findings implied differences in needs by teachers with respect to qualification. Hence this study investigated the similarities and differences in needs between Physical Science teachers by their highest qualification.

Fok, et. al (2005) carried out a study in Hong Kong, whose purpose was to assess the self-perceived in-service teacher training needs of three categories of teachers based on their teaching experience (5-10 year experience; 11-20 year experience and over 20 years experience). The fundamental result of this study was that teachers at various stages of their professional development were found to have varying competencies. However, there was no correlation between the competencies and the training needs. As stated earlier on, this study ensured that the In-service training needs were categories according to years of teaching experience so that any intervention met the teachers at their points of immediate needs. It was therefore critical, as informed by Fok, et al. (2005), to identify needs of Physical Science teachers In-service training needs by years of teaching experience.

A study by Noh, et al. (2004) investigated the perceived professional development needs of Korean science teachers majoring in Chemical Education in Korea, and examined their preferences for online and onsite in-service teacher training programmes. The participants included secondary science teachers and pre-service science teachers. Results indicated that both groups were however interested in motivating students to learn science, preparing instructional materials, conducting laboratory sessions and updating their knowledge in chemistry. Teachers also preferred on-line training programmes to traditional onsite ones. Statistically significant differences were found in such areas as writing knowledge, attitudes and skills objectives; using computers for teaching science and evaluating personal effectiveness as a science teacher. In this study

it was necessary to investigate also whether conducting laboratory session was a problem to the teachers. The nature of Physical Science teaching is such that laboratory experiments are part and parcel of an effective Physical science teaching and learning lessons.

Halim, Osman and Meerah (2006) surveyed the perceived needs of practising Malaysian secondary school science teachers, characterized by gender, school location and area of specialization. Findings from the study indicated that the most prevalent needs of the Malaysian secondary school science teachers were the integration of multimedia and the use of English in science instruction. Significant associations were also found between the needs of the teachers and their characteristic variable (gender, school location and areas of specialization) and the associations were more apparent between the teachers' in-service needs and school location. From Halim, Osman and Meerah (2006) study, the competency levels of the teachers' use of multimedia equipment were assessed in this study.

Germann and Barrow (1995) investigated differences in perceived in-service needs of veteran and non-veteran Biology teachers as recommended by the National Research Council. Veteran and non-veteran teachers chose differing subjects for which mastery courses should be taught. Non-veteran teachers perceived a greater need for science teaching-methods courses. The findings indicated that different categories of teachers by experience possessed different in-service training needs. Hence the in-service

training needs of Physical Science teachers were assessed with respect to years of teaching experience.

The literature on past studies on in-service training needs and preferences of teachers informed this study in a number of ways as described above. First, it was informative on the current methodological approaches in assessing in-service training needs of science teachers. Secondly it identified some of the key areas of focus (constructs) when assessing in-service needs and preferences of science teachers. Thus this study adapted the constructs and methodological approaches in assessing the needs of Physical Science teachers in Malawi. However, none of the studies investigated the In-service training needs and preference of Physical Science teachers in Malawi. All the studies focussed on other science disciplines (Agriculture, Chemistry and General Science). These studies had not been specific to Physical Science (a combination of Physics and Chemistry). As Halim, Osman and Meerah (2006) contend, in-service needs are also a factor of areas of specialisation. Hence, there is a gap in the literature on the in-service needs and preferences of Physical Science.

In addition, the studies have been conducted in mostly developed countries such as the United States and Malaysia. But as argued by Washburn et al (2001), in-service needs vary by geographical location. Roberts and Dyer (2001) concur that dissimilar groups of teachers have dissimilar in-service needs. There has not been any study conducted on In-service needs and preferences of Physical Science teachers in Malawi.

Hence, there is need to assess the in-service needs of Malawian secondary school Physical Science teachers to fill the gap that is in the literature.

Chapter summary

This chapter has discussed the conceptual framework of the study consisting of Huberman's theory of teacher professional development, Maslow's theory of human needs and Hertzberg's Two factor theory. In addition, the chapter has discussed in-service education in terms of its definition, purpose and factors influencing the provision of in-service education. Finally, the chapter has presented past studies conducted on this topic and consequently identified a gap in the literature which this study was designed to fill. Chapter 3 provides a discussion on the design and research methods for data collection and analysis this study.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

Chapter overview

This chapter presents the research design and methods employed in this study. The chapter begins by presenting pragmatism as the theoretical perspective guiding the entire design of the study. Then it discusses the mixed methods approach in terms of its nature, rationale and overall approach in the study. The next sections discuss the population of interest, initial selection decisions and access to negotiations and sampling techniques. Finally, the chapter details the data collection and analysis procedures followed by a discussion on ethical considerations, ensuring trustworthiness, role of the researcher and treatment of errors in the study.

3.1 Pragmatism and Mixed methods Approach

Katsulis (2003) contend that there at least five philosophical frameworks that can support a mixed research design in a study. These are advocacy, pragmatism, structural theory, realism and postmodernism. In this study, the choice of a philosophical framework that guided the research method design was influenced by the nature of the problem being investigated. The objective of the study was to identify and prioritise in-service training needs and preferences of Physical Science teachers. To get a more holistic picture of the teachers' needs and preferences the study aimed at not only

identifying but also get an in-depth understand of the teachers' needs and preferences. To do so there was need to be objective to minimize researcher's biases and at the same time subjective to adequately understand the teachers needs and preferences. Thus, methods were chosen so long they adequately worked best for the problem. That is, a practical solution (a solution that works best at that time) was required. Hence, in this study, pragmatism was the philosophical foundation/framework, which supported the research design in this study. According to Patton (2002), a pragmatic position implies the choosing of a paradigm and method considering what will work best in a given situation to meet practical issues faced in an inquiry and thereby answer the research question. That is, the research question dictates the methods and not the paradigm or method. Hence, data collection and analysis methods are chosen because they are most likely to provide insights into the problem with no philosophical loyalty to any alternative paradigm (Mackenzie and Knipe, 2006). Johnson et. al. (2003) concur that the philosophy of pragmatism says that researchers should use the approach or mixture of approaches that works the best in a real world. That is, what works is what is useful and should be used regardless of any philosophical assumptions, paradigmatic assumptions, or any other type of assumptions. According to Onwuegbuzie and Teddlie (2003; Tashakkori and Teddlie (2003; and Creswell (2003) pragmatism entails pluralistic systems of philosophy and reality.

Thus in this study, the focus was on what works best for the problem to be solved rather than gluing oneself to only any one of the two particular traditional paradigms. Kivinen and Piironen (2006) concur that pragmatism is an appropriate tool for assisting

social scientists in their methodological work, especially as regards to problem driven case studies.

Therefore, using a “pragmatist lens” (Tashakkori and Teddlie, 2003), the compatibility thesis and fundamental principal of mixed research (Johnson, et al. 2003), a mixed research design was employed in this study to comprehensively understand the training needs and teachers’ preferences. The compatibility thesis is the idea that quantitative and qualitative methods are compatible while the fundamental principle of mixed methods says that a researcher should use a mixture or combination of methods that has complementary strengths and non overlapping weaknesses . Thus Johnson et. al. (2003), defines a mixed research as a research in which quantitative and qualitative techniques are mixed in a single study to answer research questions. And as highlighted by Tashakkori and Teddlie (2003) and Creswell (2003), in a mixed method approach the researcher collects, analyzes, and integrates both quantitative and qualitative data in a single study or in multiple studies in a sustained program of inquiry. Thus in this study both quantitative and qualitative methods were employed to identify and understand the teachers’ In-service training needs and preferences.

Johnson et. al. (2003) contend that there are two types of mixed research designs : mixed model and mixed method research designs. Mixed model research entails mixing qualitative and quantitative techniques within (use of closed and open ended questions) or across stages (one technique follows the other) of the research process. In this study both types were employed as detailed in Figure 3.1 below.

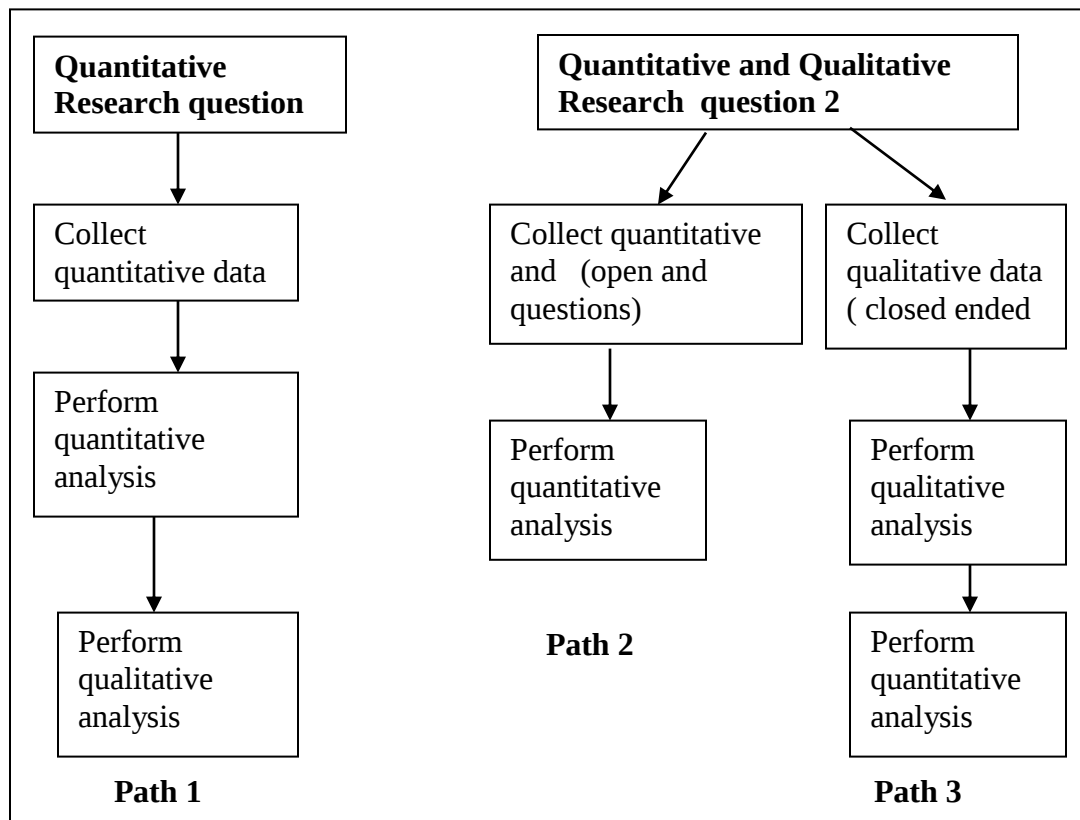


Figure 3.1 : Mixed model research designs (Adapted from Johnson et. al., 2003)

In this study, across stage model was employed to answer question 1 while question 2 employed both across stage (path 3) and within stage (paths 2 and 3) mixed research models. Thus, the use of open ended questions (path 3) and closed ended questions (path 2) resulted into qualitative and quantitative data being collected at the same time for the same questions.

Johnson et. al. (2003) further point out that with mixed method research designs, a qualitative phase and a quantitative phase are included in the overall research study to answer the same research question(s). In this study, mixed method research design was

employed in only question 2. Both the quantitative and qualitative mini studies were conducted at the same time of the study (with the qualitative phase following the quantitative phase). Hence, the study employed a concurrent mixed method design (Creswell, 2003). Concurrent triangulation strategy was chosen to shorten the data collection time period. However, the quantitative technique was more dominant than the qualitative techniques to enable collection of large amount and variety of data within a same period. Figure 3.2, gives a summary of the mixed methods design employed for question 2.

Question no.	Time order implementation decision	Priority (weight)
2	Concurrent (Quant. + Qual.)	Quantitative (QUANT + qual)

Figure 3.2 : Mixed method research design (Adapted from Johnson, et al.. (2003))

In this study, integration of qualitative and quantitative data was therefore done at data collection, analysis and interpretation phases of the study.

3.2 Rationale of a mixed model and methods research designs

In this study, the mixed model and methods approach was employed to serve a number of purposes. First, the within stage mixed model (use of open and closed ended questions) was employed to give opportunities to teachers to express their views and perception in addition to the ones given. This design expanded the breadth and range of inquiry so that a wider picture of the problem was got According to Johnson, et al. (2003)

and Greene, et al. (1989), expansion is one of the five most important rationales or purposes of mixed research design. They contend that with expansion, the researcher seeks to extend the breadth and range of inquiry thereby providing more richness and detail to the study. Hence, the study collected not only close ended information but also open ended information from the respondents' own words from a questionnaire for the purpose of understanding the problem better.

The rationale for using across stage mixed model design during data analysis was to clarify results obtained from one technique by using another technique. In this study, it involved transforming qualitative data into quantitative and vice versa. By using the qualitative approach to elaborate, enhance, and clarify the results from the quantitative approach and vice versa, a better perception and understanding of the research problem obtained. Greene, et al. (1989) refers to this rationale as complementarity and seeks to elaborate, enhance, illustrate, and clarify. Thus, the mixed approaches were employed in this study to complement each other.

The use of mixed method design in question 2 served two main purposes. First, by collecting qualitative and quantitative data to the same question, it enabled me to cross validate the data obtained through quantitative approach. This approach increased the accuracy of the findings. Hence the use of mixed methods approach was employed so as to get more comprehensive evidence by converging or confirming results from the quantitative approach with those from the quantitative approach thereby increasing the trustworthiness and credibility of the findings. As pointed out by Greene, et al. (1989),

mixed methods approach seeks to confirm, converge, and corroborate results from different methods thereby providing a more comprehensive evidence for the research problem. This purpose is known as Triangulation (Greene, et al.. 1989). Thus I triangulated quantitative and qualitative data to get convergence, corroboration and correspondence of results thereby increasing the accuracy and trustworthiness of the data.

In this study, a mixed research design was adopted with a quantitative approach being more dominant throughout the study. The choice of two methods in the same study was for the purpose using the strengths of a quantitative approach to offset the weaknesses of the qualitative approach and vice versa. The choice of quantitative approach as a dominant approach was for the following reasons: to be able to meet all the 70 targeted teachers within a short time, hence collect a large amount of data within a short time so as to meet the time limit of the study; to able to analyse data quickly through the use of statistical software such as SPSS-hence reduce time for data analysis and ensure that the study is conducted and completed within the allocated time period; and to minimize researchers' biasness in the study as much as possible thereby increasing statistical significance and consequently the reliability of the results of the study.

Johnson, et al. (2003) and Johnson and Onwuegbuzie (2004) concur that using quantitative methods in a mixed yields the following benefits: data collection is relatively quick as large data is collected within a short time; provides research results that are relatively independent of the researcher. Additionally, they argue that quantitative data analysis techniques are usually faster than qualitative techniques. This advantage of

quantitative method enhanced the speed with which the research study was conducted hence complete the study within the time given.

The choice of qualitative approach was necessitated by the need to mainly collect data based on participants' own categories of meaning and personal experiences so that data best represents their needs and preferences. The qualitative method enabled me to get explanation and reasons for the teachers' choices in the quantitative method thus exploring beyond the quantitative data. In so doing, I got an in-depth understanding of the teachers' needs and preferences for In-service education as the two methods had complementary strengths and non-overlapping weaknesses- the fundamental principle of mixed methods designs (Johnson et al. (2003). Tashakorri and Teddlie (2003) concur that mixed methods approach provides strengths that offset the weaknesses on both quantitative and qualitative alone. That is, with the mixed methods approach, the two sets of approaches complement each other (Greene, et al. 1989).

3.2 The overall approach and design

The overall approach in this study was the concurrent mixed methods. As highlighted by Creswell (2003:16), in a concurrent mixed approach, the researcher collects both qualitative and quantitative data at the same time and then data is integrated in the interpretation of the overall results. A concurrent mixed methods approach was employed to reduce the time for data collection. Hence, both quantitative and qualitative techniques were used at the same time. However, a greater priority or weight was given to the quantitative approach. The quantitative approach was selected as a dominant

method simply to enable me generate a large amount of data within a short time, hence facilitating that the study was conducted within the time limits of the programme. Thus this approach gave opportunities to all the Physical Science teachers in CWED thereby increase the reliability and generalizability of the results for CWED Physical Science teachers. Additionally, the choice of quantitative approach as a dominant method was to increase the statistical significance (Johnson and Onwuegbuzie, 2003), of the results since large amount of data was collected and at the same time necessitate that data analysis was less time consuming so that the study is conducted within the time limits of the programme. As argued by Johnson and Onwuegbuzie (2003), one of the strengths of a quantitative approach is that data analysis is relatively less time consuming as it often employs the use of statistical softwares.

In this study, the two sets of data (qualitative and quantitative) were integrated accordingly at different phases of the study. According to Johnson and Onwuegbuzie (2003:22), data integration refers to a stage where both sets of data are integrated into either a coherent whole or two separate sets of coherent wholes. Data integration in this study was therefore accomplished at data collection, data analysis and data interpretation. Table 3.1 gives the summary of the mixed methods research design of this study.

Table 3.1 Summary of the mixed research design in the study

Implementation strategy	Priority	Integration	Overall Theoretical framework
Concurrent mixed methods	Quantitative	Data collection, analysis and interpretation	Pragmatism

Source: Adapted from Creswell (2003)

3.4 The Setting or population of interest

This Needs Assessment (NA) study assessed primary level needs. As highlighted by Witkins and Altschuld (1995), primary level needs are essentially needs of the service receivers, that is, the people for whom the system exists and the prime target for NA. Thus the study assessed the self-perceived in-service training needs and preferences of secondary Physical Science teachers (as recipients of in-service training and education) in CWED. The rationale for primary needs was influenced by the bottom up approach to policy formulation process, which begins, from the individuals at the implementation level. Hence, this NA derived information and perceptions of values of secondary Physical Science teachers in CWED as a guide to making policy and programme decisions that will directly benefit the teachers with the needs. According to Waters and Haskell (1989), gathering data from potential clientele and actively involving them in the process of making policies and programme decisions increases not only the acceptance of the policies and decisions but also the likelihood of achieving appropriate outcomes. Evans (1994:25) concurs that stakeholder involvement and expression can have longer term benefits and improve the probability of successful policy implementation.

Therefore, the setting of interest in this study was the secondary schools in the 4 education districts of Ntchewu, Dedza, Lilongwe and Mchinji, which form the Central West Education Division in the central region of Malawi. And the population of interest in this study was the practising secondary Physical Science teachers in CWED in the 2006 academic year.

3.5 Initial selection decisions and access to negotiations

Considering that I could not access the target group of teachers directly, I sought permission from the gatekeepers. As highlighted by Marshall and Ross man (1999), it is important to negotiate access to the site and or participants through either formal or informal gatekeepers in the organization during research. In the first place, permission to conduct the study in public secondary schools in Malawi was sought from the Secretary for Education (see Appendix II and III).

Then I requested the six Education Division Managers for statistics of practicing Physical Science teachers in their divisions with respect to names, qualifications and duty stations. Table 3.2 gives the characteristics of Physical Science teachers in Malawi in the 2006 school year.

Table 3.2: Number of Physical Science teachers in Malawi in 2005

Category of teachers by highest qualifications	Number of Physical Science teachers per schools per division						
	CEED	CWED	NED	SEED	SHED	SWED	TOTAL
Diploma	12	39	29	13	18	22	133
Bachelors degree	6	31	24	19	14	17	111
Masters degree	0	0	0	0	0	0	0
TOTAL	18	70	53	32	32	39	241
Number of schools offering Physical science	11	25	23	15	14	16	104

Source: Educations Division Statistics (2006).

Table 3.2 shows that there were 241 (111 degree and 133 diploma holders) Physical Science teachers in 104 (24% of the total) public secondary schools where the subject was being offered in the 2006 academic year. The Central West Education Division Manager was also requested to permit me to access Physical Science secondary schools teachers in the Division (see Appendix IV). The Education division manager communicated to me verbally that permission was granted for me to conduct the study in the selected school. Another level of gatekeepers was at school level. I, therefore, wrote an advance letter to each of the targeted Physical science teachers through their head-teachers informing them of an impending study and requesting for their participation in the study. A copy of MoE's letter granting me permission was attached accordingly. See appendix V for details of the advance letter. By forwarding the letter to the teacher, it meant that permission from the Head teacher had been granted. Hence head-teachers facilitated the process of accessing the teachers in their schools before and during the data collection exercise.

I also telephoned the head-teachers and/or Physical Science teachers at least a day to the scheduled date in order to confirm the availability of the teachers, and to rearrange the time of the visit. In some cases, the targeted teachers called me to confirm on the date or rearrange the dates accordingly. This approach enhanced the accessibility and availability of the teachers at the time of my visit to schools. Upon arrival at the school, I first reported my presence to the head-teacher. I then introduced myself and explained the purpose of the study and any ethical issues involved and sought the head-teacher's permission to conduct the study with the teachers. At an appropriate venue, away from the staff room and arranged by the school, I thanked the teachers for their presence. I

explained the purpose and objective of the study and also explained the ethical issues related to their being involved in the study. The teacher(s) were then asked to read the informed consent form and signed accordingly indicating their acceptance to be involved in the study (see Appendix VI). For a drop-off survey and mail survey questionnaire, a covering letter, consent form and questionnaire and return envelope were sent to the Physical Science teachers through their headteachers (see Appendix VII for sample cover letter).

3.6 Sampling

This needs assessment study was conducted in CWED, which was purposively sampled from a list of six education divisions. To get a accurate picture of the in-service training needs and preferences, it was important to involve teachers who had not received any intervention in the specific field. For instance, teachers in SEED had been participating in SMASSE INSET project as facilitators (core-trainers). Hence such teachers' INSET needs and preference would be influenced by their experiences in the activities of the project. However, this study targeted qualified Physical Science teachers who had not received an INSET. And CWED was one such division free of INSETs interventions for Physical science teacher at project or programme levels. Thus CWED was purposively selected as a representative case I could learn the most from and accurately answer the research questions. Morse (1986) concurs that a good informant-case is one who has the knowledge the research requires.

Additionally, CWED was purposively selected as a division with the largest number of information rich cases (29% of Physical Science teachers in Malawi) and with

the largest number of public secondary school (24%) offering Physical Science. As highlighted by Patton (1990), the logic and power behind purposeful selection of cases is that the sample should have information rich cases. CWED had more information rich cases than the other education divisions hence its selection. The large number of teachers also facilitated group analyses of data as there were an appreciable number of participants per group with CWED.

However, CWED had a population of interest of 70 teachers consisting of 31 degree and 39 diploma holders in 25 public secondary schools. Being a mixed methods study, quantitative and qualitative methods of gathering data were employed accordingly on the same population of interest. This study therefore employed two distinct sampling techniques to identify the participants in the study. In the quantitative approach, a *census inquiry* was employed. As defined by Kothari (2004), a census inquiry is a complete enumeration of all the items in the population of interest. Hence, all the 70 Physical Science teachers who were teaching the subject in the 2006 school year in CWED participated in the study. The choice of the census inquiry was influenced by such factors as (i) the relatively small size of the number of Physical Science teachers, which was readily accommodated by the time and financial resources of the study, (ii) to accommodate teacher mobility due to transfers, retirement and deaths and (iii) reduce sampling errors as much as possible. As contended by Kothari (2004:55), when the universe is small, it is no use resorting to sample study. In addition, Mattson (1995) argues that a Needs Assessment study with a population of interest under 100 respondents requires a 100% sample size. Hence, this study employed a census inquiry to

collect quantitative data to get a better and holistic picture of the needs of different categories of the teachers.

In the qualitative approach, a purposively a purposive sampling technique was employed to select teachers. As defined by Tashakkori and Teddlie (2003), purposive sampling involves selecting certain units or cases based on specific purpose rather than randomly. In this study, purposive sampling was employed simply to achieve representativeness of the teachers who participated in the quantitative techniques. Thus a purposive sample size of 30 teachers based on qualification: 15 diploma and 15 degree teachers), teaching experience (8 teachers in the 1-3 years category; 5 in the 4-6 years category; 15 in the 7-18 category and 1 each in the 19-30 and 31-40 years categories). The purposively sampled teachers were also a representative sample of the teachers in the four districts in which this study was conducted. This sample size of 30 teachers was selected as being appropriate for me to learn the most from. Patton (1990) points out that there are no rules for sample sizes in qualitative inquiry since sample sizes in qualitative study are a factor of many things such as purpose of study, what is at stake, resources, what will be useful, and what you want to know. In this study, what was at stake was to get a representative sample of the teachers to participate in the qualitative approach in order to get needs and preference, which were representative of the teachers in the study. However, Tashakkori and Teddlie (2003) advise that sample sizes in purposive sampling are typically small (usually 30 cases or less). Hence, the purposively sample size of 30 in this study . Table 3.3 gives a summary of the sampling technique and sample sizes in the study.

Table 3.3: Sampling techniques and sizes

Type of Approach	Sampling technique	qualification		Teaching experience					Districts			
		Dip.	Degr.	1-3	4-6	7-18	19-30	31-40	Lilongwe	Dedza	Ntcheu	Mchinji
QUAL	purposive	15	15	8	5	15	1	1	20	4	3	3
QUANT	Census	31	29	16	11	29	3	1	39	8	6	7

Key: **QUAL** - Qualitative approach; **QUANT** - quantitative approach; **Dip.** - Diploma; **Degr.** -Degree.

3.7 The Data Collection

As a mixed methods study I employed both quantitative and qualitative methods to identify and prioritize opinions, beliefs and attitudes of Physical Science teachers for an in-service education. In the quantitative approach, I employed a census survey to generate and generalize quantitative descriptions of opinions, beliefs and attitudes of Physical Science teachers in CWED. Creswell (2003), Soriano (1995), and Witkins and Altschuld (1995), also point out that a survey is the most common research method of gathering data in Needs assessment studies. In this study, the choice of a survey was influenced by the need to get a quick turnaround in the data collection within the available time and financial resources. Soriano (1995:35) concurs that surveys are cost effective and very easily and expediently generate significant amount of numerical or quantitative data.

3.7.1 The survey design

In this study, a cross sectional survey was employed to collect data from the population of interest. That is, data from each respondent was collected at only one point in time thereby giving a single set of data for each respondent (Creswell, 2004). The use of the cross-sectional survey was necessitated by the time available for research, which was dictated by the programme requirements.

In this survey, data was collected from Physical Science teachers by asking a set of pre-formulated questions in a pre-determined sequence. That is, a questionnaire was developed as an instrument for data collection in this survey.

3.7.2 The survey questionnaire

A survey questionnaire was developed and employed as an instrument to collect data. The survey questionnaire consisted of a set of 58 items with pre-determined options in written form. The choice of a questionnaire as an instrument for data collection in this study was influenced by the following factors. In the first place, the respondents were educated or literate hence filling the questionnaire on their own was easy. Secondly, a questionnaire would minimize my personal and respondents' biases in the process of data collection. This called for asking exactly the same questions to all respondents thereby ensuring consistent meaning of questions to all respondents. The questionnaire reduced the chances of sidetracking. Hence differences in respondents' answers to questionnaire questions were attributed to differences in respondents (Fowler, 1993). Thirdly, this study required that a large amount of data be collected and analyzed within a short period of time as dictated by course requirements. A questionnaire was therefore appropriate for

this purpose of generating a large amount of data in a relatively short period of time consequently minimizing the cost of the study (see appendix VIII). As highlighted by Kothari (2004), questionnaires are cost effective in terms of time, effort and cost.

3.7.2.1 Format and content of the survey questionnaire

In this study, the structured questionnaire contained both close and open-ended questions with the open-ended questions included to expand the scope and breadth of issues under investigation. However, there were more close ended questions than open-ended questions in order to generate as much data as possible within a short period of time.

The structured questionnaire had three main sections labelled A, B, and C. Section A aimed at getting the demographic profiles of the teachers. This included the age, sex, and highest qualification, teaching experience and institutions from where the teachers received their highest qualification. This information was needed for the purpose of understanding the population of interest and identifying the training needs of each category of teachers. As contended by Soriano (1995:59) basic demographic questions must always be included in a needs assessment to clarify the population of interest.

Section B of the survey questionnaire was developed on the basis of the Borich Needs Assessment Model (Borich, 1980) and designed to collect data on the in-service training needs of the teachers. A pool of 40 professional competencies modified from previous instruments on needs assessment of science teachers (Roberts and Dye, 2001;

Rhea, 2002; Germann and Barrow, 1995; Baker, 2000; Layfield and Dobbins, 2002; Washburn, et al. 2001 and Garton and Chung, 1995) formed the content of this section. The 40 entry level professional competencies were in the dimensions of management of science instruction, diagnosing and evaluating students, generic pedagogical knowledge and skills, knowledge and skills in Physical Science, administering Physical Science facilities and equipment, planning activities, integrating multimedia technology in science teaching and use of ICT in Physical Science education in Malawi.

In this section, each item was a statement and respondents were asked to rate the importance of each professional competency as well as their competency levels on each item on a 5-point Likert-type scale. Table 3.5 gives the distribution of items for dimensions of entry level competencies. The importance scale ranged from 5 = very important; 4= important; 3 = average importance; 2 = unimportant and 1=very unimportant while the competency level scale ranged from 1=very low; 2 = low; 3= average; 4=high and 5= very high.

Table 3.4: The distribution of items for each dimension of entry level competencies of the teachers on Section A of the questionnaire.

Dimension	Number of items	Item distribution
management of Physical Science instruction,	10	B1, B6, B7, B15, B18, B19, B20, B22, B36 and B39
diagnosing and evaluating students,	2	B5, B10,
generic pedagogical knowledge and skills,	12	B2, B3, B4, B8, B16, B23, B24, B25, B33, B34, B35 and B40
knowledge and skills in Physical Science subject,	10	B11, B12, B13, B17, B14, B26, B27, B28, B29, and B38
administering Physical Science facilities and equipment,	3	B21, B30, and B31,
integrating multimedia technology in Physical Science teaching	1	B32
use of ICT in Physical Science education	2	B9, B37

Section C focussed on teachers' preferences in In-service education programmes. This section employed the marketing model of needs assessment whose purpose is to learn about and adapt to the needs of the client population (McKillip (1987:21). According to McKillip, the marketing model also provides a means of planning a total programme in an organization. Kotler (1982:37) as cited in McKillip (1987:22), the marketing model focuses on determining the needs and wants of the target markets and to satisfy them through the design, communication, pricing and delivery of appropriate and competitively viable products and services. Thus, this section identified elements of INSET programmes, which would best meet the teachers' needs and priorities and enhance their voluntary participation in INSET activities.

Therefore, Section C contained a set of 19 items closed and open-ended questions that have a bearing on the effectiveness of INSET programmes in terms of its design, planning and management. The 19 items were derived and modified from instruments on in-service needs and preference of science teachers (Rhea, 2002; Garton and Chung, 1995; Concklin, et al., 2002; and Abolaji and Rheneau, 1988). The dimensions of the questions included preferences for in-service courses, reasons for non-participation, recognition and incentives, structure of INSETs, inhibiting factors for their participation, location or venues of INSETs and roles of stakeholders in INSETs provision (see appendix X). In this section, the teachers were asked to circle the response or responses that best described their opinions. There was also a provision for the teachers to suggest other issues in some of the questions if the options provided did not best describe their opinions.

3.7.2.2 Validity, reliability and practicality of the survey instrument

Testing of the validity, reliability and practicality of the instrument before its administration was carried out to reduce measurement errors. According to Kothari (2004), and Mark (1996), validity refers to the degree to which an instrument measures what it is supposed to measure. Thus, the face and content validity of the instrument was ascertained by a panel of experts in the field of Physical Science Education who were lecturers at Domasi College of Education. The main function of this team was to add, edit or eliminate irrelevant items from the initial pool of items and ensure that there was adequate coverage of the topic being studied. A team comprising critical friends also validated the instrument. This team included an expert in English language and fellow students in the Masters programme. Both these teams reviewed the items with respect to readability, clarity, format, ease and adequacy of items and responses.

Reliability of the needs assessment instrument was established by employing the internal consistency (Cronbach Alpha) approach focusing on the two main sections of the instrument : Section B and C. Reliability of section B was 0.95 while that of section C was 0.65 giving an overall reliability of the instrument at 0.80.

According to Kothari (2004), the practicality of an instrument is judged in terms of economy and convenience among others and usually is measured by the length of the instrument and the ease of administering the instrument (layout and instructions) respectively. In this study, the practicality was assessed by having the instrument field pre-tested to find out how the data collection protocols and the survey instrument work

under realistic conditions. The survey questionnaire was therefore, field pre-tested at four secondary schools in South east Education Division (SEED) involving a total of 10 Physical Science teachers (5 diploma holders and 5 degree holders. I personally administered the field pre-tests. As Fowler (1993:102) points out, probably the best way to pre-test a self-administered questionnaire is in person, with a group of potential respondents.

In addition to completing the questionnaire, the 10 Physical Science teachers also commented on question clarity, questionnaire format (instructions, flow and layout), and length of instrument. The questionnaire was then accordingly revised using the comments generated from the Physical Science teachers, which enhanced clarity of the items, removed obscurity, established the approximate time to completing the instruments and ensured smooth question transitioning.

In this study, I used three survey methods to collect survey data. These were the self-administered survey, the drop-off survey and mail survey. The self-administered survey was adopted specifically to increase the response rate and at the same time it enabled me to provide support to teachers who had problems in filling the questionnaire. Drop-off surveys were used to accommodate the participation of Physical Science teachers who were not available in schools at the time of my visit. The questionnaires with supporting documents were then left with the head-teachers for the teachers to fill upon their arrival to the schools. I then personally collected the completed questionnaire on my return journey from other schools on the same day or following day. Mail surveys

were employed to accommodate participation of teachers whose schools were not accessible due poor road conditions. Table 3.4 gives the number of Physical Science teachers who were involved in the three survey methods in this study.

Table 3.5 Participants in the survey methods

Survey method	Number of teachers involved	Number of returned questionnaires	Response rate
Self-administered survey	46	46	100%
Drop-off survey	10	10	100%
Mail-survey	12	6	50%
Total	68	60	88.2%

According to Table 3.5, the majority of the teachers (46 out of 68) participated in the self-administered survey. In addition, the mail-survey produced the lowest response rate of 50%. However, the overall response rate of 88.2% was achieved. Appendix XVI gives a summary of the survey design in the study.

3.7.3 The face to face interview method

Face-to-face (personal) interviews with purposively sampled teachers were conducted as a method of collecting qualitative data in the study. This method was chosen to comprehensively understand the teachers' responses to predetermined items and to confirm or cross validate the quantitative data. Thus, triangulation and complementarity of the two sets of data were the main purposes for using face-to-face interviews. According to Blaxter, Hughes and Tight (2001:172), the interview method involves questioning or discussing with people. Soriano (1995:19) also concurs that the interview method refers to the collection of information from respondents through "real

time” contact. Hence, face-to-face interviews in this study involved a presentation of oral-verbal questions, which were also replied through oral verbal responses.

3.7.4 The interview schedule

I developed an interview schedule as a data collection instrument. The schedule was made up of broadly three parts: the introduction, main body and closure (see Appendix IX). In all, the schedule contained 14 questions which served three purposes: to get a clarification and explanation of their choices in the questionnaire items; to cross validate their responses in the earlier method; and to get an expanded perception on in-service education.

Just like the survey questionnaire, the draft interview schedule was pre-tested to assess how the instrument worked in practical situations. Pre-testing helped to know the estimated time of the activity and get an indication of how data was to be transcribed. A final interview schedule was therefore developed and used.

In this study, face-to-face interviews immediately followed the first activity of filling the questionnaire. Thus, purposively sampled teachers were requested to participate in the interviews. A consent form was duly signed by each sampled teacher for his/her participation in oral interviews. There were two forms of oral interviews, which I employed. These were the one-on-one interviews and group discussions whose sizes varied from two to four teachers. I asked the teacher(s) predetermined open-ended questions with some follow-up probing questions. Hence, it was an unstructured or open-

ended interview (Soriano, 1995). Table 3.5 gives the summary of the number of schools and teachers who participated in the oral interviews.

Table 3.6 Sample design in oral interviews

Type of oral interview	Number of schools	Number of teachers		Total number of teachers
		Diploma teachers	Bachelors degree teachers	
One-on-one	10	5	5	10
Group discussions(2-4 teachers per group)	6	5	8	13

Thus, a total of 23 (38%) teachers participated in oral interviews. In addition to writing down notes from the discussion, I also tape recorded most of the discussions. Appendix XVI gives a summary of the survey design in the study.

The following protocol was observed during the data collection process: (1) schools and teachers were communicated through telephone about my visit a day before (2) courtesy call at the head-teacher's office and meeting the participants at a quite place (3) introduction of participants and the researcher (4) description of the purpose of the visit and study (5) detailing the voluntary nature of the study and the related confidentiality of the data and anonymity of the teachers in the report (6) participants reading instructions and signing a consent form (7) filling of questionnaire (8) participation in oral interviews (9) courtesy call at the head-teacher's office.

3.8 Data Processing

Sindhu (2003) contends that the mass data collected through reliable and valid tools is yet but raw. That is, the raw mass data require processing or preparation so that they are amenable to data analysis and consequently answer the research problem. In this study, the quantitative and qualitative data were therefore processed or prepared for analysis. Technically speaking, processing implies editing, coding, classification and tabulation of collected data (Kothari, 2004:122).

3.8.1 Editing

Data editing is a process of examining the raw data to detect and correct errors and omissions (Kothari, 2004). Sindhu (2003) concurs that editing implies checking of data for accuracy, utility and completeness. Hence, in this study, editing involved identifying errors and omissions in the raw data, eliminating incomplete or invalid information and making corrections wherever possible to ensure accuracy, consistency with other data gathered, and uniformly entered to facilitate coding and tabulation.

There were however two stages of editing the raw data: during the data collection phase and after data collection phase also known as field and central editing (Kothari, 2004) respectively. As soon as a respondent completed the questionnaire, I quickly browsed through the questionnaire to check for omissions and errors arising from not following instructions among other factors. Omissions and inaccuracies were therefore identified and corrected right at the school before moving to another school. Then I edited all the completed questionnaires at my working place (central editing). This

activity involved correcting wrong entries by either contacting the respondent for clarification through telephone or making appropriate changes for consistency with the instructions. However, where it was not possible to correct the data, the data for that item was regarded missing. As argued by Soriano (1995), missing values in a research survey are more than not ignored.

In this study, the qualitative data from face-to-face interviews was collected in the form of handwritten notes and tape-recorded during interviews. For the handwritten notes, field editing involved completing, translating and rewriting the hand written notes on the very day so that they make sense. Tape-recorded data was also field edited by listening to the tapes on the very day ensuring that the voices were audible and clear. Where it was neither audible nor clear, the respondent was asked to clarify. During the central editing phase, the tape-recorded data were first transcribed and then stored to a hard copy and then to an electronic copy.

3.8.2 Coding

Edited data was coded and a codebook was developed accordingly. As defined by Kothari (2004:123) coding refers to the process of assigning numerals or symbols to answers so that responses can be put into a limited number of categories or classes appropriate to the research problem. In this study, the quantitative data was coded by assigning of symbols and numerals together. Thus, all the question numbers were given codes while the options were given data labels accordingly.

3.8.3 Classification

Classification was done mainly on qualitative data collected from face to face interviews. As defined by Kothari (2004), data classification is simply the process of arranging or placing data in groups or classes on the basis of common characteristics. Thus, the transcribed data was re-read and code words were assigned to each text segments using the verbatim coding method. According to Soriano (1995), verbatim coding involves looking through interview responses for information that is directly pertinent to the objectives of the needs assessment. Later the codes were collapsed into themes and categories. Thus, qualitative data was classified using descriptive characteristics.

3.8.4. Data file creation

The third activity was to create a data file. Data file creation involved entering coded data, mostly quantitative data, into a computer package known as the Statistical Packages for Social Sciences (SPSS) and stored in a USB and hard drive. The hard copy interview transcripts were however filed in an arch file, which was also safely stored.

3.8.5 Tabulation

Tables and figures were constructed from the SPSS data file to facilitate further analysis of the data. While tables were mostly constructed on in-service training needs, statistical figures (bar graphs, pie charts) were constructed from the demographical profiles and the data on preferences of the teachers in the second question of the study.

3.9 Data analysis

According to Onwuegbuzie and Teddlie (2003) analyzing quantitative and qualitative data within a mixed methods framework encompasses at least seven stages. These stages are data reduction, data display, data transformation, data correlation, data consolidation, data comparison, and data integration. Kothari (2004:122) concurs that data analysis refers to the computation of certain measures along with searching for patterns of relationship that exists among data groups. In this study, data analysis included data reduction, data display, data transformation, data comparison, and data integration. However, qualitative and quantitative data were analyzed separately with integration of the analyzed data occurring at the interpretation stage.

3.9.1 Analysis of Data for Research question 1

Research question 1 sought to assess the in-service training needs of Physical Science teachers in CWED with respect to highest qualification, teaching experience and training institutions. The Physical Science teachers were therefore asked to rate, using a five-point Likert scale, 40 professional competencies on the importance of the competencies to the success of their teaching and on their perceived level of competencies. In this study, a Borich Model of Needs Assessment (1980) was employed in the analysis of quantitative data for this question. The model involves calculating a Mean Weight Discrepancy Score (MWDS) as an index for measuring the magnitude of training need and ranking the training needs accordingly. Table 3.6 gives the stages/methods which were used in this study to the calculate the MWDS.

Table 3.7 Procedures for calculating the Mean Weighted Discrepancy Score

Step	Description of activity	Formula used
1	Calculate Discrepancy Score (DS) for each teacher on each professional competency	$DS = \text{importance rating} - \text{competency rating}$
2	Calculate the average of the importance ratings (I_{av})	$I_{av} = \frac{\text{sum of importance ratings}}{\text{number of respondents}}$
3	Calculate a Weighted Discrepancy Score (WDS) for each teacher on the competency	$DS \times I_{av}$
4	Calculate a Mean Weighted Discrepancy Score (MWDS) for each professional competency	$MWDS = \frac{\text{sum of WDS}}{\text{number of respondents}}$

The final stage in this model was therefore ranking the professional competencies using the calculated MWDS. Ranking of the professional competencies was done according to each category of teachers based on highest qualification, teaching experience and training institutions. And consequently the ranked professional competencies were presented in tables for further analysis. However, the larger the MWDS the greater the in-service training need for that competency. And using this model any MWDS equal to or greater than 4.0 was considered to mean a high in-service training need for the professional competency, while any MWDS equal to or less than 2.0 indicated a lesser in-service need for the item.

It must be pointed out that calculation of MWDS was done using the Microsoft excel package. That is, data entered in the SPSS package was converted into Microsoft Excel 98 and all computations and rankings were done using the excel.

3.9.2 Analysis of data for question 2

Qualitative and Quantitative data was collected for research question 2. During the data processing phase, the transcribed qualitative data was coded and classified into qualitative themes. That is, the quantitative data was quantified by counting the number of times each theme occurred in the text data. According to Creswell (2003) this procedure is known as data transformation. Transformation of qualitative data to quantitative was done to facilitate the ranking of the themes in terms of frequency and percentage of each frequency of each response in the overall data. This data was then stored in a hard copy awaiting further analyses.

A larger amount of data for question 2 was derived from the survey questionnaire hence it was quantitative. Using the SPSS package, descriptive statistics were therefore calculated to facilitate analysis of the quantitative data. I therefore calculated the frequency and/or percentages of choice for each item and ranked the items in order of the frequencies for comparison purposes. The data was further displayed pictorially (charts, graphs and tables) ready for interpretation.

3.10 Ethical considerations in the study

Blaxter, Hughes and Tight (2001:158) contend that all social research (whether using surveys, documents, or interviews) give rise to a range of ethical issues around privacy, informed consent, anonymity, secrecy, being truthful and the desirability of the research. Researchers have, therefore, clear ethical responsibilities (Salant and Dillman, 1994). In this study, ethical considerations were therefore adhered to in data collection, data analysis and interpretation.

3.10.1 Right to privacy and participation

In this study two strategies were employed to ensure the teachers' right to privacy and participation. In the first place I ensured that participants were never forced to participate in the study. Firstly, a briefing meeting in which the teachers were briefed on the purpose of the study, reasons and benefits for their participation and right to participate or not. Secondly, the teachers were given an opportunity to indicate their willingness to participate in the study by signing a consent form. I went through the contents of the consent form together with the teacher(s). Those who agreed to participate freely signed the consent form and participated in the study. However, there were very few teachers who did not want to be tape- recorded in the oral interviews and they were allowed accordingly. Sallant and Dillman (1994) contend that researchers must respect anyone who decides not to participate in the survey. Creswell (2003) concurs that participants have a right to participate voluntarily and the right to withdraw at any time. Such teachers however accepted that data be collected by writing down notes instead of

tape-recording. Although, writing down notes slowed the interview process, it enabled such teachers to participate in the study and also substantial data be collected.

I also sought permission from gatekeepers to have access to the schools and participants at research sites. Permission from the Secretary for Education, the Education Division and Head-teachers were sought to respect privacy of the teachers as well as those of the sites. As highlighted by Creswell (2003:65), researchers need to respect research sites so that the sites are left undisturbed after the research study.

3.10.2 Right to confidentiality of responses

The second ethical consideration in this study was confidentiality. Confidentiality meant protecting the privacy of respondents by keeping the data sources as confidential as possible. In the first place, numbers and not names identified questionnaires. Then I used stamped self-addressed envelopes for mail questionnaires to ensure that the teachers posted the questionnaire directly to me.

3.10.3 Right to remain anonymous

I also ensured anonymity of the sites and participants by using aliases or pseudonyms for individuals and sites in so doing protecting their identities. Hence no real names of schools or participants were used in this report. The use of group data rather than individual's data also facilitated that the participants remained anonymous.

3.10.4 Collection and use of Accurate data

In this study I also ensured accuracy of information by first holding a debriefing meeting with the participant at the end of the interview whose purpose was to cross check with the participant that the data collected was accurate. Where possible, telephone communications were made to cross check the accuracy of data from participants while at my workplace.

3.11 Ensuring trustworthiness of the study

According to Creswell (2004) terms such as authenticity and credibility are synonymous to trustworthiness. To ensure trustworthiness, authenticity or credibility of the study, I triangulated between methods of data collection (used questionnaire and interview to collect data on the same issues), and also used community of friends and community of critical friends to review and determine the accuracy of the proposal and instruments. The instruments were also field tested.

3.12 Handling of errors in the study

Sallant and Dillman (1994) argue that surveys yield accurate results when researchers succeed in avoiding four kinds of errors: coverage errors, sampling errors, measurement errors and non-response errors. A coverage error occurs when the list or sample frame from which a sample is drawn does not include all elements of the population that researchers wish to study (Sallant and Dillman, 1994:10). A coverage error is, therefore, a discrepancy between the intended target population and actual survey population (Lu and Mille, 2002). To control the coverage error or frame error, I collected

an up-to-date, complete and accurate list of Physical Science teachers per school from the CWED and ensured that names were not duplicated. Finally, I verified with head-teachers whether the targeted teachers were indeed qualified Physical Science teachers or not.

According to Sallant and Dillman (1994:17), a sampling error occurs when researchers survey only a subset or sample of all people in the population instead of conducting a census. This error occurs as a result of selecting a sample instead of the entire population. The error is never completely avoided unless a survey census is carried out. In this study, the sampling error was therefore controlled by using a census population. Lu and Mille (2002) concur that sampling errors are controlled by increasing the sample size.

A measurement error occurs during data collection (Lu and Mille, 2002) or when devising lists or selecting samples. It occurs when a respondent's answer to a given question is inaccurate, imprecise or cannot be compared in any useful way to other respondents' answers (Sallant and Dillman, 1994:17). To guard against the measurement error, the questionnaire and interview schedule was subjected to a community of friends and was also pretested to ensure that items are clear, unambiguous, have no obvious biases, as short as possible, accurate and that question ordering encourages respondents to continue answering. In addition, both the questionnaire and interviews were self administered to control errors arising from using multiple interviewers. I also informed respondent that the data collected from them will be treated as confidentially as possible and that the results of the study would be presented in such a way that it does not reveal

the data from individual respondent. In addition, I informed respondents to consider the exercise as important for all Physical Science teachers.

The non-response error occur when a significant number of the sampled population does not respond to the questionnaire and are different from those who do in a way that is important to the study (Sallant and Dillman, 1994:20). To control non-response errors, I self administered the questionnaire. I sent an advance letter to respondents through their head-teachers requesting for access to the respondent and explaining the importance and purpose of the study, as well as the participation and cooperation of the respondent in the study. I also confirmed my visit with head teachers or respective respondents through phone calls a day before the visit to the school and interview respondents at times convenient to them. Those teachers who were targeted through mailed questionnaires were reminded by telephone and in writing to send the completed questionnaires accordingly.

3.13 Limitations of the study

According to King (2005), the limitations of a study are those characteristics of design or methodology that set parameters on the application or interpretation of the results of the study. This study had therefore three main limitations. The first limitation in this research study was the non-availability of targeted teachers during the data collection phase despite prior arrangements with them. To ensure their participation in the study, drop-off survey questionnaires were left with head teachers to give them to the teachers who were not present. The schools were revisited and filled questionnaire collected on a

return-trip. This approach ensured that such teachers eventually participated in the study and had an opportunity to meet and discuss issues with the me.

This study was conducted in partial fulfilment of a Masters degree course whose activities were time bounded. Hence, data was collected within two weeks reducing the time spent per school. In addition, data collection was confined within the time the teachers indicated they were free from school activities. To maximize the visit to any given school and presence of teachers, prior arrangements on the date and time of data collection were made with headteachers and the teachers concerned. Teachers' free time was mostly allocated for data collection. This arrangement ensured that data was collected without an undue pressure on the teachers. Additionally, communication with the teachers who participated in this study continued afterwards through telephone to get clarification on their responses.

In this study, access to five schools in CWED was not possible due to bad roads resulting from heavy rains, which had damaged the road surface and bridges. Hence some schools could not be reached through roads. As a mitigation factor, mail questionnaires with a stamped and self-addressed envelope were sent to the targeted teachers in such school. This approach was employed to reach the teachers in these schools and it ensured their participation in the study as planned. During follow-up calls for the questionnaires, it was also possible to conduct mini telephone interview with the teachers who had returned the questionnaires.

In the qualitative, face to face interview method, it was planned that data would be tape-recorded to speed up the process of interviewing the teachers and increase accuracy of data collected. Unfortunately, 2 of the 30 teachers refused to be tape-recorded during oral interviews against a background of fear of the unknown in the use of such data. Hand written notes were taken down although it slowed the interview process and consequently lengthened the duration of the interview process. Follow-ups through telephone were made during the editing phase of the data to get more clarification on vague handwritten notes.

3.14 Delimitations of the study

The delimitations of a study are those characteristics that limit the scope (define the boundaries) of the inquiry as determined by the conscious exclusionary and inclusionary decisions that were made throughout the development of the proposal (King, 2005). Therefore, this study had been delimited in a number of ways in order to ensure that it could be completed within the constraints of resources such as time and finances. These delimitations simply defined the boundaries of this study. First, this study surveyed the needs and preferences of Physical Science teachers in only one of the six education divisions. CWED was selected because it had more schools offering the subject and more qualified teachers than the other divisions.. Additionally, CWED was a division with no interventions in form of organised INSET for such teachers. Hence the needs and preferences of the teachers were due to the problem under-study. Thus, the advantages of more information rich subjects and environment relatively free of INSETs interventions enabled the collection of adequate and appropriate data for the study.

To facilitate quick and easy access to schools, the study was conducted only in Government and Grant Aided secondary schools. This reduced the number of gatekeepers for me to access the schools and teachers and enhanced commitment of the teachers in the study.

Thirdly, the study was also delimited in the class of informants. Only qualified and practicing Physical Science teachers participated in the study. This target group of informants was selected as the problem under study was about this category of teachers.

Fourthly, the study focused on self-perceived needs and preferences of the this category of teachers. In other words, the study focussed on INSET receivers needs assessment rather than INSET providers or stakeholders. It was the primary level needs assessment study (Witkins and Altschuld, 1995) to provide informed data on the classroom competency needs of the teachers as they perceived them.

Fifthly, the study was delimited in the scope of models of INSETs. The study focussed on the update and competency models of INSETs (Nasseh, 1996) whose primary objective are to equip practicing teachers with knowledge and skills comparable to those teachers graduating from colleges now as well as strengthen the existing competencies of the teachers. Hence the emphasis is on structured training activities intended to increase the skills and knowledge of Physical Science teachers.

Finally, the study was bounded by the period of interest. The study investigated the problem from 1994 onwards. The period was of interest as it marked the at least first decade into the multi-party political era, which had been characterised by more teacher education issues. Being conducted in 2006, the study used 2005 education statistics (MoE, 2005). to inform its design. In general, these delimitations affected the applicability of the results of this study to settings and individuals beyond those that were studied.

Chapter summary

This chapter has presented the design and research methods of the study. The presentation was broadly centred on the pragmatism and mixed methods approach, the rationale and overall approach of this mixed methods study, the population of interest, initial selection decisions and access to negotiations, sampling, data collection process, data management, data analysis, ethical considerations in the study, ensuring trustworthiness, and treatment of errors. The next chapter presents, discusses and interprets the findings from the study.

CHAPTER 4

ANALYSIS AND DISCUSSION OF RESULTS

Chapter Overview

This chapter presents, discusses and interprets the results from the research study. The chapter begins with the demographic profile of the respondents followed by the in-service training needs of the teachers surveyed in this study with respect to their qualifications, teaching experience and training institutions. Finally, the chapter presents, discusses and interprets the findings on the teachers' preferences in in-service training programmes according to qualifications

4.1. Demographic profile of respondents

Soriano (1995:59) contends that in needs assessment the basic demographic profile of respondents are important because they clarify the population of interest. In addition, Halim, Osman and Meerah (2006) found that there existed significant associations between the teachers' needs and demographic profiles. In this study the demographic profiles included age, sex, teaching experience, qualification and training institution of the 60 teachers who participated are presented in Table 4.1.

Sixty Physical Science teachers in CWED participated in this study. Fifty-six (93%) and 4 (7%) were female. Hence, the training needs and preferences identified in this study were essentially the needs and preferences of male Physical Science teachers. Of the 60 teachers, 29 were Bachelors degree holders while 31 were diploma holders. Hence, only academically and professionally qualified teachers participated in the study.

Table 4.1: Demographic profile of Physical Science teachers in CWED (N=60) in 2006 academic year.

Personal and professional characteristics		Highest qualification		Total (N=60)
		Degree teachers (N=29)	Diploma teachers (N=31)	
		Frequency (%)	Frequency (%)	
Sex	Male	28 (96.6)	28 (90.3)	56 (93.3)
	Female	1 (3.4)	3 (9.7)	4 (6.7)
Age	25-34 years	21 (72.4)	13 (41.9)	34 (56.7)
	35-49 years	8 (27.6))	17 (54.8)	25 (41.6)
	50-64 years	0 (0%)	1 (3.3)	1 (1.7)
Teaching experience	1-3 years	12 (41.3)	4 (12.9)	16 (26.7)
	4-6 years	6 (20.7)	5 (16.1)	11 (18.3)
	7-18 years	10 (34.5)	19 (61.2)	29 (48.3)
	19-30 years	1 (3.5)	2 (6.5)	3 (5.0)
	31-40 years	0 (0.0)	1 (3.3)	1 (1.7)
Institutions which awarded respondents' highest qualifications	Chancellor College	16 (55.2)	1 (3.2)	17 (28.3)
	Polytechnic	4 (13.8)	4 (12.9)	8 (13.3)
	Mzuzu University	7 (24.2)	0 (0.0)	7 (11.7)
	Domasi College of Education	0 (0.0)	26 (83.9)	26 (43.3)
	CUEA	1 (3.4)	0 (0.0)	1 (1.7)
	Bunda College	1 (3.4)	0 (0.0)	1 (1.7)

Slightly over half of the teachers 34 (56.7%) of the population were in the age category of 25-34 years. And a total of 59 teachers were between 25 and 49 years of age. Using Super's theory of career development (Schermerhorn, et al. 1992), the majority of the Physical Science teachers CWED were in the career advancement stage characterised by individuals seeking growth and increased responsibility through the continued development and utilization of their skills.

Table 4.1 also shows that the 29 teachers (10 degree and 19 diploma teachers)} were in the 7-18 years teaching experience category. Using Huberman (1989) theory, 56 Physical Science teachers in CWED were within the professional development stages in which the individuals prefer technical assistance and are interested in trying out new instructional techniques and also prefer conferences, workshops and seminars as sources of addressing their in-service needs. Forty-three percent were graduates from Domasi College of Education followed by 26% from Chancellor College.

4.2 In-service training needs of Physical Science teachers in CWED

The first objective in this study was to assess the in-service training needs of Physical Science teachers in CWED. Using Borich Needs Assessment Model (Borich, 1980), in-service training needs of diploma and degree holders were assessed with reference to their teaching experience. But, as highlighted by Garton and Chung (1996:54), when one uses the Borich Model of Needs Assessment, a professional competency with MWDS greater than 4.0 indicates a *high need for in-service training* while a MWDS of less than 2.0 indicates *less need for in-service training* in that professional competency.

4.2.1 In-service training needs of degree Physical Science teachers

Teachers' in-service training needs were assessed by their years of teaching experience. Table 4.2 is an extract of Appendix X and gives only the high in-service training needs of Physical Science teachers with a degree qualification.

Table 4. 2 High In-service training needs of degree Physical Science teachers in CWED.

1-3 years category of teachers(N=12)				4-6 year category of teachers (N=6)				7-18 years category of teachers (N=10)			
Rank	Code	Competency	MWDS		Code	Competency	MWDS		Code	Competency	MWDS
1	B21	Repairing or reconditioning laboratory equipment	7.9		B33	Teaching about public issues regarding Physical Science	5.6		B23	Teaching special needs students.	14.2
2	B32	Using multimedia equipment in teaching	7.3		B23	Teaching special needs students.	4.9		B37	Using computers in classroom/laboratory teaching	11.0
3	B35	Organizing fund raising activities for the school	5.4		B21	Repairing or reconditioning laboratory equipment	4.3		B21	Repairing or reconditioning laboratory equipment	10.6
4	B23	Teaching special needs students.	5.3		B6	Motivating students to learn	4.2		B17	Teaching using experiments	8.0
5	B33	Teaching about public issues regarding Physical Science	5.3						B32	Using multimedia equipment in teaching (e.g. TV)	7.9
6	B22	Organizing student field trips	5.1						B33	Teaching about public issues regarding Physical Science	7.9
7	B15	Managing role models or guest speakers to students.	4.9						B20	Managing science clubs, fairs and congresses	7.2
8	B37	Using computers in classroom/laboratory teaching	4.9						B35	Organizing fund raising activities for the school	7.0
9	B24	Selecting student references materials (textbooks etc)	4.8						B36	Supervising students-teachers on teaching practice programmes.	6.6
10	B31	Improvisation of equipment and materials	4.8						B39	Conducting action research (classroom research)	6.2
11	B36	Supervising students-teachers on teaching practice programmes.	4.7						B34	Using participatory teaching methodologies in Physical Science education	6.0
12	B30	Teaching using locally available resources	4.4						B22	Organizing student field trips	5.6
13	B29	Teaching all Form 4 Physical Science topics	4.0						B5	Assessing students laboratory work	5.1
									B12	Teaching skills in Physics topics	4.8
									B19	Supervising students laboratory work	4.8
									B8	Understanding student learning styles	4.7
									B38	Teaching the relationship between Physical Science and the environment	4.7
									B1	Teaching Physical Science in laboratory settings	4.0
									B31	Improvisation of equipment and materials	4.0

The 1-3 years category of teachers indicated that they had high in-service training needs in 13 of the 40 competencies while the 4-6 and 7-18 years categories indicated 4 and 19 of 40 competencies respectively. In-service training was therefore needed by all the three categories of teachers. This finding confirmed the rationale for INSETs. As argued by Wood(1983) and Lowethaw(1980) pre-service education by itself is not enough and not a guarantee of effectiveness as knowledge or know-how acquired by teachers during the pre-service training decreases appreciably after of qualification. Abolaji and Reneau (1988) concur that teachers needed to improve their knowledge and competency on the job beyond what was acquired in the initial certification in order to become effective professionals.

The results displayed in Table 4.4 also show that the number and type of competencies with high in-service training need as indicated by the three categories of teachers were different. In the first place, the 7-18 years category of teacher indicated high in-service training need in more competencies than the other two. Recent trends show that science is one such subject area in which there are rapidly changes in pedagogical content knowledge and skills. Thus, the long period that this group of teachers stayed without in-service education may have contributed to such a large number of competencies. The 4-6 years category of teachers tended to have the least number of competencies (4 of 40 competencies) with high in-service training need. Although the reasons are not yet established, this group came out of college at the time of implementation of the new curriculum. Maybe pre-service programmes contained rigorous courses to meet the demands of the new curriculum.

The types of competencies with high in-service training need as indicated by the three categories of teachers were generally different in all but three. The common competencies were repairing or reconditioning laboratory equipment (B21), teaching special needs students (B23) and teaching about public issues regarding Physical Science (B33). This three may have been due to pre-service programmes lacking courses, which would equip teachers with such competencies. Hence, the results in Table 4.4 showed that different categories of degree teachers tended to have different types of competencies with high in-service training needs. In other words, teachers with different teaching experiences tended to have different in-service training needs.

This finding confirmed the stage theories of teacher professional development (Huberman, 1995 and Pang, 2001) and the results of earlier studies, which found that teachers in-service training needs varied with their years of teaching experience (Fok, et al., 2005; and Layfield and Dobbins, 2002). Layfield and Dobbins (2002) also found that beginning and experienced teachers of agriculture in South Carolina had some common in-service training needs in their top ten competencies despite marked variation in other in-service training needs. Garton and Chung (1996) also found that the agriculture teachers in the states of Missouri, USA, had also high in-service needs in teaching special needs students. As pointed out by Bezzina and Camillerri (2001), it would appear that the teaching force had almost suddenly been faced with inclusive education without adequate training.

Generally, the in-service needs of the degree Physical Science teachers in Malawi were different from the in-service needs of the agriculture teachers in the US and elsewhere. This finding also confirmed literature which report that dissimilar groups tend to have different in-service needs (Roberts and Dyer, 2001) and that the in-service needs of teachers depended on their geographical location (Washburn, 2001).

Further analysis of the results in Table 4.4 showed that the 1-3 years category of teachers indicated to have high in-service training needs in managing science instruction (B15, B32 and B36); pedagogical knowledge and skills (B23,B24,B33 and B35); knowledge and skills in Physical Science (B29); administering science facilities and equipment (B21, B30 and B37), integrating multimedia technology in a classroom (B32) and use of ICT in Physical Science education (B3). Thus, this category of teachers indicated that they had high in-service training need in all but one of the seven broad dimensions: diagnosing and evaluating students.

On the other hand, the 4-6 years category of teachers tended to have high in-service training needs in only three of the seven broad dimensions: managing science instruction (B6), pedagogical knowledge and skills (B23 and B21) and administering science facilities and equipment (B21). Although the 7-18 years category of teachers indicated high in-service training needs in all the seven dimension, they tended to have more weak competencies in managing science instruction (B1, B19, B20, B22, B36 and B39) and pedagogical knowledge and skills (B8, B23, B33, B34 and B35). Again the

results justify the need for in-service education for all the categories of degree teachers although in different competencies within the same dimensions.

4.2.2 In-service training needs of diploma Physical Science teachers

Appendix XI gives the in-service training needs of three categories (1-3 years, 4-6 years and 7-18 years) of diploma teachers ranked in order of Mean Weight Discrepancy Scores (MWDS). Different categories of diploma teachers also indicated they had different in-service training needs as shown by the different sizes of MWDS and rankings of the competencies. The stage theories (Huberman, 1995, Pang, 2001) therefore were also upheld in this category of teachers. Table 4.3 gives only the competencies with high in-service training needs as indicated by the three categories of diploma teachers. An analysis of the results in the table found that the teachers in the 1-3 years; 4-6 years and 7-18 years categories indicated that they had high in-service training need (MWDS of 4.0 or above) in 14, 21 and 19 of the 40 professional competencies respectively. However, the 4-6 and 7-18 years category of teachers indicated that they had more competencies with high in-service training need than the 1-3 year group. Again, it would appear that the longer the teachers stayed without in-service training the more competencies in the high in-service training needs category they indicated.

Table 4.3 High in-service training needs of diploma Physical Science teachers in CWED.

Rank	Code	Competencies for 1-3 years teachers (N=4)	MWD S	Code	Competencies for 4-6 years teachers (N=5)	MWD S	Code	Competencies for 7-18 years teachers (N=19)	MWD S
1	B23	Teaching special needs students.	10.8	B21	Repairing laboratory equipment	14.0	B23	Teaching special needs students.	12.1
2	B4	Developing critical thinking skills in my students	7.9	B32	Using multimedia equipment in teaching	14.0	B37	Using computers in classroom/laboratory teaching	11.3
3	B9	Knowing how to use a computer (computer literacy)	7.2	B23	Teaching special needs students.	10.6	B9	Knowing how to use a computer (computer literacy)	8.4
4	B14	Teaching skills in chemistry topics	7.2	B37	Using computers in classroom	10.1	B21	Repairing or reconditioning laboratory equipment	8.3
5	B36	Supervising students-teachers on teaching practice programmes.	7.2	B9	Knowing how to use a computer	9.0	B32	Using multimedia equipment in teaching (e.g. TV)	6.8
6	B8	Understanding student learning styles	6.0	B35	Organizing fund raising activities for the school	7.6	B35	Organizing fund raising activities for the school	6.7
7	B13	Teaching knowledge or concepts in Chemistry topics	6.0	B22	Organizing student field trips	7.0	B39	Conducting action research (classroom research)	6.3
8	B21	Repairing or reconditioning laboratory equipment	6.0	B20	Managing science clubs, fairs and congresses	6.4	B33	Teaching about public issues regarding Physical Science	5.8
9	B39	Conducting action research (classroom research)	6.0	B33	Teaching about public issues regarding Science	5.9	B4	Developing critical thinking skills in my students	5.6
10	B15	Managing role models or guest speakers to students.	5.4	B24	Selecting student references materials	5.8	B36	Supervising students-teachers on teaching practice programmes.	5.4
11	B30	Teaching using locally available resources	5.4	B31	Improvisation of equipment and materials	5.8	B2	Teaching students problem solving skills	5.2
12	B35	Organizing fund raising activities for the school	5.0	B34	Using participatory teaching methodologies in Physical Science	5.5	B20	Managing science clubs, fairs and congresses	5.1
13	B40	Teaching students with mixed abilities (such as slow learners)	4.5	B15	Managing role models or guest speakers to students.	5.3	B5	Assessing students laboratory work	4.6
14	B20	Managing science clubs, fairs and congresses	4.3	B8	Understanding student learning styles	5.0	B14	Teaching skills in chemistry topics	4.6
				B38	Teaching the relationship between Physical Science and the environment	5.0	B13	Teaching knowledge or concepts in Chemistry topics	4.5
				B5	Assessing students laboratory work	4.8	B22	Organizing student field trips	4.4
				B13	Teaching knowledge or concepts in Chemistry topics	4.8	B40	Teaching students with mixed abilities (such as slow learners and fast learners)	4.2
				B39	Conducting action research	4.4	B11	Teaching knowledge or concepts in Physics topics	4.0

	B6	Motivating students to learn	4.0		B29	Teaching all Form 4 topics	4.0
	B18	Organizing laboratory work for students	4.0				
	B28	Teaching all Form 3 Physical Science topics	4.0				

In general, diploma Physical Science teachers in CWED irrespective of their years of teaching experience also indicated a need for in-service training. This finding also supported the rationale for in-service training in the professional development of teachers (Sikes and Troyna (1991) in Good (2003); Lowethaw , 1980; . Wood, 1983; National Academy of Sciences, 2005; Abolaji and Reneau, 1988).

In addition to the number of professional competencies in which the teachers strongly required in-service training being different for different groups, the types of competencies were also different in all but five of the 40 competencies [Teaching special needs students (B23), repairing lab equipment, conducting action research (B39), organising fund raising activities (B35) and managing science clubs (B20)]. The competencies were also ranked differently among the three categories of teachers. That is, the sizes of the MWDS of the professional competencies were generally different for the three categories of teachers. Thus, different categories of diploma teachers also indicated different in-service training needs. This finding also confirmed the stage theories of teacher professional development, which argue that teachers at different stages of their careers possess different strengths and competencies (Huberman, 1995 and Pang, 2001). The results also concur with the findings of earlier studies by Fok, et al. (2005; Layfied and Dobbins, 2002; Moyer and Husman, 2000) in which they concluded that teachers at different stages of career development possessed different strengths and competencies.

Further analysis of the results in Table 4.5 found that the three categories of teachers indicated high in-service training needs in all the seven broad dimensions. However, those five common competencies found that they belonged to the broad dimensions of general pedagogical knowledge and skills, administration of laboratory equipment and use of ICT in science instruction. The common in-service training needs may suggest a gap created in the pre-service training programmes. In addition, ICT is a relatively new phenomenon in teacher education, hence the low competencies in ICT among teachers. That is, pre-service training may have had no courses which equipped the teachers with these five competencies, hence their being common in-service training needs among different categories of diploma teachers.

4.2.2 Contrasting high in-service needs competencies between degree and diploma Physical Science teachers in CWED.

The study also compared and contrasted the self perceived in-service needs of diploma teachers to those of degree teachers. This meant comparing and contrasting the top ten competencies within the same teaching experience category. Table 4.4 gives the high in-service needs competencies of degree and diploma Physical Science teachers as ranked by MWDS and years of teaching experience.

Table 4.4 Contrasting top ten high in-service needs competencies between degree and diploma Physical Science teachers by MWDS and experience

	1- 3 years teaching experience		4-6 years teaching experience		7-18 years teaching experience	
Rank	Diploma teachers	Degree teachers	Diploma teachers	Degree teachers	Diploma teachers	Degree teachers
1	B23	B21	B21	B33	B23	B23
2	B4	B32	B32	B23	B37	B37
3	B9	B35	B23	B21	B9	B21
4	B14	B23	B37	B6	B21	B17
5	B36	B33	B9		B32	B32
6	B8	B22	B35		B35	B33
7	B13	B15	B22		B39	B20
8	B21	B37	B20		B33	B35
9	B39	B24	B33		B4	B36
10	B15	B31	B24		B36	B39
11	B30	B36	B31		B2	B34
12	B35	B30	B34		B20	B22
13	B40	B29	B15		B5	B5
14	B20		B8		B14	B12
			B38		B13	B19
			B5		B22	B8
			B13		B40	B38
			B39		B11	B1
			B6		B29	B31
			B18			
			B28			

An analysis of the similarities and differences between the in-service needs of degree and diploma Physical Science teachers found that some of the high in-service training needs of diploma and degree teachers were common. For example there were 6 out of 13 (B35, B30, B15, B21, B36 and B23), 4 out of 21 (B23, B33, B6 and B21) and 10 out of 20 (B5, B20, B36, B33, B39, B23, B37, B21, B32 and B 35) competencies, which were common to the 1-3 years 4-6 years and 7-18 years category of teachers

respectively. The common high in-service needs seem to indicate the shortfalls in the pre-service teacher education programmes which equips the teachers with the competencies.

This finding probably seemed to indicate that the diploma and degree teachers tended to have few common in-service training needs. Results also seemed to indicate that the majority of their in-service training needs were different. Thus, care is needed when designing in-service education content so that they teachers are met at their point of need. That is, depending on the in-service education content the diploma and degree teachers may be treated as one group or different groups in in-service programmes.

However, there were marked differences in the competencies identified by any pair of the categories of the diploma and degree teachers with the majority of competencies for the diploma teachers falling under the dimension of generic pedagogical knowledge and skills. Such a difference may have been due to different levels of cognitive development in which this dimension is grounded. This finding concurs with Glatthorn and Fox (1996), who contend that teachers with different levels of cognitive development possess different in-service training needs.

Further analysis of the similarities and differences between degree and diploma Physical Science teachers found that for the teachers in the 7-18 years, 7 of the top ten competencies were the same. These included teaching special needs students (B23), using computers in a classroom (B37), repairing and reconditioning (B21), using multimedia equipment (32), organising funding raising activities (35), conducting action research

(B39), teaching about public issues regarding Physical Science (B33) and supervising student teachers during teaching practice (B36). These competencies are contained in all but the dimension of knowledge and skills in Physical Science of the teachers' competencies. This may seem to indicate that within the 7-18 years category, the in-service training needs tend to standardize and become the same for the diploma and degree Physical Science teachers. Hence, one in-service course content (without subject matter content) could probably meet the needs of the two categories of Physical Science teachers in the study.

4.2.4 In-service training needs of Chancellor College degree graduates.

Appendix XII gives a summary of professional competencies ranked according to the size of MWDS as indicated by graduates from Chancellor College. Table 4.5 gives the top ten competencies with high in-service training needs as indicated by graduate teachers from Chancellor College.

Table 4.5 Top ten competencies with high in-service training needs as indicated by graduate teachers from Chancellor College

RANK	Item	TEACHER COMPETENCY (N=2)	Item	TEACHER COMPETENCY (N=6)	Item	TEACHER COMPETENCY (N=7)
1	B35	Organizing fund raising activities for the school	B33	Teaching about public issues regarding Physical Science	B23	Teaching special needs students.
2	B23	Teaching special needs students.	B23	Teaching special needs students.	B21	Repairing or reconditioning laboratory equipment
3	B32	Using multimedia equipment in teaching (e.g. TV)	B21	Repairing or reconditioning laboratory equipment	B37	Using computers in classroom/laboratory teaching
4	B5	Assessing students laboratory work	B6	Motivating students to learn	B33	Teaching about public issues regarding Physical Science
5	B8	Understanding student learning styles			B17	Teaching using experiments
6	B33	Teaching about public issues regarding Physical Science			B29	Teaching all Form 4 Physical Science topics
7	B31	Improvisation of equipment and materials			B32	Using multimedia equipment in teaching (e.g. TV)
8	B15	Managing role models or guest speakers to students.			B20	Managing science clubs, fairs and congresses
9	B1	Teaching Physical Science in laboratory settings			B39	Conducting action research (classroom research)
10	B10	Assessing/evaluating student performance			B22	Organizing student field trips

The results in Appendix XII show that the 1-3 years, 4-6 years and 7-18 years categories of Physical Science teachers from Chancellor College indicated high in-service training needs in 18, 4 and 22 of the 40 professional competencies. Thus the 4-6 years category of degree teachers from Chancellor College had the least challenges in teaching the subject while the 7-18 had the most challenges. This could mean the preservice training prepared them adequately for the new curriculum, which was implemented

during their preservice training unlike the 7-18 years category that graduated way before the implementation of the new curriculum. Thus the absence of an orientation into the new curriculum could have contributed to such a large number of competencies with high in-service training need.

An analysis of the top ten competencies (given in Table 4.5) found that only one of the top ten competencies was common to the three categories of degree teachers from Chancellor College, that is, teaching special needs students (B23). This result may have been due the recent demands on teachers on inclusive (equitable) education in Malawi and the lack of or inadequate preparation during preservice training in that particular field. Garton and Chung (1996) and Layfield and Dobbins (2002) also found that agriculture teachers in Missouri and South Carolina had a high in-service training need in teaching special needs students. However, further analysis revealed that the graduate teachers from Chancellor College indicated high in-service training need in the three of the seven broad dimensions of teacher competencies: managing science instruction, generic pedagogical knowledge and skills, diagnosing and evaluating students.

4.2.5 In-service training needs of Polytechnic degree and diploma teachers.

Appendix XIII gives a summary of professional competencies ranked according to the size of MWDS as indicated by graduates from Polytechnic. Table 4.6 gives the top ten competencies with high in-service training needs as indicated by graduate teachers from the Polytechnic.

Table 4.6 Top ten competencies with high in-service training needs as indicated by graduate teachers from Polytechnic (degree and diploma)

RANK	TEACHER COMPETENCY 1-3 years (N=2) degree		TEACHER COMPETENCY 7-18 years (N=2) degree		TEACHER COMPETENCY 7-18 years (n=2) diploma	
1	B21	Repairing or reconditioning laboratory equipment	B35	Organizing fund raising activities for the school	B23	Teaching special needs students.
2	B31	Improvisation of equipment and materials	B23	Teaching special needs students.	B37	Using computers in classroom/ laboratory teaching
3	B20	Managing science clubs, fairs and congresses	B32	Using multimedia equipment in teaching (e.g. TV)	B21	Repairing or reconditioning laboratory equipment
4	B6	Motivating students to learn	B34	Using participatory teaching methodologies	B32	Using multimedia equipment in teaching (e.g. TV)
5	B8	Understanding student learning styles	B36	Supervising students- teachers on teaching practice programmes.	B33	Teaching about public issues regarding Physical Science
6	B11	Teaching knowledge or concepts in Physics topics	B37	Using computers in classroom/laboratory teaching	B2	Teaching students problem solving skills
7	B13	Teaching knowledge or concepts in Chemistry topics	B20	Managing science clubs, fairs and congresses	B4	Developing critical thinking skills in my students
8	B1	Teaching Physical Science in laboratory settings	B21	Repairing or reconditioning laboratory equipment	B35	Organizing fund raising activities for the school
9	B7	Managing student behaviour problems in the classroom	B22	Organizing student field trips	B3	Teaching students decision making skills
10	B12	Teaching skills in Physics topics	B31	Improvisation of equipment and materials	B14	Teaching skills in chemistry topics

Although the competencies were mostly ranked differently by the two categories of degree teachers, only one of the top ten competencies was common. This common competency was repairing laboratory equipment (B21). Since the basis to repairing the majority of laboratory equipment is in Physics topics, then the finding may indicate lack of or inadequate coverage of Physics topics in the teacher training programme. However, analysis of the data in the table 4.5 also showed that of the top ten competencies, the most needed competency for in-service education for the 7-18 diploma teachers was also teaching special needs students. In general, Polytechnic teachers (degree and diploma)

indicated that they had high in-service need in three of the 7 dimensions: managing science instruction and knowledge and skills in Physical Science subject, and generic pedagogical skills.

4.2.6 In-service needs of Physical Science teachers from Mzuzu University

Mzuzu University is relatively new in the field of secondary teacher education. Hence their graduates were only in the 1-3 years category of teachers. The teachers indicated that they generally needed in-service training since only 3 of the 40 professional competencies had MWDS of less than 2.0, implying a less need for in-service training (Appendix XIV). In addition, the teachers indicated that they strongly needed in-service training in 18 of the 40 professional competencies. In particular, the teachers indicated that they strongly needed in-service training in teaching all form 4 (B29) and form 3 Physical science topics (B28). This suggested that the programme at Mzuzu University may not have adequately prepared Physical Science teachers for senior classes.

Table 4.7 gives the top ten competencies with high in-service need for the degree teachers from Mzuzu University

Table 4.7 Top ten competencies with high in-service training needs as indicated by graduate teachers from Mzuzu University.

Rank	Item	TEACHER COMPETENCY (N=7)
1	B21	Repairing or reconditioning laboratory equipment
2	B32	Using multimedia equipment in teaching (e.g. TV)
3	B37	Using computers in classroom/laboratory teaching
4	B22	Organizing student field trips
5	B33	Teaching about public issues regarding Physical Science
6	B35	Organizing fund raising activities for the school
7	B23	Teaching special needs students.
8	B24	Selecting student references materials (textbooks etc)
9	B15	Managing role models or guest speakers to students.
10	B30	Teaching using locally available resources

In table 4.7, 3 of the top ten competencies (B23, B33 and B24) fell under the broad dimension of generic pedagogical knowledge and skills. This may suggest a general weakness in the courses, which equip the teachers with pedagogical knowledge and skills. Teaching special needs students (B23), was rated high, just as indicated by teachers from the other institutions.

4.2.7 In-service training needs of teachers from Domasi College of

Education

Appendix XV gives a summary of the professional competencies and their MWDS as indicated by Physical Science teachers who graduated from Domasi College of Education. The Appendix shows that both the 1-3 years and the 7-18 years category of teachers indicated that they strongly needed in-service training in 19 of the 40

professional competencies although the two groups ranked these 19 competencies differently. Table 4.8 gives the top ten competencies with high in-service training needs as indicated by teachers from DCE.

Table 4.8 : Top ten competencies with high in-service training needs as indicated by graduate teachers from DCE.

RANK	TEACHER COMPETENCY 1-3 years (N=3)		TEACHER COMPETENCY 4-6 years (N=4)		TEACHER COMPETENCY 7-18 years (N=17)	
1	B23	Teaching special needs students.	B21	Repairing or reconditioning laboratory equipment	B23	Teaching special needs students.
2	B4	Developing critical thinking skills in my students	B32	Using multimedia equipment in teaching (e.g. TV)	B37	Using computers in classroom/laboratory teaching
3	B9	Knowing how to use a computer (computer literacy)	B23	Teaching special needs students.	B9	Knowing how to use a computer (computer literacy)
4	B36	Supervising students-teachers on teaching practice programmes.	B35	Organizing fund raising activities for the school	B21	Repairing or reconditioning laboratory equipment
5	B15	Managing role models or guest speakers to students.	B37	Using computers in classroom/laboratory teaching	B35	Organizing fund raising activities for the school
6	B8	Understanding student learning styles	B22	Organizing student field trips	B32	Using multimedia equipment in teaching (e.g. TV)
7	B14	Teaching skills in chemistry topics	B9	Knowing how to use a computer (computer literacy)	B39	Conducting action research (classroom research)
8	B21	Repairing or reconditioning laboratory equipment	B33	Teaching about public issues regarding Physical Science	B36	Supervising students-teachers on teaching practice programmes.
9	B39	Conducting action research (classroom research)	B34	Using participatory teaching methodologies in Physical Science education	B20	Managing science clubs, fairs and congresses
10	B20	Managing science clubs, fairs and congresses	B20	Managing science clubs, fairs and congresses	B4	Developing critical thinking skills in my students

An analysis of the competencies found that three of top ten were common to the three categories of teachers: teaching special needs students (B23), managing science clubs, fairs and congresses (B20) and knowing how to use a computer (B9). However, B20 and B9 were unique to DCE teachers, while B23 was found to be a common weak competency needs among teachers from different institutions. Probably, the preservice programme at DCE did not adequately prepare the teachers in these two competencies (B9 and B20) or never prepared the teachers at all. Although the competencies were generally different for the different categories of teachers, further analysis showed that at least three of the top ten competencies indicated by each category of teachers from DCE were under two of the seven broad dimensions of teacher competencies: managing science instruction (B20, B36, B39, B22) and generic pedagogical knowledge and skills in Physical Science (D23, D4, D8, D32, D33, D34). This finding may suggest a general weakness of the Physical Science programmes at DCE in preparing teachers in managing science lessons and using the science teaching methodologies.

4.2.8 Comparison of in-service training needs of Physical Science teachers from different teacher education institutions

Appendix XIX gives the comparison between training needs of teachers from the four main different institutions. Using Huberman's theory (1989), comparison was made between teachers with the same qualification and within the same teaching experience category. Table 4.9 however gives the differences and similarities in the top ten professional competencies as indicated by Physical Science teachers in CWED.

Table 4.9 Contrasting top ten competencies between teachers in the same category among institutions.

Degree teachers			Degree teachers			Diploma teachers	
1-3 years			7-18 years			7-18 years	
Chanco	Poly	MU	Chanco	Poly		DCE	Poly
B35	B21	B21	B23	B35		B23	B23
B23	B31	B32	B21	B23		B37	B37
B32	B20	B37	B37	B32		B9	B21
B5	B6	B22	B33	B34		B21	B32
B8	B8	B33	B17	B36		B35	B33
B33	B11	B35	B29	B37		B32	B2
B31	B13	B23	B32	B20		B39	B4
B15	B1	B24	B20	B21		B36	B35
B1	B7	B15	B39	B22		B20	B3
B10	B12	B30	B22	B31		B4	B14

An analysis of the data in table 4.10 found that five of the top ten competencies for the Chancellor College and Polytechnic teachers in the 7-18 years category were common. These five common competencies were teaching special needs students (B23), repairing lab equipment (B21), using computers in the classroom (B37), using multimedia equipment and materials (B32), managing science clubs (B20) and organising field trips. Similar results were obtained in the analysis of data for the diploma teachers from DCE and Polytechnic in the 7-18 years category. This result may indicate similarities in the preservice programmes of the two institutions hence the teachers graduate with common weaknesses and strengths. The finding suggested that it was possible to bring together teachers from the two institutions for one in-service education content. However, differences also existed in the nature of competencies with high in-service training needs as indicated by teachers from different institutions. Thus the

remaining top five competencies on which the teachers had different responses also implied that some of the teachers' competencies seem to have depended on the teacher education programme they went through, a factor in the teacher education institution.

4.3 Teachers' preferences for in-service education programmes

The second objective of the study sought to identify and prioritize the preferences of Physical Science teachers in CWED in INSETs. Both qualitative and quantitative data was generated from the survey questionnaire and face-to-face interviews respectively to achieve the objective. The sections, which follow, discusses the findings from the study.

4.3.1 Models of INSET

(a) Teachers' definition of in-service education and training (INSET)

Physical Science teachers in CWED were asked to define the term in-service education and training (INSET). Some of the common definitions were : ... “a form of training or education that a teacher gets as he works” (4b);....“ training of qualified teachers to update them (39b);...and ..“training provided to teachers while in service to beef-up knowledge and skills (15b). The teachers' common perception was that INSET was a formal and structured training activity given to teachers beyond their certification point. The teachers' perceptions of INSET concur with the definition provided by Halim, Osman and Meerah (2005) who defined INSET as structured training activities that are intended to increase the skills and knowledge of science teachers in an area. However, this perception, detaches the teachers from being responsible for their self improvement. The study found that at least 70% of the teachers (N=60) never attended an INSET of any form (induction (70%), orientation into new curriculum (72%), refresher courses (80%),

MANEB courses (65%), conferences (82%) and subject association (95%)). Hence, their perception of an INSET as being structured activity may have been due to lack of such exposures.

(b) Teachers' reasons for participating in INSETs and goal of INSETs

Physical Science teachers in CWED were asked to indicate reasons for their participation in INSETs. Figure 4.1 gives the summary of the responses from the teachers according to their qualification.

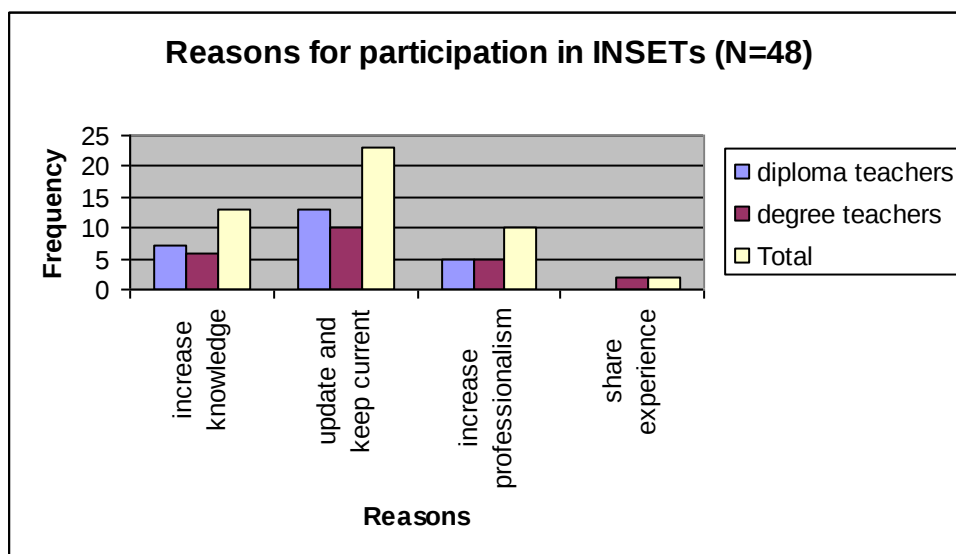


Figure 4.1: Teachers' reasons for participating in INSETs

Figure 4.1 shows that of the four reasons; update and keeping abreast with current developments was the most popular reason for the teachers' participation in INSETs. The majority of the diploma (13 out of 25) and degree (10 out of 23) indicated that the main reason for their attending INSETs would be to update or keep current. Hence the teachers preferred to have their knowledge and skill updated accordingly. The teachers pointed out

that the rapid expansion of knowledge and changes in the curriculum were the driving forces for them to attend INSETs.

Thus the majority of the teachers perceived the primary goal of INSET as that of updating and keeping the teachers updated. For instance, some teachers gave the following as the primary goal of INSETs:.....“ update knowledge in relation to changing world” (2b, 3b); update information in order to teach effectively” (39b).....“ keep current” (41b, 13b). Burko and Putman, 1995; and Eraut, 1994 concur that one of the central goals of professional development or indeed in-service education included the elaboration and expansion of a teachers “knowledge base.

The teachers may have observed a gap between the knowledge and skills required on the ground and that which they acquired during pre-service training. To be able to play their roles and fulfil their responsibilities to their best capabilities, not only do teachers need to be prepared well for the profession but also they need to maintain and improve their knowledge, skills and values through life- long learning or in-service education (Halim, Osman and Mereeh, 2006; Wood, 1983; Sikes and Troyna (1991) cited in Good, 2003).

Their preference was therefore on the update model of INSETs (Nasseh, 2004). . Nasseh contends that the mission of the update model is to provide practicing professionals with levels of knowledge and skills comparable to those graduating today from professional schools.

Abolaji and Reneau (1988) found that the most popular reason for agriculture teachers in Kwara State, Nigeria for their participation in INSETs was to increase knowledge. The teachers focussed on the upgrade model of INSETs (Nasseh, 2004). The finding in this study therefore differs with that by Abolaji and Reneau (1998). But in-service needs depended on the geographical location of the teachers (Washburn ,2001) and dissimilar groups of teachers possess dissimilar in-service needs (Garton and Chung, 1996). Hence the difference between the findings could be explained by the difference in geographical location as well as in the subject area.

(c) Teachers’ preferences for venue or location of INSET

Physical Science teachers in CWED were further asked to give their preferred venue or location of INSETs. The results on teachers’ preferences for location or venue of INSETs are illustrated in Table 4.10.

Table 4.10 Teachers’ preferences on venues of INSETs

category of teacher	Type of venue			
	school	cluster centre	Secondary Teacher training institution and universities	Teacher Development centres
diploma teachers(N=30)	0	2	26	2
degree teachers(N=27)	1	4	20	2
Total	1	6	46	4

An analysis of results in Table 4.11 shows that the majority of the diploma (26) and degree (20) teachers, giving a total of 46 of the 57 respondents, preferred secondary

teacher education institutions and university campuses as appropriate venues of their INSETs. This meant that the teachers therefore preferred to attend INSETs away from their secondary schools. In other words, they preferred offsite INSETs (Craft, 1996; and Glover and Law, 1996) as opposed to school based or cluster based INSETs. According to Craft, this model is a traditional and dominant model and involves teachers from different schools coming together for varying lengths of time for training. Craft (1996:14) further pointed out that although the model has some weaknesses such as perceived gaps between theory and practice, teachers have found such courses stimulating both in terms of acquiring new ideas and in exchanging experiences with those other teachers.

In follow up interviews, the teachers gave a variety of reasons for preferring secondary teacher education colleges and universities as venues for their INSETs. The majority of the teachers cited the availability of practicing experts in the subject areas with appropriate experiences and knowledge, availability of appropriate infrastructure (laboratories library and hostels) and availability of equipment. Some of the teachers also mentioned that they wanted to be away from their schools and families which they regarded as sources of disturbances during their participation in INSETs.

The teachers' choice of secondary teacher education may have been influenced by the need for a stable environment relatively free from threats and a place matching their status. According to Maslow's Hierarchy of needs theory (Maslow, 1968), these needs are safety and love needs. The choice may also mean the desire of the teachers to renew

their relationship with institutions of higher learning, which seem to wean them off once they have graduated.

Abolaji and Reneau (1988) found similar results in which agriculture teachers in Kwara state in Nigeria preferred state university campus as an appropriate venue for their INSETs. The agriculture teachers wanted the venue of in-service courses to be away from the vicinity of their local schools, far from school and family disturbances. Rhea (2002) on the other hand found that science teachers in Eastern North Carolina preferred to attend professional development workshops at their schools. However they also expressed strong need for local colleges and universities as venues of INSETs. A study by Garton and Chung (1996) found that agriculture teachers in Missouri, US, wanted to attend INSETs at the summer vocational conferences centres. The level of development of a country would appear to be a contributing factor to the choice of venue of INSETs.

(d) Teachers' preferences on mode of provision of INSETs

Physical Science teachers in CWED were asked to give their preferences over INSET delivery approaches. The majority of the teachers, 40 (20 diploma teachers and 20 degree teachers) representing 67% of the total respondent, preferred residential mode. With the residential mode, teachers would receive instruction through face to face delivery methods at the venue of INSETs. The teachers' need for residential INSET programmes matched with their earlier need of secondary teacher education institution as venues for INSETs. Probably the teachers wanted to get an opportunity to concentrate fully on INSET activities and to interact with the facilitators thereby getting an

opportunity to be attended to quickly. The findings seem to suggest that the teachers were not exposed to the other modes of receiving INSETs such as distance education.

Again, Abolaji and Reneau (1988) found that agriculture teachers in Kwara state preferred residential programmes to distance programmes. Countries such as Japan and Ireland also offer residential INSET programmes to teachers. Rhea (2002) and Garton and Chung (1996) also found that residential programmes were preferred by teachers than non residential programmes.

(e) Teachers' preferences on mode of delivery of INSET

The respondents were also asked to circle their preferred mode of delivery of INSETs. The majority of the teachers 47 (81%) composed of 25 diploma teachers (N=31) and 22 degree teachers (N=27) indicated that the best mode of delivery for in-service training was through face-to-face approaches. The teachers cited interaction with other Physical Science teachers and facilitators as being the main benefit of this mode of delivery. But as Conklin et al. (2002) argue, the face to face approach requires a lot of time and travelling. They point out that to address the barriers of time and travel to participate in INSETs other approaches are needed to deliver in-service education such as through distance education involving the use of print and electronic media.

Conklin et al. (2002) found that face to face approaches were the most preferred mode of delivery of INSETs by users of INSETs in Ohio. Countries such as Japan Kenya, and Ireland also use the face to face mode of delivery of INSETs. Noh, Kang and

Scharmann (2004) found that Korean science teachers favoured online in-service training to traditional on-site face to face programmes.

(f) Teachers' preference on length or duration of INSETs

Teachers were also asked to indicate their preferences on appropriate duration of INSETs.. Table 4.11 gives the distribution of the teachers' preferences on the lengths or duration of the INSETs.

Figure 4.11 : Teachers' preferences on duration of INSETs.

Preferences on duration of INSETs					
	2 days	1 week	2 weeks	1 month	Total
Diploma teachers		6	11	12	29
Degree teachers	1	8	10	10	29
Total	1	14	21	22	58

Figure 4.2 shows that 58 (29 diploma and 29 degree holders) responded to this item, representing 97% of the teachers surveyed. Two most preferred duration of INSETs were 2 weeks (36%) and 1 month (38%) with an almost equal numbers of degree and diploma teachers. Thus duration ranging from 2 weeks to 1 month would appear to be appropriate for the teachers. The teachers therefore preferred slightly longer INSET courses to short courses. The majority of teachers explained that they needed longer to acquire as much knowledge and skills at once as they were generally busy throughout. Hence, the teachers needed to maximize the use of the available time. As highlighted by Hargreaves and Fullan (1992) and Darling-Hammond (1995),

professional development that has a substantial number of contact hours and is sustained over a period of time has a stronger impact on teaching practice and is more consistent with systematic efforts than those of very short durations. In addition, Desmone, et al (2002) argue that longer INSET activities are more likely to provide in-depth discussion of issues dealt with in the professional development programmes, they help teachers to understand new strategies as allow them to try out new practices in teaching.

A study by Abolaji and Reneau (1998) on in-service needs of teachers in Kwara State, Nigeria, found that the teachers preferred a one week long INSET. Garton and Chung (1996) found that agriculture teachers in Missouri preferred professional development programmes of 2 to 3 hours long. The finding in this study was different from these earlier studies may be due to the absence of in-service training to the majority of teachers or due to geographical differences between Malawi and the other countries. As pointed out by Washburn, (2001) teachers' in-service training needs depended on the geographical location as well.

4.3.2 Teachers' preferences in the organization and management of INSETs

(a) Best time of the year for INSETs.

Respondents were asked to circle their best time of the year for their INSETs.

Table 4.12 gives a summary of the teachers' responses.

Table 4.12: Teachers' preferences on best time for their INSETs

		BEST TIME FOR IN-SERVICE (frequency)					Total
		Between term 1&2	Between term 2&3	Holiday after 3 rd term	School week days	Weekends	
highest qualification of teachers	diploma in Education	1	4	24	1	1	31
	Bachelors degree	4	5	17	1		27
Total		5	9	41	2	1	58

Forty-one (71%) of the teachers surveyed indicated that the best time for them to attend in-service training was during the holiday after third term of the schools calendar (between October and December). This finding may suggest that the teachers wanted to attend INSETs after the end of the years' teaching assignment. That is, when they are free from classroom activities. Very few teachers (3%) indicated weekends as the best time for them to attend INSETs.

In a follow up interview, the teachers cited two main reasons for their choice of the holiday period after 3rd term. In the first place, they argued that the summer period was a longer period for INSETs enabling them to acquire a lot of knowledge and skills. Secondly they argued that the period was appropriate for them to reflect on the activities

of the past school year and to prepare for the new school year. One of the respondents said, “ ...this is the best time to sort out the teachers problems which were encountered in the past year” (4b). Religious demands and need for a rest were cited as the reasons for not choosing weekends as best times for INSETs.

Studies by Garton and Chung (1996) and Layfield and Dobbins (2002) also found that teachers preferred the summer vacation period as the best time for INSETs workshops. Rhea (2002) on the other hand found that 53% of teachers surveyed preferred to attend INSETs only during professional development days. Professional development days are special days set aside for teachers to participate in INSETs. Just about 43% indicated that the best time for INSETs was during the summer. Thus, the findings in this study confirm findings by Garton and Chung (1996) and Layfield and Dobbins (2002).

(b) Structure of INSETs.

The teachers were also asked to give their preferred structure of INSETs. Figure 4.13 illustrates the teachers’ responses to whether INSETs needed to be organized per cluster, district, division, or national.

Figure 4.13 Teachers’ preferences on organizational structure of INSETs

		PREFERRED STRUCTURE OF CPD				Total
		DIVISIONAL	DISTRICT	NATIONAL	CLUSTER	
highest qualificati on	diploma in Education	16	4	8	3	31
	Bachelors degree	17	0	6	6	29
Total		33	4	14	9	60

.

Slightly over half 33(55%), composed of 16 diploma teachers and 17 degree teachers, indicated that they preferred to attend INSETs per education division. Thus the majority of the teachers preferred to attend INSETs with other Physical Science teachers from the same Education Division. The teachers wanted to maintain their divisional relationships. According to Maslow (1989), this type of need is known as a social need- the need to feel part of a group.

In a follow-up face-to-face interview, the majority of the teachers gave the following reasons for the choice of divisional approach. First, they argued that with a divisional approach, all teachers in the division would have the opportunity to attend INSETs as the numbers of physical Science teachers were small enough to be accommodated at a given venue. They argued that the National approach would limit chances of teachers to attend INSETs as the numbers would be too large to be accommodated at one institution. Secondly, they argued that it would be easy to provide transport to the teachers to travel to and from the venue of training. Finally, they said the divisional approach would ensure that each division addresses the problems in the division as identified by the Methods Advisors of the division. As one teacher pointed out, “.....each division will solve problems characteristic to the division”(10b).

(c) Teachers’ preferences on forms of recognition

Physical Science teachers were asked to indicate their preferred form of recognition for having attended INSETs. Table 4.14 illustrates distribution of the teachers’ preferences on forms of recognition for their participation in INSETs.

Table 4.14 Teachers' preferences on forms of recognition

		FORMS OF RECOGNITION				Total
		NON AWARD	CREDIT AWARD	CERTIFICATE OF ATTENDANCE	DIPLOMA/DEGREE AWARD	
highest teacher qualification	diploma in Education	2	3	10	16	31
	Bachelors degree	2	3	19	4	28
Total		4	6	29	20	59

Table 4.14 shows that the majority of the respondents, 29 out of 60 (49%) indicated that certificates of attendance were the best forms of recognition for their participation in INSETs. This was a preference of 19 (68%) degree teachers and 10 (32%) diploma teachers. Hence, it was mostly the degree teachers who indicated that certificates of attendance were the preferred mode of recognition. Slightly over half of the diploma teachers, 16 (52%) indicated that a diploma/degree award was the most preferred form of recognition. Thus there was a marked difference in preference for the form of recognition with diploma teachers in favour of diploma/degree certificates and degree teachers in favour of certificates of attendance. The diploma teachers' preference may have arisen out of the desire to upgrade to higher qualifications through in-service education and training.

However, face-to-face interviews with the teachers revealed that the majority of them preferred to receive a certificate of value. They pointed out that certificate would have the value if promotion to higher grades, added advantage to further studies, and incremental salaries were attached to them. These teachers further pointed out that certificate of attendance would show their achievements in life. One of the teachers said: "... certificates give light to future opportunities" (3b).

According to Maslow (1989) recognition is one of the self-esteem needs of humans and hence a motivating factor. According to Herzberg's Two-factor theory, recognition is a critical factor leading to extreme satisfaction. That is, recognition is one of the most important motivators or satisfiers (Cole, 1996). Hence, a certificate of attendance as a form of recognition was critical for the success of INSETs and would ensure that teachers were motivated to participate in INSETs activities

(e) Nature of INSET: Voluntary or Compulsory

Respondents were asked to circle whether they wished their participation in INSETs were compulsory or voluntary. Figure 4.11 illustrates the preferences by teachers.

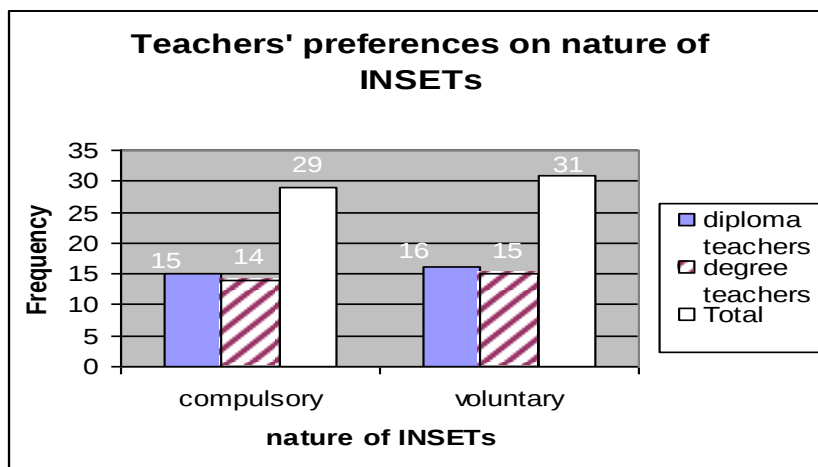


Figure 4.2 Teachers preferences on nature of INSETs

Slightly over half of the respondents, 31 (51.7%), indicated that they preferred voluntary participation while 29 (48.3%) preferred compulsory participation. Thus, the teachers were almost equally divided over the nature of INSETs. There was also an almost equal split among teachers of different qualification. For example, 16 of the 31 diploma teachers preferred voluntary INSETs to compulsory INSETs while 15 of the 29-degree teachers preferred voluntary INSETs to compulsory INSETs.

In follow up face-to-face interviews, the majority of teachers who preferred voluntary INSETs (31) argued that teachers needed to show willingness first so that they are not a source of indiscipline in the INSET venues. Thus, to get their full participation, INSETs ought to be voluntary. These teachers also argued that some content of the INSETs would not address some teachers' needs hence the reason to make INSETs voluntary. Only those teachers whose needs would be addressed by the INSET content would voluntarily attend them. Some of them argued that “..compulsory training was against democracy” (41b) and that “...penalties were unwarranted in effective INSETs” (2b).

The majority of the teachers (48%) who felt that INSETs needed to be compulsory argued that INSETs were of national importance hence all teachers needed to participate. The desire to improve the quality of teaching was a system need rather than an individual teacher's need hence participation in INSETs ought to be compulsory.. They cited orientation into a new curriculum as one of the key activities requiring mandatory participation. As one teacher commented “....if INSETs were voluntary, incompetent teachers would remain in the system”(31b).

The findings may suggest that certain forms of INSETs may be voluntary while others may need to be compulsory. At individual level, INSETs may be voluntary but at system level INSETs ought to be mandatory. The mandatory approach, however, requires that INSETs be treated as entitlements to teachers rather than privileges. As highlighted by ILO (1991) in-service education may be voluntary or compulsory. For instance, in-service trainings for teachers in Ireland are voluntary as well as mandatory while in

Japan, INSETs are also mandatory and in Kenya, they are voluntary. But unless there is a clear incentive for the teachers, voluntary INSETs may do great harm to the system.

(f) Inhibiting factors to attend INSETs

Teachers were asked to indicate the most inhibiting factors to their participation in in-service programmes. Table 4.15 summaries the teachers' responses.

Table 4.15: Teachers' most inhibiting factors to INSETs

Rank	Inhibiting factor	Diploma teachers	Degree teachers	Total Frequency (%)
1	No or late information about INSETs	20	18	38 (63.7%)
2	Lack of funds from school	13	19	32 (53.3%)
3	Biased recruitment process	18	11	29 (48.3%)
4	Registration restrictions	7	4	11 (18.3%)
5	Long distance to training venue	1	6	7 (11.7%)
6	Large workload	5	5	7 (11.7%)
7	Improper arrangements	4	2	6 (10%)
8	Unsuitable time of the year	3	0	3 (5.0%)
9	Lack of interest in INSETs	2	1	3 (5%)
10	Time away from work	3	0	3(5)

Table 4.15 shows that the majority of the teachers 38(63.7%) indicated that the most important inhibiting factor to their participation in INSET programmes was the lack of information. Eighteen-degree teachers (N=29) and 20 diploma teachers (N=31) circled this factor. This finding may imply that the teachers were ready to participate in INSETs as long as they were communicated to, invited and given more information about the INSETs. In this study, teachers' lack of interest ranked the last indicating that it was

not considered as an inhibiting factor at all. Hence, the majority of the teachers were interested in attending INSETs.

The inhibiting factors were essentially not only the barriers to teachers' participation in INSETs but also potential sources of dissatisfaction among teachers in INSETs. Using Herzberg's Two Factor theory (Cole, 2004), no or late information is related to contextual or environmental factors hinging on the administration of INSETs. The findings imply that adequate and accurate communication would be vital in the planning, administration, and management of INSETs.

A study by Abolaji and Reneau (1988) on agriculture teachers in Kwara State, found that lack of funds from school ranked first followed by no or late information from in-service providers. Thus the Nigerian agriculture teachers indicated that lack of funds from school and lack or late information on in-service programmes were the most inhibiting factors to their participation in INSETs. The current study found similar results except the ranking being interchanged. The variation in results may have been due to differences in the geographical position and subject matter being studied as shown by Washburn (2001).

(g) Elements of INSETs determining teachers' attendance

Teachers were also asked to circle all the major deciding factors for determining whether or not to attend in-service programmes. Table 4.16 summarises the findings.

Table 4.16 : Deciding factors for teachers' attendance to INSETs (N=60).

Rank	Determining factor	Number of teachers in favour		Total
		Diploma teachers	Degree teachers	N (%)
1	Content or topic of the INSET	17	18	35 (58.3%)
2	Graduate credit value of INSETs	10	10	20 (33.3%)
3	Recognition of certificates by employers	11	8	19 (31.7%)
4	Location or venue	10	4	14 (23.3%)
5	Allowance or stipend	8	5	13 (21.7%)
6	Instructor's expertise	6	6	12 (20%)
7	Learning methods employed	3	7	10 (16.7%)
8	Qualification of instructors	4	3	7 (11.7%)
9	Teacher renewal credit	2	4	6 (10%)

Fifty-eight percent of the teachers surveyed indicated that the content or topic of INSETs was the major deciding factor for determining whether or not to attend INSET programmes. Of these, 17 (54%) and 18 (62%) were diploma and degree teachers respectively. This finding implies that the selection of INSET content or topics was crucial to the success of and to the number of teachers participating in INSETs. Hence, needs assessment remains a vital tool to ensuring that the right content for these teachers is determined. Waters and Haskell (1989) concur that involving learners in the process of planning an in-service education programme increases the likelihood of implementing relevant programmes.

In addition, only 13 (21.7%), indicated that INSET allowance was the major determining factors for their participation in INSETs. Ranked 5th in the list, it meant that the teachers indeed valued more the knowledge and skills from INSETs than the money paid to them in the form of upkeep allowances

Rhea (2002) also found that INSET content or topic of INSETs was the most deciding factors for the science teachers in Eastern North Carolina. The finding in this study therefore confirms what Rhea (2002) reported.

Chapter summary

The chapter has presented, discussed and interpreted the data collected from the study. In particular, the chapter has discussed and identified the similarities and differences in in-service training needs of Physical science teachers by qualification, years of teaching experience and institution from where they received their pre-service training. Then the chapter has also discussed the teachers' preferences in INSETs in terms of models of INSETs, the planning and management of INSETs.

CHAPTER 5

SUMMARY, CONCLUSIONS AND IMPLICATIONS

Chapter overview

The chapter presents four main areas of focus. First, the chapter summarises the main findings from the study. Then the chapter gives the implications of the main findings. Thirdly, the chapter offers recommendations for practice and further areas of research on the topic. study the summary of the findings, the conclusions and implications drawn from the study's findings. Finally, the chapter gives a justification for the study and how the results from the study contribute to the body of scholarship on the topic.

5.1 Conclusions from the study

This study assessed the in-service training needs of Physical Science teachers in CWED by highest qualification, teaching experience and institution from they obtained their highest qualification. The findings in this study indicated that Physical Science teachers in CWED were not a homogeneous groups in terms of highest qualification, teaching experience and institution from they obtained their highest qualification. However, this study found that Physical Science teachers in CWED, tended to have in-s

ervice training needs in many professional competencies, irrespective of their highest qualification, institution from where they graduated and their years of teaching experience. Their high in-service needs were in the six dimensions of management of Physical Science instruction, generic pedagogical knowledge and skills, knowledge and skills in Physical Science as a subject, administering Physical Science facilities and equipment, integrating multimedia technology in Physical Science teaching and use of ICT in Physical Science. However, the seventh dimension that investigated teachers' competency in diagnosing and evaluating students was not indicated as high in-service need dimension by all categories of teachers. For instance, competencies under this dimension: assessing student laboratory work (B5) and assessing/evaluating student performance (B10) generally had low MWDS (less than 3.4) indicated by many categories of teachers

This finding justified the need for in-service training as a seamless component of teacher education and professional development to ensure the presence of effective Physical Science teachers in the system. As advised by the national Academy of Science (2005), becoming an effective science teacher is a continuous process that stretches from pre-service experiences to the end of the profession. That is effectiveness in the teaching profession requires that learning for the teacher is life long. This finding confirms arguments put forward by Wood (1983) and Lowethaw (1980). Wood (1983) reported that preservice education by itself is not enough and not a guarantee of teacher effectiveness since knowledge and skills depreciate appreciably after the time of qualification. Lowethaw (1980) concluded that preervice training is never conclusive in

all the information, skills and attitudes teacher required for objective practice. As such, Physical Science in CWED, irrespective of category, needed regular and systematic in-service training to complement preservice education as well strengthen the already acquired knowledge, skills and attitude, thereby improve their effectiveness. Noh et al. (2004) concurs that Science content and instructional methods rapidly evolve and widen thereby demanding teachers to continuously update and keep themselves current through INSETs.

Secondly, the total number and type of professional competencies with high in-service training needs were to a larger extent different for the different categories of Physical Science teachers in CWED. That is the results indicated that the in-service training needs of Physical Science teachers in CWED depended on the years of teaching experience, qualification and training institutions. Researchers such as Layfield and Dobbins (2002), Washburn, et al. (2001) found that the in-service training needs of agriculture teachers vary with teaching experience. Thus the results in this study are consistent with those researchers' findings. In addition, the findings in this study support Huberman (1995) Stage theories of teacher professional development, which argue that teachers at different stages of their career possess different strengths and weakness hence different in-service training needs. However, the results implied that there was a need for differentiated INSETs to cater for the different categories of teachers. That is, there was a need to develop different INSET content for the different categories of the teachers so that INSETs meet teachers at the points of their need and consequently become effective.

Thirdly, although the number and type of professional competencies with topmost priority needs varied from the different categories of teachers by years of teaching experience, qualification and training institutions, there were few common professional competencies within each categories of Physical Science teachers. For example, teaching special needs students and repairing laboratory equipment were indicated as common high in-service need competencies by all categories of teachers. This finding may have indicated that pre-service teacher training programmes lacked courses to equip teachers with such competencies. Or indeed, competencies were some of the emerging issues in the teaching of Physical Science being implemented after qualification. Teaching special needs was also reported by Layfied and Dobbins (2002) and Garton and Chung (1996) to be a problematic common area to beginning and experienced agriculture teachers in the states of Missouri and South Carolina in the US. The finding had therefore implication on the preservice training curriculum-that the Physical Science teacher education curriculum needed to be reviewed regularly to accommodate the common incompetencies indicated by the teachers. Additionally the finding imply that there is a need for preservice training institutions to establish lifelong relationships with their teachers so that they adequately prepare future teachers. This would likely assist the institutions to learn more about the gaps and indeed the effectiveness of their programmes.

Again based upon the stated research problem and the purpose of this study, the following specific conclusions can be drawn regarding the in-service training needs of Physical Science teachers by their highest qualification. The study found that in-service training needs of degree holding Physical Science teachers generally varied in number

and type of competency with their years of teaching experience. While the 1-3 years degree teachers identified 13 of the 40 competencies, the 4-6 and 7-18 years categories identified 3 of 40 and 19 of 40 professional competencies as having high in-service training needs. Although the in-service training needs of the degree teachers varied with their years of teaching experience, further analysis found that all the degree teachers indicated high in-service training needs in four competencies of teaching special needs students (B23), repairing and reconditioning laboratory equipment (B21), teaching public issues about Physical Science (B33) and using multimedia equipment in Physical Science education (B32). These competencies were under the broad dimensions of managing Physical Science instruction and generic pedagogical knowledge and skills. This may indicate that there is also need to provide in-service education to degree Physical Science teacher despite their rigorous training and high qualifications. As highlighted by Wood (1983), pre-service teacher education by itself is not enough and not a guarantee of teacher effectiveness. Effectiveness requires that teachers are life long learners (Halim, Osman and Meerah, 2000).

The study found that diploma Physical Science teachers also indicated high in-service needs in a number of competencies which varied with the teachers' teaching experience. Thus, while supporting the Stage theories of teacher professional development, results indicated that in-service education was also needed by the diploma Physical Science teachers in CWED for them to be effective professionals and deliver quality science education. However, it was found that all the categories of diploma teachers indicated high in-service training needs in teaching chemistry topics (B13), teaching special needs

students (B23), repairing laboratory equipment (B21), using multimedia equipment (B32) and using computers (B37). On the one hand, this may indicate the incompleteness of the pre-service training curriculum and on the other hand it may indicate the slowness of the Malawi's education system to orient teachers to emerging issues such as teaching special needs student within the Education For All (EFA) framework.

The study investigated the differences and similarities in the in-service training needs of diploma and degree Physical Science teachers. Analysis of data revealed that half of the competencies indicated by the diploma teachers as having high in-service training were different from those indicated by the degree teachers. While the high in-service training needs of the diploma teachers concentrated in the knowledge and skills in Physical Science subject, those indicated by the degree teachers were mostly in the dimension of generic pedagogical skills. Thus, in-service training needs of Physical Science teachers in CWED tended to vary with academic qualifications of the teachers. This may indicate that content of in-service education needed to match with qualification of participants. That is, different categories of teachers by qualification required different in-service education content if the in-service programme is to be effective. As pointed out by Roberts and Dyer (2004), dissimilar groups of teachers have dissimilar in-service needs.

The study investigated the in-service training needs of teachers who had graduated from Chancellor College, Domasi College of Education, Mzuzu University and the Polytechnic. In this study, in-service needs indicated by teachers with the same

qualification and within the same years of teaching experience were also compared. The study found that in-service training needs of Physical Science teachers in CWED tended to vary with the training institution. However, teaching special needs students, repairing laboratory equipment and using multimedia equipment were found to be common competencies with high in-service training needs among teachers from the four institutions. This may indicate that training institutions prepare teachers differently and graduate them with different entry competencies. This also may indicate the absence of guidelines on entry-level competencies for teachers in the education system.

Physical Science teachers indicated their preferences on the models and management of in-service programmes. The teachers gave high priority to the traditional face-to-face residential workshops of 2 to 4 weeks duration held at teacher training institutions after third term with a goal to increase their knowledge and skills. The lack of exposure to other models of in-service education and influence of technology could have contributed to the teacher's preferences. Garton and Chung (1996) point out that as the resources for the traditional models of in-service education become fewer, alternative ways of providing in-service must be explored. Hence there is need to begin exploring other cost effective in-service education models.

Finally, the study found that the teachers preferred voluntary divisional INSETs with certificates of attendance of value and stipend as the best form of recognition and incentives respectively for their participation in INSETs. No or late information from INSET organisers and content of the INSET were identified as the most inhibiting and

deciding factors respectively for their participation in INSETs. This finding indicates that teachers have preferences for their participation in INSETs. Incorporating such preferences in the formulation of INSET policy is therefore one step forward to providing effective INSETs. Noh et al. (2004) contends that understanding and incorporating the needs of the target audience ensures that the programmes are not only feasible but also relevant. Table 5.2 gives a framework of teachers' preferences in in-service programmes.

Table 5.1 Framework of Physical Science teachers' preferences in in-service training programmes.

Table 5.1: Framework of INSETs preferences of Physical Science teachers in CWED.

Element of in-service training programme	Physical Science teachers' preference
Purposes	Update knowledge and skills Upgrade teacher qualifications
Goal	To increase knowledge and skills in teaching the subject
Appropriate Venue	Secondary teacher education college and universities campuses.
Best Mode of delivery	Face to face (residential) workshops
Element of in-service training programme	Physical Science teachers' preference
Duration	Between 2 weeks and 4 weeks
Best time	Summer holiday (October-December)
Structure	Organised per Education division

Form of recognition	Certificate of attendance
Form of incentive	Upkeep allowances (stipend)
Nature	Voluntary
Most inhibiting factors to attend INSETs	Lack of information about INSETs Lack of funds from schools
Deciding factor to attend INSETs	Content/topics of INSETs

The framework of Physical Science teachers' preferences in in-service training summarises what the teachers regard as critical for their participation in INSET programmes.

5.3 Recommendations from the study.

From the results of the study, it is recommended that;

- a) MoE and CWED establish INSETs as a seamless component of Physical Science teacher education and professional development..
- b) Physical Science teachers in CWED be provided with differentiated in-service education and training as a matter of priority. Different in-service content must be designed for different categories of teachers by qualification, teaching experience and institutions providing pre-service training.
- c) The in-service training needs found in this study be adopted in future in-service education programmes for Physical Science teachers in CWED. The high in-service training needs should take precedence in in-service programme planning and development.

- d) Secondary Teacher Education institutions should study how the high in-service training needs for Physical Science teachers can be addressed in the pre-service programmes.
- e) Secondary Teacher Education institutions should establish a life long relationship with their teachers to learn more about the effectiveness of their programmes.
- f) Physical Science teacher education curriculum be regularly reviewed to accommodate emerging issues, which are sources of in-service training needs.
- g) Further needs assessment studies be conducted to build a baseline of research data to validate this study.
- h) Guidelines on the entry professional competencies of Physical Science teachers be developed to ensure quality teachers enter into the education system.
- i) In-service education providers in CWED take into account of the Physical Science teachers' preferences when formulating and implementing in-service education policies.

5.3 Areas for further study.

- a) A study to assess the in-service training needs and preferences of Physical teachers in CWED be conducted targeting the in-service service providers, Education Methods advisors at divisional level, employers and secondary teacher training institutions to get a holistic picture of the needs and preferences.
- b) This study did not explore the reasons why the 4-6 year category of degree Physical Science teachers has very few competencies in which they indicated high

in-service training needs. Hence, further study is required to understand the finding for the 4-6 years category of teachers.

- c) The study has also unveiled that Physical Science teachers' competencies depended on the institution from where they received their pre-service training. A study is therefore required to compare and contrast the pre-service teacher education programmes from different institutions to better understand this finding.
- d) Considering that this study was a census survey, the results are generalizable to Physical Science teachers only teaching in CWED. Further studies are required to identify the in-service training needs of the Physical Science teachers from the remaining 5 education divisions to generate national in-service training needs and preferences of Physical Science teachers data base nationally.

Chapter summary

This chapter has presented general and specific conclusions, implications and recommendations from the results of the study. Generally different categories indicated different INSET needs, hence the need for differentiated INSETs for the different categories of Physical Science teachers in CWED. The teachers' preferences for traditional form of divisional INSETs, held at preservice training institutions after 3rd term of school indicated that the teachers needed INSETs that cemented relationship within division. This was an indication that Education Divisions be empowered to design and implement INSETs based on the needs of the teachers in the division. However, the gaps between the teachers resulted also indicate need for a participatory approach to formulating INSETs.

Recommendations such as establishing regular INSETs, regular reviews of teacher education curriculum, establishing life long relationship between teachers and training institutions have also be given in this chapter. The chapter suggested further areas of research on the topic. These included an assessment of INSET needs of Physical Science teachers as perceived by other stakeholders; an investigation into the significance of the indicated different needs of the teachers by training institution; and assessment of in-service training needs of Physical Science teachers from the remaining five institutions.

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