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**PHYSICAL SCIENCE TEACHERS' PERSPECTIVES ON INFORMATION AND
COMMUNICATION TECHNOLOGY PROFESSIONAL DEVELOPMENT IN LESOTHO
SECONDARY SCHOOLS**

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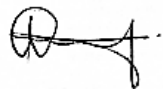
[2023]

Declaration

I, 'Maserialong Dlamini, declare that the thesis, **Physical Science Teachers' Perspectives on Information and Communication Technology Professional Development in Lesotho Secondary Schools** submitted for the qualification of Master's Degree at the University of the Free State is my own independent work.

All the references that I have used have been indicated and acknowledged by means of complete references.

I further declare that this work has not previously been submitted by me at another university or faculty for the purpose of obtaining a qualification.



07/11/2023

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Abstract

Recent studies show that integrating ICTs in the teaching and learning of Physical Science may contribute towards the improvement of learners' academic achievement. However, education systems in developing countries need help to afford educational opportunities for the 4th Industrial Revolution. Professional development programmes are essential in equipping teachers with ICT knowledge and skills for improving teaching and learning. Education reforms in Lesotho have the expectation that ICT be used to expand access to education as well as improve the quality of education. As a result, this research aims to investigate Physical Science teachers' perspectives of ICT professional development. This case study also aims to fill a gap in the research on ICT integration by giving insights into the effectiveness of the professional development of Physical Science teachers in Lesotho. Data were collected using interviews with four (4) purposely selected Physical Science teachers who had at least five (5) years of teaching experience and have been involved in at least one (1) professional development activity. The qualitative research approach located within the contours of the interpretive paradigm was employed to facilitate a more focused exploration of the research questions. The study's theoretical frameworks are Technological Pedagogical Content Knowledge and the Concern-Based Adoption Model. Data were coded and thematically analysed. The findings show that more professional development towards ICT integration is needed to ensure the provision of ICT practices in teaching activities. Teachers regard inadequate professional development toward ICT integration as the cause of unpreparedness to integrate ICT in instruction. The findings also revealed that teachers use ICTs to gather and disseminate information and rather insignificantly for effective teaching practice. The study recommends providing hands-on activities-training for in-service teachers. The study considers a well-developed professional development for in-service teachers' to be included in Lesotho Physical Science syllabus guidelines.

Key words: professional development; pedagogy; TPACK, CBAM; technology; ICT integration; Information and Communication Technology

Dedication

To my husband, Lawrence Dlamini, I dedicate this dissertation to you for the unwavering support and love that you showed our family all these years. I know beyond the shadow of doubt that I am your soul mate. To my sons and daughter, thank you for the support, understanding and your unconditional love.

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List of Acronyms and Abbreviations

BSc Ed	Bachelor of Science in Education
CBAM	Concern Based Adoption Model
DoE	Department of Education
ECoL	Examination Council of Lesotho
EU	European Union
HoD	Head of Department
ICT	Information and Communication Technology
IR 4.0	4 th Industrial Revolution
IR 5.0	5 th Industrial Revolution
LCA	Lesotho Communications Authority
LGCSE	Lesotho General Certificate of Secondary Education
LSMTA	Lesotho Science and Math Teachers Association
MoE	Ministry of Education
MoET	Ministry of Education and Training
NCDC	National Curriculum Development Centre
NECT	National Education Collaboration Trust
NEPAD	The New Partnership for Africa's Development
NGOs	Non-Governmental Organisations
PCK	Pedagogical Content Knowledge
PD	Professional Development
PGDE	Postgraduate Diploma in Education

SDGs	Sustainable Development Goals
SoC	Stages of Concern
TK	Technological Knowledge
TPACK	Technological Pedagogical Content Knowledge
TTI	Teacher Training Institute
UN	United Nations
UNESCO	United Nations Educational Scientific and Cultural Organisation

CHAPTER 1

ORIENTATION AND INTRODUCTION TO THE STUDY

1.1 INTRODUCTION

The introduction of technology in schools is a recent rudimentary research topic globally. The endeavour is to raise the standard of the learners' performance and the quality of their education. Previous studies report that Information and Communication Technology (ICT) supports teaching, transforms practices and stimulates the intellectual curiosity of the learners (Kafyulilo & Keengwe, 2014; Ottenbreit-Leftwich, Kopcha & Ertmer, 2017; Hafifah, 2020). Correspondingly, this practice moves the learners from being passive to being the builders of knowledge.

Researchers have indicated that integrating technology into classrooms contributes outstandingly to the performance of both teachers and learners (Aslan & Zhu, 2016; Hubbard, 2018). These researchers argue that modern learners are immersed in technology early in their life. Therefore, learners prefer using media and technology in almost everything. In order to keep the learners in schools, an enticing approach to their learning is required. Therefore, integrating technology into the learners' learning environments is necessary (Cha, Park & Seo, 2020; Que, 2021). The belief that ICT can augment learner-centeredness and heighten the transformation of Science teaching and instruction inculcates the need for teachers' professional development (PD) in using technology tools and skills (Kohnke, 2021). Science teachers' technological and pedagogical aptitude for ICT can be the answer to effectively integrating technology into classrooms (Healey, 2018).

However, UNESCO (2016) indicates that ICT is only the answer if the learners' needs are considered and if ICT suits their environment. Hence, scholars show that training related to ICT integration on its own is insufficient and also inefficient (Muweesi, Shizhou, Nakonde, Salome, Tomusange & Sserwadda, 2021; Ghaviferk & Rosdy, 2015; Kafyulilo & Keengwe, 2014). Technology integration in secondary schools requires enormous

support from teachers and learners to create an appropriate ICT-supported teaching and learning environment.

Researchers argue that ICT integration into the school curriculum has not received pointers toward the envisaged global gains (Kafyulilo & Keengwe, 2014; Que, 2021). The literature on this research topic has focused on Western and a few African countries, including Nigeria and South Africa. The Lesotho context still needs to be researched. In light of this observation, new research has to unpack precisely what professional learning opportunities teachers have experienced and how these opportunities have supported ICT-related teaching in Lesotho secondary schools. The present study intends to investigate Physical Science teachers' views in Lesotho regarding their experiences with ICT PD opportunities and how these opportunities have transformed their classroom experiences.

1.1.1 Professional Development in ICT integration

PD towards ICT integration may be evaluated in different ways. These include considering the teachers' determination to use ICT, the regularity of ICT use in the classroom and whether or not the learners' continuous learning is achieved (Ottenbreit-Leftwich *et al.*, 2017). Consequently, determining the benefits of ICT integration could be related to the teachers' PD opportunities that depend on how ICT is used. These opportunities should maximise the benefits of ICT use. Desimone (2011) explains that PD increases teacher knowledge and instruction leading to enhanced student achievement.

Kohnke (2021) and also Sakkoulis, Asimaki and Vergidis (2017) opine that teachers embrace technology and the subsequent digital pedagogy when they have an overall understanding of it. Many ICT activities focus on re-tooling teaching while missing the point of actively engaging teachers in the development of their own ICT skills (Starkey, 2020). However, PD needs to focus on teachers' attitudes and beliefs to enhance their competence to fully exploit technology (Rajeshwer, Narayan, Narayan & Yadav, 2021). Muianga, Barbutiu and Hansson (2019) indicate that PD establishes a rapport between teachers and learners and supports a paradigm shift from teacher centered to learner

centered instruction. Aslan and Zhu (2016) indicate that ICT-mediated instruction offers flexible and self-directed learning. Gudmundsdottir and Hatlevik (2018) and also Rajeshwer *et al.* (2021) point out that effective PD programmes entail the acquisition of ICT skills through activities that include practical sessions incorporating the use of ICT. In this regard, ICT integrated learning is not restricted to any type of technological gadget. It pertains to all contexts where the use of technology plays a crucial role in making learning more enticing, engaging, effective and efficient (Cha *et al.*, 2020; Zhang, Zhao & Cao, 2021).

Fundamental to this change is the need to equip teachers with a new set of skills required for them to use and effect successful ICT in the everyday teaching and learning process (Que, 2021). PD activities are expected to provide deep and meaningful activities situated in teachers contexts that go beyond the use of ICT gadgets in the teaching of specific Physical Science content. In this regard, teachers' beliefs and understanding of any reform are identified as imperative in influencing the implementation of this innovation, leading to the promotion of the anticipated long-lasting change in education that is intended (Sakkoulis *et al.*, 2017).

1.1.2 Teachers' technology practices

The use of technology-based instruction in education has been incorporated in education policies globally (Que, 2021; Hafifah, 2020; Maharaj-Sharma & Sharma, 2017). This incorporation hastened governments in most countries to make enormous investment in integrating ICT in secondary school teaching initiatives (Ottenbreit-Leftwich *et al.*, 2017; Kafyulilo & Keengwe, 2014). Researchers argue that teachers' digital competence may enhance pedagogy and promote increased efficiency in education (Zhang *et al.*, 2021; Blau & Shamir-Inbal, 2016; Kafyulilo & Keengwe, 2014). However, these researchers found that PD related to ICT skills offered to teachers is, in most cases, deficient. This is because educational practices still rely on textbooks and teachers as the only disseminators and providers of information (Bautista, Tan, Ponnusamy & Yau, 2015; Bautista & Ortega-Ruiz, 2015). These researchers' view is that ensuring that teachers are

adequately equipped with the 'will', the 'how' and the 'tool' competences is mandatory to ensure the success of ICT integration.

Researchers observe that few Science teachers exercise the use of computers for teaching and learning purposes, while the majority use computers for office or personal reasons (Kafyulilo & Keengwe, 2014). Rajeshwer *et al.* (2021) further observe that the majority of teachers have a good knowledge of Microsoft (MS) applications, social sites and social media platforms. However, these researchers observe that Science teachers need more confidence using technological gadgets to facilitate and support creativity and the learning of complex concepts in Physical Science. Highlighted in the Physical Science examiners report is the conceptualization of the yearly performance, which shows that the Chemistry part of the discipline is believed to be the most challenging for the Lesotho General Certificate for Secondary Education (LGCSE). The 2020 and 2021 Physical Science (0181) examiners reports note the learners' low performance in the Chemistry sub-discipline includes, amongst others, organic, inorganic and nuclear chemistry (ECoL, 2020; ECoL, 2021). These topics have troubled many teachers and learners for decades. However, in the inorganic sub-discipline there may exist topics that do not necessarily need ICT. Bhukuvhani, Zezekwa and Sunzuma (2011) explain that there is a difficulty in the methodology and approach to teaching these topics. Understanding the merits of technology integration in education would encourage teachers to work confidently and collaboratively with the learners towards the same envisaged educational goal and also towards solving this problem.

Some countries, such as Cyprus, Israel, the USA, Malaysia, Singapore and Korea have integrated ICT into their education system by introducing policies for teachers' PD on ICT (Hafifah, 2020). The need for teachers' PD cannot be under emphasised as it is a necessity to augment the work performance and motivation of teachers who are already in the field (Kivirand, Leijen, Lepp & Tammemae, 2020). Muianga *et al.* (2019) argue that some developing countries such as Lesotho and Mozambique increasingly invest funds towards the integration of ICT into the education system according to the reference in their education policies. They leave out the person factor. The observation by Muianga *et al.* (2019) is that traditional teaching and learning then take dominance in the classrooms.

The question is whether enough is done to help teachers to incorporate ICT into their everyday instruction and classroom activities. Hence this study proposes to investigate Physical Science teachers' perspectives on ICT integrated teaching PD.

Scholars acknowledge that ICT alone does not enhance the quality of education (Kihoza, Zlotnikova, Bada & Kalegele, 2016). Hence, transformational knowledge of how ICT can be used to enhance the teaching and learning processes is imperative. Effective teaching requires that teachers have both subject matter knowledge and specific skills related to the use of technology tools (Kohnke, 2021). Despite this insight, teachers' PD on pedagogical ICT skills is still neglected (Kihoza *et al.*, 2016; Muianga *et al.*, 2019). Therefore, these researchers recommend that PD training activities should have clear objectives and be executed by competent trainers.

Teacher educators from institutions of higher learning, education inspectors, education managers and national curriculum developers are together responsible for preparing and supporting the continuous PD of teachers. It is also of paramount importance that pre-service teachers' educators associate with the government and schools in preparing and supporting continuous PD to prepare teachers for the implementation of ICT policy. Kivirand *et al.* (2020) and also Dillong, Chang, Rondeau and Kim (2019) indicate that involving teacher educators in curriculum initiatives may change the prospective teachers' practice to accommodate this education innovation. These researchers conclude that a lack of collaboration in relation to teacher PD in some education systems has resulted in dire teacher development activities.

1.2 MOTIVATION AND RATIONALE OF THE STUDY

The study focuses on the significance of PD for ICT integration from the perspective of Physical Science teachers. Having taught Physical Science for a long time and being a Physical Science external examiner for the LGCSE for eleven years, I realised that some parts of the syllabus are consistently problematic to most learners. The Chemistry syllabus could be more explicit and is also abstract in certain areas and hence it is not

easy for learners to understand. Visualising these concepts may help to create a graphic picture of what is conveyed.

I believe that ICT integration should provide solutions to the Chemistry ambiguity and 'abstractness' problems. Considering that there is ICT policy that commits, "*to integrate ICTs in mainstream curricula as well as other literacy programmes and provide for equitable access for students at all levels*" (Government of Lesotho, 2005: 31), prompted the study and gave rise to the need to investigate teachers' perspectives of PD on ICT integration in Lesotho secondary schools.

Koehler, Mishra, Akcaoglu and Rosenberg (2013) and also Kalanda and De Villiers (2013) opine that some teachers attribute their lack of ICT integration to their lack of training. Kohnke (2021) indicates that considering PD as a gesture of paramount importance boosts the confidence of teachers in any educational endeavour. PD offered towards any initiative enables teachers to embrace the change. Therefore, this study focuses on the answer to the question that arises: 'Is the PD for ICT integration, as perceived by Physical Science teachers, responding to the challenges in ICT integration?' The study focuses on orientations to Physical Science teaching in the 21st century. These orientations are also linked to the features conspicuous for teachers' understanding and application of ICT integration.

The yearly examiners' reports point to low performance in Physical Science arising from problems during lesson implementation, content synthesis, or both. I reckon that if learning could be interesting for the learners, then meaningful learning would take place. Research indicates that teachers' efforts to integrate ICT are significantly influenced by their confidence levels, comfort with traditional teaching methods and recollection of past teaching experiences (Maharaj-Sharma, Sharma & Sharma, 2017; Alghamdi, 2020). This study's findings should help to inform policy developers, curriculum developers, subject resource persons and school inspectors about the way teachers understand and perceive ICT integration. The study could also help enlighten as to what is necessary and prerequisite in order that the intended policy gap is filled. Furthermore, the institutes of higher learning should improve the training given to prospective teachers to suit the 21st century classroom as intended by the education planners.

1.3 BACKGROUND OF THE STUDY

Social, economic and technological changes make education and teacher PD more crucial than ever. Education systems in developing countries struggle to afford the educational opportunities suitable for the 4th Industrial Revolution (IR 4.0) (World Economic Forum, 2018) which will make it more difficult to reach the 5th IR (Sarfraz, Sarfraz, Iftikar & Akhund, 2021). Some countries have turned to ICT with a focus on the potential of these technologies to enhance access, efficiency and quality teaching and learning. This study investigates how PD in ICT integration can support educational objectives. To place the study in context, the prevailing international and local disposition towards PD about ICT use by teachers is discussed in the next section.

1.3.1 Global perspective of PD on ICT integration

Teacher PD has gathered concrete knowledge of what works towards promoting teachers' learning and what does not. Most research has revealed results showing disappointing effectiveness in PD for complementing and strengthening teachers' knowledge and instructional practice through the use of ICT (Bautista & Ortega- Ruiz, 2015). Thus, most countries consider the purpose of education in the 21st century as being to educate learners to be able to carefully analyse and creatively approach situations with competency in technological skills (Niemi, 2015; Luhanya, Bakkabulindi & Muyinda, 2017). This section discusses how the PD of teachers in other countries is implemented to cultivate the success of their education system.

The literature shows that Hong Kong, Finland, Singapore, the United States, the United Kingdom (the top performers in education) and also Trinidad and Tobago have established strong effective professional learning education systems drawing on the tenets of PD (Maharaj-Sharma, *et al.*, 2017; Bautista & Orteg-Ruiz, 2015). In Singapore, teachers engage in multiple types of activity during the time allocated towards their yearly PD entitlement (Bautista, Wong & Gopinathan, 2015). These countries consider teachers as true professionals and therefore prioritise their PD. They invest large amounts of money to undertake subject-specific PD and to provide teachers with opportunities for

network learning, thereby presenting a high quality PD with concerted sharing. Understanding the success of the strategies of these countries has the potential to inform policy developers in other countries around the world.

A report from the Federal Republic of Nigeria (2019) indicates a national policy on education and the inclusion of the ICT in the school system. The policy states that the Government should provide the necessary infrastructure and training for the integration of ICT in the school system in recognition of the role of ICT in advancing knowledge and skills in the modern world. The policy is a concession to South Africa and other African countries because they believe that a combination of education and ICT can be a powerful driver for growth on the African continent (De Santis, 2012). South Africa has also shown quite a stride in the right direction in ICT integration. The National Education Collaboration Trust (NECT) in the United Nations (UN) (2016) in South Africa initiated a project to reflect on the work done on the local status of ICT education. The report reveals slow implementation and unequal handling of resources. Padayachee (2017) observes that teachers are uncertain of the enforcement of 'e-education' due to the lack of skills and also poor infrastructure. On the other hand, Amory, Rahiman and Mhlanga (2015) show key findings that indicate that there is a need to develop the capacity of the districts to produce teacher PD services, although currently there are no guidelines in place. The researchers argue that in South Africa there is uneven distribution of ICT development opportunities, which has created a gap in the full adoption of ICT in the country. It is reported by these researchers that inadequate PD in ICT integration for use by teachers in their classrooms is often denoted by *oversold* and *underused* ICT devices (De Santis, 2012; Dlamini & Mbatha, 2018; Kohnke, 2021).

Research on PD in these countries outlines a particular approach entirely focusing on upgrading teachers' skills through training courses leading to a more sophisticated approach that takes PD as life-long learning (Bautista & Orteg-Ruiz, 2015). Hence, for ICT integration implementation to succeed, dedication has to begin with the leaders in education. The efforts towards change may require leaders with knowledge, tools and the skills to initiate this change. Evaluating the efficacy of the ICT integration implementation process from success stories on PD, may inform other countries about the clear

expectations of the UN regarding ICT implementation. Thus, the 21st century school reforms should emphasise creating learners who are college and career ready through the development of skills and understanding.

1.3.2 Lesotho ICT integration professional development

Quality education is a notable concern in developed and developing countries. As a result, individual countries focus on different aspects in an attempt to improve the quality of their education, as conceived by the UN. Countries, such as Lesotho, have embarked on a journey to enhance ICT integration, as this approach seems to be a good tool for ensuring accessible, relevant, efficient quality education in schools (MoET, 2019). The mandate emanates from the National ICT policy which highlights ICT as a set of tools that enable the country to achieve the Sustainable Development Goal (SDG) 4, as articulated in the Lesotho educational framework 2030 (UN, 2022). In the past ICT was considered a luxury in developing countries such as Lesotho. Therefore, it was never considered a viable and possible option for development (Bautista & Ortega-Ruiz, 2015). However, the UN recommends ICT as a priority for the development of poor countries and for further development in developing countries (UNESCO, 2016).

To reinforce the diffusion of ICT in developing countries such as Lesotho, the European Union (EU) devised methods to follow up on funds invested and coerced governments to embrace ICT. It was anticipated that the use of technology in schools would change teachers' practices and improve learning experiences. The policy was never an implementation priority due to a lack of PD. This paved the way for the policy to go on to school shelves. The Lesotho government has worked with non-government organisations (NGO) projects and the Ministry of Science and Technology to support ICT integration in schools. Some secondary schools in Lesotho have been fitted with refurbished computers from the Lesotho Communications Authority (LCA), as a move towards ICT integration in the curriculum.

The two projects: the Survey of ICT education in Africa- Lesotho country report and the NEPAD-IPPF were launched with the intention to keep Lesotho abreast with technological

advancement and to foster economic growth. The former project was supported by Oracle and Microsoft but only operated in six (6) secondary schools (Isaacs, 2007) where ICT was fully established. Lesotho then embarked on computer education as a subject in certain schools (MoET, 2004).

Around 2012, Computer Education was offered by all the schools and it was also examinable in some schools. However, the main objective of the policy was to enhance the provision of quality education in schools through ICT applications and the use of the internet (Isaacs, 2007) which had not been met through computer skills education. Kalanda and De Villiers (2013) and also Lisene and Jita (2018) show that Lesotho experiences a low ICT-integration rate. Scholars have pointed out that investing in the PD of teachers is the most prominent gesture for the improvement of both the teachers' competencies and the learners' performance (Muianga *et al.*, 2019; Kalanda & De Villiers, 2013; Bautista & Ortega-Ruiz, 2015). Therefore, governments have to pursue the PD of teachers to ensure relevant knowledge and ICT skills are imparted so that teachers can be aware of these innovative teaching strategies that can re-energise teachers' creativity.

The barriers that can prevent teachers from using ICT in Science classrooms include access to technological devices, time and support through PD, resources, attitudes, beliefs, practices and resistance (Muianga *et al.*, 2019). These barriers apply to Lesotho and the trend is similar to this in other developing countries. Kalanda and De Villiers (2013) and also Lisene and Jita (2018) explain that Lesotho Physical Science teachers are reported to have limited use of ICT for teaching. This problem is related to a lack of support as well as lack of knowledge and skills in ICT implementation. This implies that technology alone is not a remedy for an ineffective education system. Therefore, teachers have to be adequately trained to be knowledgeable and adequately skilled to use ICT to teach specific subject content. Another barrier is access to computers. In some schools, where computer labs are available, only certified personnel are allowed into the computer rooms. Thus, if one does not have a laptop, one cannot use ICT effectively and competently to teach Physical Science. Moreover, the lack of Wi-Fi in schools has resulted in the use of smartphones as the only technological gadget at the disposal of teachers and learners.

Atibuni and Olema (2017) posit that many curriculum reforms in Lesotho have been unsuccessful. They conclude that the implementation of these reforms is ineffectual due to teachers' unpreparedness. Dillong *et al.* (2019) and also Wakefield, Tyler, Frawley and Dyson (2018) advise that teacher education providers should embrace PD for teachers as this can improve the success of the education policy. Teacher educators are involved only to a minimal extent in developing countries such as Lesotho in curriculum reform preparation (Schleicher, 2016). Researchers regard the limited involvement of education providers in the provision of adequate PD for teachers to be responsible for producing incompetent teachers (Kaya & Godek, 2016). For the successful implementation of the education policy, the teachers should be exposed to PD towards any invention to be enacted. Seemingly, due to the contextual challenges experienced differently by different countries, not all the countries document success stories in education reforms (Atibuni & Olema, 2017; Alvior, 2015).

The integration of innovative technology in schools is a complex process. Its success depends on the involvement and readiness of the teachers to implement it (Blau & Shamir-Inbal, 2016). However, many previous studies on ICT integration do not focus on ICT integrated learning in developing countries with limited infrastructure, a dearth of educational resources and unskilled teachers (UNESCO, 2016; Cha *et al.*, 2020). Given the significance of PD as an essential part of enhancing teachers' competencies in integrating ICT in their practice, teachers continue to hesitate, aspire and struggle to adopt technology after being engaged in PD activities. Hence, this study intends to investigate Physical Science teachers' perspectives of PD on ICT practice or activities.

1.4 PROBLEM STATEMENT

The literature reviewed for this study shows that ICT in education activities enhances the learners' performance and results in quality education. However, in this study the researcher argues that in Lesotho, the context in which Science teachers view their PD towards ICT integration influences achievement of quality education. The LGCSE Physical Science syllabus indicates that learners should demonstrate knowledge and understanding of scientific and technological applications with associated social,

economic and environmental implications. The syllabus intends to produce learners who are efficient members of a technological society (MoET, 2019). However, this syllabus can be considered as an inhibiting factor since it does not provide any guidelines on ICT integration. It puts teachers at liberty to either use or not use ICT.

The absence of guidelines for PD implementation that specify how Science teachers could use ICT, promotes the teachers' regression into their comfort zones and traditional teaching. The deployment of PD leaders, with no expertise in the specific discipline or subject, by the Department of Education (DoE) to train teachers to integrate ICT activities into teaching, poses the problem of not achieving the set objectives. The devaluing of teachers may impede the ICT activities in PD (Bingimlas, 2009; Tam, 2015). Zhao (2013) and Zhang *et al.* (2021) assert that PD that targets specific teacher needs and is facilitated by other teachers who are subject experts, increases practical and critical reflection. However, there is lack of data pertaining to teacher perspectives about ICT activities in subject specific PD activities.

Research on the PD of teachers may help develop better guidelines to assist teachers to practise using ICT tools to teach critical subjects such as Physical Science. Previous studies have considered the depth and breadth of the actual use of technology tools and skills without the context of PD (Kalanda & De Villiers, 2013). This is a significant research problem to address, as the initiative towards ICT integration can only be successful if teachers, the lead role players, are trained to enhance their professional self-efficacy (Blau & Shamir-Inbal, 2016). Therefore, Science teachers have to ensure that the training is clearly defined, addresses and matches teacher and learner needs so as to address the intended objectives (Guskey, 2014). The skills acquired through PD instil confidence which facilitates effective teaching as teachers become more knowledgeable.

Maharaj-Sharma *et al.* (2017) find that the personal beliefs and general perceptions that teachers have influence teachers' ICT integration efforts. They find that personal factors such as attitude, motivation and confidence are crucial considerations for teachers in their decisions to integrate technology in their classroom activities.

1.5 RESEARCH QUESTIONS

The main question for the study emanates from the influence provided by the provision of PD for the teachers on ICT integration in their teaching activities in other countries. The study proposes to address this main question:

What are Physical Science teachers' perspectives on PD activities on ICT integration in Lesotho?

The subsidiary questions of the study are:

- How do Physical Science teachers perceive the effectiveness of professional development on ICT?
- What are the views of Physical Science teachers in terms of their preparedness to integrate ICT into their everyday instruction?
- How can the perspectives of Physical Science teachers on professional development be understood and explained?

1.6 RESEARCH AIMS AND OBJECTIVES

The main objective of this exploratory study is to investigate Physical Science teachers' perspectives on the PD activities on ICT integration in Lesotho secondary schools.

The secondary objectives of the study are:

- To investigate the effectiveness of PD on ICT as perceived by Physical Science teachers.
- To determine the views of physical science teachers towards their preparedness to use ICT during instruction.
- To figure out and describe the perspectives of Physical Science teachers on ICT professional development.

1.7 SUMMARY OF THE THEORETICAL FRAMEWORKS

A theoretical framework precludes as a guide on which to build and support a study (Grant & Osanloo, 2014). It maps a way for the researcher to conduct research appropriately. For the purpose of this study two frameworks are employed. The Concern-Based Adoption Model (CBAM) proposed by Hall and Hord (1987) is adopted for understanding the teachers' concerns with regard to the change process in education (Paramasveran & Nasri, 2018; Roberts, 2015). 'Concern' is an important element considered to bring appropriate interventions which are the key to success of the anticipated change. Sardoc (2018) indicates that in an initiation of any educational change PD is important in effecting change in classroom activities, attitudes and beliefs.

The Technological Pedagogical Content Knowledge model (TPACK) is used because understanding the content and technology is fundamental to the teachers for ICT implementation (Koehler & Mishra, 2008). This framework was used in studies interested in ICT integration in different subjects. In particular, in this study TPACK is used to examine whether the PD of Physical Science teachers enables effective ICT integration in instruction.

1.8 SUMMARY OF THE METHODOLOGY

Methodology refers to the practical '*how*' a researcher orderly designs a research study (Jansen & Warren, 2020). This research is a qualitative case study. The aim of the research is to investigate Physical Science teachers' perspectives on PD towards ICT integration. A case study approach is used in this study to allow an in-depth exploration of the research question so as to elicit rich data (Gustafsson, 2017). Bhandari (2020) opines that an approach involving a case study develops a comprehensive understanding of the phenomenon.

The research population comprises Physical Science teachers in Lesotho secondary schools. Each of the four teachers from different secondary schools is considered as a distinct case. Data was gathered in three sets.

The first part of the data was gathered through semi-structured interviews. The second set was gathered through lesson observations and the last part of the data was obtained from an analysis of lesson plans, scheme and records of work. Using different methods to collect data on the same subject improves the credibility and validity of the results (George, 2021). The data generated from transcripts of the interviews were thematically analysed. The outcomes were then compared to find the similarities and the differences between the four cases.

1.9 THE VALUE OF THE STUDY

Rajeshwer *et al.* (2021) and Kalanda and De Villiers (2013) assert that the unwavering integration of ICT may enhance Science teaching and learning. Application of knowledge and skills of ICT in everyday teaching requires a purposeful positive perception towards teaching with technology tools. Some teachers attribute their lack of ICT integration to lack of training (Koehler *et al.*, 2013). This shows that teachers regard their PD as the fundamental integral part of their professional growth and may change their attitude and confidence towards the use of technology. Changing teachers' attitudes and concerns about the use of ICT in Science classrooms may require a sense-making process of teachers as the executors of the ICT prescriptions (Blau & Shamir-Inbal, 2016). Hence, PD of teachers is crucial to effect any changes in classroom activities.

The literature focuses mainly on the challenges teachers encounter in implementing ICT-integration. A few studies were found about developed countries that mainly focused on PD on ICT-integration. Studies found in Lesotho on ICT integration are inclined towards the teaching of Physical Science, Biology, and technical subjects. However, none of them focused on the perspectives of teachers on PD towards ICT integration. The present study intends to close this gap in the existing literature and to contribute to the body of knowledge by seeking information on the perspectives of Physical Science teachers on PD towards ICT integration in Lesotho. The ICT policy clearly dictates that educational institutions are responsible for contributing towards advancing the teaching and learning systems through the use of ICT so as to achieve quality education (Lesotho Government, 2005).

This study aspires to discern whether Lesotho Physical Science teachers are competent to use ICT and to take advantage of the benefits for their everyday teaching activities. The current study may present crucial information concerning the current PD status of the teachers as reflected in their perspectives. The research may serve as an eye opener for the authorities in the DoE and the NCDC to revise the formulation and the execution of PD towards ICT policy. Additionally, the findings of this study may convey the relevance of PD to NGO to be able to support training sessions financially. Furthermore, teachers of different subjects may benefit from the study if the PD procedures are improved to suit their teaching content. Prospective teachers may benefit if the induction programme is revived and used as a platform to help novice teachers with technology incorporation in teaching and learning activities.

This study may highlight insights about the relative importance of PD, the teachers' views and the challenges of PD implementation towards ICT integration through the lens of Physical Science teachers. The study may further inspire future researchers to look into PD as a matter of concern from different perspectives such as the use of quantitative methods since this study will only follow qualitative research methods. The recommendations from the study may contribute towards constraining some of the difficulties encountered with the adoption of the ICT policy (2005). The study may also facilitate my own personal growth and ultimately change my attitude towards ICT and my teaching strategies as an experienced teacher. Individual schools may also empower their staff (school-based professional development) for the improvement of the teaching and learning environment.

1.10 DEFINITION OF TERMS

Concepts or terms used in the title of this study are defined or described to help the reader understand the study. In the context of this study,

ICT (Information and Communication Technology) refers to electronic devices used in teaching and learning processes.

ICT is defined by Agabi, Agbor and Ololube (2015:107) as the application of technology, particularly in schools, which influences teachers and learners to accelerate accomplishment of educational objectives. ICTs expose information by using computer and internet-based technologies to augment improved education through informal and formal instructions. The use of ICT interconnects areas such as home, school and work, where learning occurs. On the other hand, Alshmrany and Wilkinson (2017:143) argue that ICT signifies a different set of technological tools used to create, broadcast, store and manage information. ICT is also defined by Razak, Habibah and Ismail (2019) as the communication tools and web-based systems to support teachers in the teaching process for acquiring and creating knowledge. As a researcher I therefore propose my definition of ICT in the context of this study as: The use of technological tools to update teaching and learning and to enrich lessons through access to a variety of online educational resources.

Integration is defined by *dictionary.com* as an act of combining into an integral whole. Therefore, for the purpose of this study.

ICT Integration refers to the use of ICT resources for teaching and learning by incorporating them into daily classroom activities (Agabi *et al.*, 2015).

Professional development: Malik and Shafeeq (2016) refer to professional development as a variety of specialised training intended for improving teachers' professional knowledge, competence, skills and effectiveness. With the ever growing and changing technology, teachers face daily challenges and responsibilities in their teaching profession. A teachers' one-time workshop is not enough (Malik & Shafeeq, 2016). Professional development should therefore provide several educational programmes related to an individuals' work.

Physical Science is a discipline that consists of Physics and Chemistry. It enables and promotes the use of scientific processes to promote understanding of the world and natural phenomena (ECoL, 2012).

1.11 STUDY OUTLINE

The study is organised according to the following structure:

Chapter 1: Provides a general overview of the study, that is, it is about the orientation and background of the study. It also presents the research problem, research question and research aim and objectives.

Chapter 2: Presents a literature review as well as theoretical frameworks that guide the study.

Chapter 3: Deals with research design and methodology to be followed in the study. The measures of trustworthiness and ethical considerations are also discussed.

Chapter 4: Reports on the perspectives of Physical Science teachers on ICT professional development and analysis and interpretation of data. The chapter includes comparisons of the findings with the literature.

Chapter 5: Presents a summary of the findings, conclusions, recommendations and suggestions for further research.

1.12 ETHICAL CONSIDERATIONS

Babbie (2014) explains that ethics gives an account of the general agreements shared by the researchers who engage in a scientific inquiry. They point at what is appropriate and what is inappropriate in research undertakings. Therefore, the responsibility of the researcher is to take into account the effects of research on the participants and to act in a manner to preserve their dignity as humans (Trochin, 2022). Ethical clearance was applied for from the University of the Free State. Permission to conduct the interviews in schools was sought from the MoET. The participants were made aware of the intentions and objectives of the study so as to build rapport. The principle of voluntary participation was applied and all the participants had to sign a consent form to show their willingness to participate. Participants were made aware that they could leave the study at any point if they felt uncomfortable. Privacy and confidentiality of the participants was observed.

1.13 LIMITATIONS AND DELIMITATIONS

1.13.1 Limitations

The limitations for the study are the subject observed and the duration of the study. The study is limited only to Physical Science. It would be interesting to see the results from a similar study conducted for other secondary school subjects such as mathematics. The duration of the study was also limited. The research was conducted within a time constraint. Data were gathered on certain days within two weeks.

1.13.2 Delimitations

Geographically, Lesotho is demarcated according to three regions: the highlands, lowlands and the foothills. The three regions are inhabited by different human settlements with different economic prestige. The teachers used in this study are exposed to different types of ICT tools and have access to free Wi-Fi. In contrast, there are those teachers working in the same district but living in the rural areas. The teachers in the rural areas are disadvantaged because their schools are not connected to free Wi-Fi and have little internet access (Habibi, Razak, Yusop, Mukminin & Yagin, 2020), necessary to inspire them to use ICT in their teaching instruction.

The study required that the four Physical Science teachers from the Maseru district be interviewed. In this way the qualitative data would be obtained from teachers from the same background with the same socio-economic status. It would have been ideal to collect data from different geographical regions of the country to get different perspectives on the research problem. This would help identify different ICT integration constraints. However, poor ICT tools and connectivity in some areas of the country led to a focus on schools in the town. The findings of the study cannot be generalised to all Lesotho secondary schools.

1.14 SUMMARY OF THE CHAPTER

In this chapter the reasons and central issues around the need for this research are discussed. The chapter outlines the problem statement, the research purpose and the significance of the research, also research questions, aims and objectives, as well as the methodology chosen to follow to reach the desired outcome. The chapter indicates that technology is a concept that is quite familiar in the sphere of teaching and learning. It points out that most studies focused on the use of ICT to enhance education and learners' performance. The question asked is whether Physical Science teachers' perspectives on ICT professional development can provide new insights into the successful implementation of the ICT Policy (2005) in Lesotho secondary schools. The relevant theoretical frameworks that guide the study, the value of the study, the delimitations and ethical considerations are discussed.

The next chapter reflects on ICT integration, the benefits of ICT integration, as well as the need for PD towards ICT integration. This is achieved by a review of international and national literature on the topic researched.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

The advances in technology have made a tremendous impact on the way people live. Throughout the world education systems are making efforts to incorporate ICT into the teaching and learning process (UNESCO, 2014). To this end, considerable research has been conducted (Kohnke, 2021). Recommendations from this body of research highlight the importance of teachers' PD in order to enhance the teaching and learning process (Yang & Hong, 2022). However, research has hardly investigated the perspectives of teachers regarding PD towards integration of ICT into teaching and learning. Therefore, this study explores the perspectives of Physical Science teachers regarding incorporating ICT in teaching instruction. To achieve this it is necessary to consider and explain the important theoretical concepts of ICT integration with reference to both national and international literature. Exploring the sources in this context should provide the necessary knowledge base to help address the research question.

This chapter provides thorough descriptions of the following concepts or components established in previous studies on the title of this study:

- Integration of ICT in teaching and learning
- The theoretical framework perspective of ICT integration
- Teacher professional development
- The CBAM framework for teacher professional development

A comprehensive review of the above components may provide clarity on ICT integration and the requisite PD for teachers. The focus of the review is directed towards the diffusion of ICT integration into classrooms. Yang and Hong (2022) indicate that the use of technology is extensively recognised as a requirement and an opportunity for improving the quality of education. Considering ICT has put learning in the hands of the users. However, some countries are grappling with the implementation of ICT. The advantages and challenges are discussed in the next section and there is an attempt to link the facts

of contextual, theoretical and conceptual frameworks for a broader understanding of the research problem.

2.2 INTEGRATION OF ICT IN TEACHING AND LEARNING

ICT integration in the process of teaching and learning earns significant consideration globally (Jogezai, Ismail & Baloch, 2018) for attempts to achieve meaningful teaching and learning processes. There are two common research concerns about how teachers view technology. Researchers have investigated the level of ICT integration proficiency with a few studies examining the changes in aptitude over time. Recent research has found that using ICT in the classroom is an essential part of teachers' pedagogical practice to develop 21st century competencies (Blau & Shamir-Inbal, 2016; Kohnke, 2021). These researchers indicate that teaching skills such as critical thinking, creativity, collaboration and communication require consideration about teaching instruction needed to meet this educational shift. However, they conclude that evidence of ICT transforming education is minimal, as it is not yet entrenched in the teaching practice of many Science teachers. Ertmer and Ottenbreit-Leftwich (2013) suggest that to transform education with ICT involves consideration of how contextual, cognitive and affective factors may act as barriers to or enablers of this innovation. Attention should focus on the consequences of ICT integration and the factors that prevent successful integration of ICT in education.

2.2.1 The significance of ICT integration

The world is changing rapidly and education systems have to change with it (Alkahtani, 2017). A large body of empirical evidence shows that ICT integration in teaching and learning has been a point of discussion for many years. Researchers have shown the need for the development of ICT teaching strategies to meet a global resolution for achieving quality education (Ghavifekr, Razak, Ghani, Ran, Meixi & Tengyue, 2014; Jogezai *et al.*, 2018; Yang & Hong, 2022). Many studies have presented the advantages of using ICT in teaching practice and especially for teaching Science. Hu, Yuan, Luo and Wang (2021) and also Ghavifekr *et al.* (2014) indicate that when used in instructional

activities, ICT can provide an attractive and relevant learning experience for learners. Nowfeek, Farwis and Nowzath (2021) show that ICT has made a great contribution to education in Sri Lanka where the motivation of learners increased due to multimedia capabilities such as visual aids, including audio and video. Many educational systems put forward through their educational policies the need to integrate ICT in teaching strategies to promote effective teaching and learning.

Technology is widely used for preparing learners for life in the 21st century, so that they are readily face the future with the competences needed for globalisation (Ghavifekr *et al.*, 2014). The skills required include, amongst others, critical thinking and ability to solve the problems of communication and collaboration, information literacy and technology (Bayley, 2022). These skills can eliminate communication barriers that exist, promote learners' independence and also support learning outside the classroom. Other benefits have also been reported by Mathevula and Uwizeyimana (2014) who argue that the utilisation of ICT brings shared learning resources, shared learning spaces, collaborative learning and a move towards independent learning. The use of technological skills may help learners navigate the plethora of information at their fingertips and help them organise and make use of accurate and credible information (Ghavifekr *et al.*, 2014). When learners develop these skills they become more resourceful. The mastery of these skills boosts the motivation of learners and teachers and broadens their knowledge (Musa, Mamuda, & Kamba, 2020).

What is required is not only knowledge of how to use technology but also a thoughtful interrelationship between the pedagogy suitable for the related content, the technology suitable for a particular content and how this technology may be used to effect certain pedagogical strategies (Mishra & Koehler, 2006; Nowfeek *et al.*, 2021). ICT used in the Science classroom promotes active learning which also dictates the pace of learning with a wide source of information (Nowfeek *et al.*, 2021). Researchers show constructive results related to increased learners' interest, motivation and participation in the classroom because of the volume of information at the learners' disposal and a socially interactive educational environment that is conducive for learning. However, the increasing importance of Science education has made it necessary for teachers to have

a sound knowledge of effective instructional strategies for Science teaching. Yang and Hong (2022) insist that teacher PD has to be based on ICT pedagogical knowledge to transform teaching strategies. This basis improves the ability of the learners to compare and contrast, to use collaborative-cooperative and animated media successfully so as to construct knowledge.

In the context of teaching, ICT use facilitates teaching and learning by enabling a shift from a teacher-centred approach to a more learner-centred one because learners are allowed to compute or do things by themselves. Teachers become facilitators and do less talking allowing more time for learners' involvement. Nowfeek *et al.* (2021) found that the use of ICT afforded teachers a greater opportunity to reach the learners of different learning styles, such as those who normally get bored by the book, those who do not talk too much and those who are artistic. ICT integration therefore requires that teachers be vigilant and purposefully structure ICT integrated lessons to include artistic and tactile learners.

Yang and Hong (2022) indicate that there is less consideration from governments about the teachers' requirements for ICT competence and understanding of how to use ICT to transform pedagogies as well as the knowledge related to ICT. These scholars further point to the value of understanding teacher PD in ICT integration. Mathevula and Uwizeyimana (2014) and also Das (2019) attest that the careful training of teachers on the deployment of ICT can go a long way towards enabling teachers to utilise the limited existing resources effectively to accomplish the educational goals. However, the question is, if ICT integration is likely to show continued improvement on the quality of teaching and learning or even to show pedagogic benefits, then why has there been a slow integration of ICT in schools? In the next section the challenges or problems encountered by teachers for ICT integration are discussed considering that the study aims to also explore the factors that hinder the provision of ICT integration professional development.

2.2.2 The challenges of ICT integration

Researchers have indicated that the aim and purpose of using technology in teaching and in the learning process is to improve the quality, accessibility and delivery of education (Ismail, Jomezai & Baloch, 2020). Irrespective of the drives, initiatives and policies of stakeholders in the education department, the challenges still rest on a lack of critical strategies to harness the full potential of ICT use in education (Yalley, 2022). Teachers are expected to be able to construct and connect content knowledge with technological skills for effective teaching and learning (Malik & Shafeeq, 2016). Schools require Physical Science teachers with a sound background in both scientific content and technological skills. This brings about a challenge as to how to address the technological approach. Despite the massive benefits that ICT presents for its users, some teachers and school administrators in Lesotho are still disadvantaged (Lisene & Jita, 2018).

Review of the related studies shows that ICT use can convey lessons with interesting real-life experiences through the use of visual and audio illustrations (Alkahtani, 2017). It also helps teachers and learners communicate outside the classroom or hold tutorials online. Despite the benefits of ICT use in transforming education, it is reported that the majority of teachers adopt ICT for preparing lessons and hand-outs, keeping records and sourcing information than they do to guide learners to use ICT tools to do independent research and class presentations (Alkahtani, 2017; Sharma, 2021). The integration of innovative technology in schools is a complex process and Ghavifekr *et al.* (2014) describe the challenges that are faced by teachers on integrating ICT into the classroom as being related to resources, the level of training of the teachers and their ICT skills, personal beliefs, school culture and others.

In the light of this process, it is important that countries develop training programmes that effectively target teachers' PD and learners' learning needs (Aljassar & Altammar, 2020; Blau & Shamir-Inbal, 2016). For example, the use of digital simulations as a specific application of ICT may enhance exploration and investigation of phenomena which are difficult to handle, either too fast or too slow for direct observation or those which use toxic chemicals (Sharma, 2021). Hence they bring the world 'to the learners' finger tips'. However, Hernandez (2017), Ghavifekr and Rosdy, (2015) and Zhang (2013) show that

teachers' acceptance and use of ICT in the classrooms is still low. Musa *et al.* (2020) and Ramorola (2013) indicate that the efficiency of ICT integration depends on the teacher's abilities, attitudes and beliefs. This indication shows the barrier of implementation to be the teachers' beliefs and readiness to use ICT in their classrooms. Alkahtani (2017) corroborates that the fear of losing influence over the values and direction of classroom activities leads to resistance towards the acceptance of ICT. The relationship between competency and confidence may reflect the balance between training and pedagogically focused approaches in ICT integration professional development. Teachers with little experience in technology-enhanced classrooms must first gain an understanding of how the use and involvement of ICT may be integrated in their subject content teaching (Albion, Tondeur, Baruch & Peeraer, 2015).

Besides teachers' beliefs and competence as aspects leading to inefficient and insufficient ICT integration, infrastructure and the facility of ICT are also necessary (Ghavifekr & Rosdy, 2015). From this point of view, Ghavifekr and Rosdy's (2015) study in Malaysia argues that school management systems need to support the teachers' efficacy. The literature shows that this venture may help teachers replace traditional teaching methods with technology-based teaching and learning tools and facilities. On the other hand, developed countries such as China experience improved students' learning interest because their school managers believe that the professional growth of teachers is a prerequisite and they provide it (Guo & Yang, 2016). Alkahtani (2017) and Kohnke (2021) report that studies conducted in Kenya, Nigeria and Malaysian Smart Schools experience successful integration, but teachers are confronted with the challenge of time-factors and technical problems.

This is a challenge in secondary schools in most developing countries that have a dearth of resources in terms of proper conventional laboratory facilities (Mangare, Kandamali, Mushi, Ndumbaro & Muhuwa, 2022). These challenges emanate from a lack of funds for schools and make it impossible for every classroom to be equipped with a projector and for every teacher and learner to be equipped with a tablet.

Findings from a Saudi Arabian study show that in some cases only authorised personnel are allowed to use the ICT laboratory and this makes it difficult for teachers to access

information. ICT materials or tools are shared, or have to be booked (Yalley, 2022). However, they cannot be booked for several lessons in a row. The Chilean government rationed ICT tools by making them accessible only to better performing schools (Alkahtani, 2017). These findings seem to be similar to the situation in Lesotho. The schools in the countries such as the Netherlands and the United Kingdom have recognised the value of technical support for teachers in order to diffuse ICT integration in the classrooms (Yang & Wang, 2012). This shows that to implement technology use in classrooms, teachers need an insight into the technological and pedagogical role of ICT so as to use it meaningfully in their content delivery.

The use of ICT in teaching and learning, just like in any other innovation, compels teachers to acquire a new set of skills, attitudes and pedagogical approaches (Alkahtani, 2017). This supports the argument by Sarfo, Amankwah, Baafi-Frimpong and Asomani (2017) that teaching in the current century is increasingly complex since teachers find themselves trapped between interests and obligations. Thus, teachers have to adopt new teaching styles to suit the 21st century classroom. Several researchers indicate that a lack of confidence prevents teachers from using ICT in their teaching (Kohnke, 2021; Ghavifekr, Kunjappan, Ramasamy & Anthony, 2016). Adebi-Caesar's (2012) study conducted in Manya Krobo in Ghana noted that 90.7% of teachers interviewed did not receive any ICT training. These findings were corroborated by Mathevula and Uwizeyimana's (2014) study in Mopani district in Limpopo which also indicated that more than two thirds of the respondents reported to have not used ICT or do not use it regularly either due to unpreparedness, poor internet connection or lack of ICT tools. The teachers became reluctant to use ICT because they could get embarrassed when learners know more about technology than they do (Ghavifekr *et al.*, 2014). For these ICT tools to have meaning in education, teachers have to be conversant in utilising them to implement an integrated ICT lesson.

In Lesotho, there are no guidelines stipulated in the syllabus for how ICT has to be integrated into teaching practice. If relevant training is offered, this training could influence how teachers integrate ICT within the curriculum to profoundly influence learning (Hu, *et al.*, 2021). In South Africa the government partnered with NGO and established a

Vodacom Mobile Education Programme (VMEP) to boost teacher training across the country (Ayemoba, 2013; Alkahtani, 2017). The process referred to the use of technology in teaching and learning as an important issue because learning environments are affected by technology. Therefore teachers have to be life-long learners to keep themselves updated with the changes in technology and innovative instructional activities. The functional role of teachers not only requires a change in their methodological practices but also requires a change of mind involving their beliefs in the different environments where learning can be achieved. Hence it may be easier to remove or to reduce the barriers towards the meaningful integration of ICT into teaching and learning.

2.3 THE THEORETICAL FRAMEWORK PERSPECTIVE OF ICT INTEGRATION

The capacity of the teachers for ICT integration suggests that the content and the technological pedagogy are related to the framework of knowledge that has to be mastered by a 21st century teacher (Mathevula & Uwizeyimana, 2014). The TPACK model is used in the education research field as a map for understanding how technology may be effectively integrated into the classroom (Kafyulilo, Fisser, Pieters & Voogt, 2015). According to Mishra and Koehler (2006) the TPACK framework extends Shulmans' (1986) idea of Pedagogical Content Knowledge (PCK). The transition shows that there is growth and a tremendous explosion of technological devices to be used towards accessing quality education in this fast growing knowledge. Hence, teachers' competencies in knowledge accessing skills are important for them to take advantage of the technology and the vast information at the teachers' disposal.

Recent research shows that technology may play a significant role in transforming education to include more enlightened and collaborative activities (Malik, Rohendi & Widiaty, 2018). For proper and effective integration of ICT in classrooms, teachers have to understand the complex relations between the components of the TPACK model. This may guide them towards understanding how technology may be included in the teaching of Physical Science. Malik *et al.* (2018) indicate that TPACK defines the teacher's competence to facilitate learning about certain content through pedagogy and technology.

In the subsequent sections the TPACK model of ICT integration and TPACK competence for teachers will be discussed.

2.3.1 The TPACK model of ICT integration

According to Kafyulilo *et al.* (2015), TPACK comprises three core components: technological knowledge (TK), pedagogical knowledge (PK) and content knowledge (CK). Interaction between these three components results in technological pedagogical knowledge (TPK), technological content knowledge (TCK), pedagogical content knowledge (PCK) and technological pedagogical content knowledge (TPCK). These seven components make up what is called 'technological pedagogical content knowledge' (TPACK). TPACK is employed as a measure of teachers' knowledge to design specific pedagogical activities that would enhance the teaching of subject related content (Mishra & Koehler, 2006; Santos & Castro, 2021).

2.3.2 TPACK model as an ICT professional development framework

For successful PD the core elements of the framework are that PD increases the teachers' knowledge of ICT skills and their approach to pedagogy and the instructional change that could enhance learning (Niemi, 2015; Mishra & Koehler, 2006). TPACK was proposed by Mishra and Koehler in 2006 to deal with the challenges of ICT integration (Koehler & Mishra, 2008). This study specifically focuses on teacher understanding of ICT use for specific pedagogical activities that enhance the teaching of a specific subject matter (Mishra & Koehler, 2006). TPACK has been largely regarded as a PD framework for facilitating pedagogical practice towards ICT integration (Koehler & Mishra, 2008).

The TPACK model is regarded as a framework that creates a relationship between teachers' contextualised content, pedagogy and technology to achieve successful classroom content delivery (Koehler, Mishra, Kereluik, Shin & Graham, 2014). The study employs this framework because of the implication that teachers' understanding of technologies and pedagogy are both important for ICT implementation when teaching the

subject content (Mishra & Koehler, 2006). This framework is then suitable for investigating teacher instructional knowledge in the technological era.

The different aspects of TPACK demonstrate the relationship between the use of technology, content and pedagogy (Malik *et al.*, 2018). Significantly, their blending is crucial for a better understanding of the interaction between technology and pedagogy that should develop new forms of PD. An understanding of the core components of TPACK is important. They are explained below:

Content knowledge (CK): The question: What is your knowledge of the subject? Implies that the teacher has to know the depth and breadth of the subject content.

Pedagogical knowledge (PK): What are the innovative teaching strategies that teachers need to meet the learners' needs and requirements of the subject? Pedagogy refers to the interactions between teachers, learners and the learning environment (Santos & Castro, 2021). Thus, learning depends on the pedagogical approaches that the teachers use.

Technological knowledge (TK): What digital tools are appropriate and available to use? Is the teacher competent enough to use these tools? The teacher has to use tools that need to be well known and the most suitable for the lesson at hand.

Considering the requirements of the three components of TPACK, the focus has to be on where they intersect to consider the relationship between them. This in turn gives rise to:

Pedagogical content knowledge (PCK): This component results in understanding the best practices for teaching a particular specific content. It includes finding a common ground for best instructional strategies.

Technological content knowledge (TCK): Knowing how to use ICT tools to enhance content delivery during the lesson.

Technological pedagogical knowledge (TPK): This intersection considers comprehension of how to use the technology as a mode designed to achieve the learning outcomes.

Brought together the components extends Shulman's (1986) idea of pedagogical content knowledge and introduces the **Technological Pedagogical Content Knowledge (TPACK)**.

TPACK endeavours to explore the nature of knowledge required by teachers for ICT integration in their teaching. Teacher understanding of technology is crucial for ICT integration in the classrooms (Yang & Hong, 2022). Incorporating technology in the classrooms is believed to change how specific content is taught and understood. Lack of a 'TPACK sense' keeps technology separated from daily teaching and learning. Some researchers have argued that understanding pedagogy is critical because it determines how teachers implement ICT in their everyday teaching (Yalley, 2022). This shows that the non-inclusion of ICT programmes in the teacher training curriculum may be another challenge facing the adoption of ICT.

Technology is needed to redress some of the problems encountered by learners. However, the central argument remains with a particular teacher and requires the best strategies for teacher PD in ICT. Therefore, Kafyulilo *et al.* (2015) and Healey (2018) argue that a single technological solution will not apply to every teacher or for every lesson. Teachers should draw on a particular ICT solution for their specific context and then adjust it to develop their own understanding between content, pedagogy and ICT. They should then develop their own strategies appropriate to their classroom context. To achieve this, Malik and Shafeeq (2016) suggest that teachers need training in technical skills and PD to improve the teaching and learning process through the use of ICT tools. In as much as there is an urgent need for ICT PD for teachers, the literature tends to disapprove of existing PD.

2.4 TEACHER PROFESSIONAL DEVELOPMENT

Professional development is significant in promoting change in schools. Teachers themselves have spent years of their education in traditional teaching. Consequently, their experiences as learners have been imprinted in their minds and as a result shape their everyday teaching (Dlamini & Mbatha, 2018).

Malik and Shafeeq (2016: 454) define professional development as “...a variety of specialised training, formal and informal education and advanced professional learning intended to help administrators, teachers and other educators for improving their professional knowledge, competence, skills and effectiveness.”

The PD that is intended to facilitate change should be teacher specific and focus on the day-to-day teaching and learning experiences in classrooms (Dlamini & Mbatha, 2018). The use of ICT and the evolution of online learning environments provide an opportunity to innovate and reform teacher PD (Ayemoba, 2013; Khaliq & Baig, 2018). ICT allows for the accessibility of knowledge and proficiency, both of which were previously unavailable, enabling new relationships and new models for PD.

ICT integration can afford multiple kinds of interaction leading to inquiry, collaboration, negotiation and problem solving within realistic contexts (Malik & Shafeeq, 2016). One of the advantages of ICT-related PD is that it can support teachers’ reflections of the old ways of teaching. Therefore, in order for teachers to learn how to integrate ICT into their teaching content they need to be provided with enough time and support and be removed from their familiar surroundings and circumstances. The affordability of ICT requires that technology be driven by the needs of education hence teacher ICT integration PD is discussed in the next section.

2.4.1 Teacher Professional Development for ICT integration

Innovative pedagogical practice using ICT has been researched and practised in other countries’ (developed and developing) education systems for over two decades (Albion *et al.*, 2015). Ertmer and Ottenbreit-Leftwich (2013) show that in order to transform traditional education into 21st century education the contextual, cognitive and affective factors which may act as barriers to ICT integration have to be addressed. These factors are inadequate to explain why the majority of teachers have not demonstrated successful ICT integration.

Teacher quality significantly affects the accomplishment of the national learning objectives and as a result teachers’ pedagogical beliefs are crucial and should be

considered in any education venture. Ertmer and Ottenbreit-Leftwich (2013) and also Alkahtani (2017) show that most teachers do not use ICT to effect meaningful changes in their teaching instruction but rather to source information. ICT efficiency depends on how technology is used and for what purpose (Ghavifekr & Rosdy, 2015). The problem arises from placing the emphasis only on ICT while the solution lies in integrating the pedagogy, content and technology. The emphasis on *how* rather than *what* will lead to technology-enabled teaching and learning.

In this section the quality of teacher education is to be examined as a way to improve the quality of education. Malik and Shafeeq (2016) show that it is through PD that teachers are engaged in life-long learning. PD on ICT skills incorporated into a new pedagogical approach would help teachers face the challenges of the ever-changing technology. Albion *et al.* (2015) also indicate that extensive training of teachers on technical abilities is necessary for improving education through ICT integration. The knowledge of teachers should be improved in order to increase the efficacy of the teaching and learning processes.

2.4.2 The importance of teacher professional development for ICT integration

According to Lawrence and Veena (2013), the importance of PD for ICT integration attracts commendation in the literature. Using ICT in the classroom for the teaching and learning process requires the development of a set of skills by the teacher with the view to internalise a methodology that makes the most of technological tools (Das, 2019; Avisteva, 2019). These skills can only be acquired and put to use in the classrooms if teachers are afforded the opportunity to acquire sufficient PD to keep up with ICT developments.

Research on the use of ICT in different educational settings identifies the inability of teachers to understand *why* and *how* they should use ICT for effective ICT integration (Das, 2019). According to Mathevula and Uwizeyimana (2014) ICT use for teacher PD is identified as a potential vehicle that can bring transformation and innovations to teacher education. Teachers have to experience and take a learner position before returning to

the position of being teachers (Lin, Cai & Yin, 2021; Arkorful, Barfi & Aboagye, 2021). Teacher training is deemed to be one of the first options prior to facing new educational challenges.

Lim, Lim and Koh (2012), Albion *et al.* (2015), Sarfo *et al.* (2017), Das (2019) and Alghamdi (2020) demonstrate that countries such as South Africa, Ghana, Australia, Singapore, Israel and Vietnam have developed projects in collaboration with relevant stakeholders to focus on research, monitoring and evaluation leading to effective planning for the successful integration of ICT in education. Most governments and teacher training institutions recognise the importance of integrating ICT into education and teacher training. Hence there has to be development and implementation of a comprehensive professional development programme, which includes the use of ICT in the respective content. The programme should focus on providing educators with appropriate skills and approaches to face ICT integration obstacles (Alghamdi, 2020; Sengai, Mokhele & Makumane, 2022). In this way, ICT may be seen as curriculum tools rather than isolated tools in ICT rooms.

In any change envisaged in education, teachers' concerns, interests and needs are mainly linked to their professional development. The effectiveness of the new innovation depends on the effectiveness of implementation. Hence, in this study the theoretical model to investigate the change process is adopted.

2.5 CBAM FRAMEWORK FOR TEACHER PROFESSIONAL DEVELOPMENT

Education systems in developed and developing countries consider ICT integration to be crucial (Sharma, 2021; Alrwaished, Alkandari & Alhashem, 2017; Jomezai, Ismail & Ahmed, 2016; Guo & Yang, 2016; Ramorola, 2013). Many countries have invested heavily in improving ICT infrastructure. Research in ICT integration focuses on teachers as role players in the implementation of the integration (Mathevula & Uwizeyimana, 2014; Jomezai *et al.*, 2018). Their attitude and pedagogical beliefs are considered to be important in this anticipated change in education (Dlamini & Mbatha, 2018). This indicates

that teachers' concerns and resistance to change are significant in determining the adoption and implementation of education innovations (Jogezai *et al.*, 2018).

2.5.1 The CBAM model

The CBAM framework adopted in this study was developed by Fuller's (1969) 'concern theory' of teacher development. The nature of the research question pursued in this study necessitates the adoption of CBAM as an analytical lens. Hall and Hord (2020) posit that CBAM leads to understanding the teachers' needs, which may be met through appropriate support and planning. How the change process is perceived by a teacher is a personal experience and can influence the implementation of any innovation. CBAM is used and explained in this study for its strength in identifying the concerns of individuals during the implementation of educational change. Central to the CBAM framework is the assertion that facilitating change leads to apprehension, mainly as a result of the existing attitudes and perceptions of the implementers of the change process (Paramasveran & Nasri, 2018; Sarfo *et al.*, 2017). CBAM is also used for its ability to guide teachers towards strategising ICT integration from the perspective of teachers' concerns (George, Hall & Stiegelbauer, 2013; Jogezai *et al.*, 2018).

CBAM comprises of stages of concern (SoC), the level of use (LoU) and innovation configuration (IC) (Roberts, 2015). Sarfo *et al.* (2017) and Khoboli and O' Toole (2012) argue that CBAM follows assumptions that change is a process not an event and that change depends on the perceptions and feelings of an individual. The researchers show that individuals progress through stages of feelings resulting from their perceptions of the use of the innovation. Change facilitators must proceed rationally, be assessed regularly and provide the necessary support.

Most previous studies on change in education used the CBAM model to evaluate teachers' concerns arising when implementing an innovation. The studies referred to are those in Saudi Arabia (Alghamdi, 2020), Pakistan (Jogezai *et al.*, 2018), Ghana (Sarfo *et al.*, 2017) and Nigeria (Dele-Ajayi, Fasae & Okoli, 2021). The findings in these studies indicate that teachers' concerns were closely attached to awareness management and

information respectively. This scenario portrays a significant relationship between the SoC and teachers' individual teaching experience. A steady proliferation of technology tools has led to an increased interest in their claim to improve education. Dele-Ajayi *et al.* (2021) indicate that researchers have forecast that more teaching and learning will take place through ICT in the coming years.

The current study adopts the SoC component which traces the feelings, questions, uncertainties and resistance that teachers may have in response to ICT integration. It shows how the individuals most affected by change react to the implementation of the innovation. Hall and Hord (1987) conceptualise teachers' concerns regarding any education implementation as a development construct consisting of seven sequential stages. Table 2.1 shows the CBAM Stages of Concern that were also used to construct the interview questions.

Table 2.1: Description of the Stages of Concern

Patterns	Stages of concern	Definition	Expression
Impact	Refocusing	Here teachers' concern is centred on what is to be done to better help the innovation.	I have some ideas about what will work even better
	Collaboration	Teachers' concern is focused on the coordination and cooperation with others on the use of the innovation	Is what I am doing relating to what my co-workers are doing?
	Consequence	Teachers expressed their concern on the impact of the innovation on learners. Particular attention is centred on relevance of the innovation for learners.	How is my use affecting the learners?
Task	Management	Teachers express their concern on the processes and tasks related to efficiency, organisation, scheduling and time demands to implement the innovation.	Getting the materials ready takes too much time

Self	Personal	The concern is about how the innovation affects them personally and their plans to do it.	How will using it affect me?
	Informational	Consider the requirements of the innovation and how they function.	I would like to know more
Unrelated	Awareness	Teachers have inadequate knowledge about the nature of the innovation and they have little concern about what it involves.	I am concerned about other things

The need for teacher development for the use of technology has been explored by several studies such as Alghamdi (2020), Alkahtani (2017), Malik and Shafeeq (2016) and Ramorola (2013). Jogezei *et al.* (2018) and Roberts (2015) show that teachers' concerns are critical in improving teachers' PD. Hence, innovation and change create opportunities for learning.

2.5.2 CBAM model in teachers' professional development

Currently teaching is different from what it was a century ago due to the tremendous changes in technology that teachers are confronted with. PD of teachers has to be considered to be a critical issue that can ensure quality active learning (Su & Wang, 2022; Kohnke, 2021). It is expected that teachers' technological level should be adequate to meet the needs of 21st century education (Jogezei *et al.*, 2016; Alghamdi, 2020). The knowledge of the teachers should be updated in order to increase the effectiveness of the teaching and learning process. Teachers currently are faced with the challenge of teaching a more creative, curious generation with 21st century skills and abilities. The learners are often technologically more competent than the teachers. This scenario has created a generation gap that can make the teachers feel uneasy about adopting the new technologies and as a result can rely on their conventional teaching and learning methods (Alghamdi, 2020).

Isabirye and Moloji (2013) show that PD leads to personal growth and development, crucial for effective teaching and learning, academic achievement as well as institutional

relevance. Classroom instruction is influenced in most cases by the quality of PD that teachers receive (Bullard, Rutledge & Kohler-Evans, 2017; Alghamdi, 2020). Therefore choosing 'what and how' PD has to be provided depends on the needs of all stakeholders including teachers and learners. Sarfo *et al.* (2017) explain that a change model such as CBAM is effective for the identification and addressing of the teachers' concerns. It is also effective for the implementation of a new innovation and for the promotion of PD. Therefore, it is imperative that educators, as individuals, are aware of the anticipated change that may modify their way of thinking and doing things as they progress through various stages of the anticipated change (Hall & Hord, 2020).

Researchers have shown how CBAM can be used to identify teachers concerns about a newly introduced innovation and on the importance of teachers' improvement in both technical and educational ICT skills (Sarfo, *et al.*, 2020; Isabirye & Moloji, 2019; Jomezai *et al.*, 2018; George *et al.*, 2013). However, these studies neglect the fact that the users of ICT in the classrooms have to be trained for this adoption in order to implement it with fidelity. Teachers, like learners, learn new skills readily if they are allowed to set individual goals pertaining to technological innovations that match the context in which they work. On reviewing several studies on ICT implementation, researchers such as Yang and Hong (2022), Isabirye and Moloji (2019), Jomezai *et al.* (2018) and Ramorola (2013) indicate that ICT training should meet teachers' demands and be relevant for the pedagogical aspect of ICT implementation. These researchers have recognised unsatisfactory use of ICT mostly due to a lack of professional opportunities for teachers. ICT professional development of Physical Science teachers may influence how teachers integrate ICT within their teaching syllabus. It is therefore important to gain an in-depth understanding of ICT-related PD in the context of Lesotho which might intensely influence the teaching and learning required for quality improved education.

2.6 TPACK AND CBAM MODEL IN ICT INTEGRATION

Based on the concerns teachers have on PD on ICT integration, it may be argued that ICT may enrich the learning resources and materials to enhance learners' education. However, without winning the hearts and minds of the teachers the vision may be hollow.

Teachers develop awareness and understanding on the interplay between technology, pedagogy and subject matter knowledge. This could guide them into developing the necessary knowledge and skills to effectively integrate technology into their teaching. Koh, Chai and Lim (2017) and Mishra and Koehler (2006) indicate that teachers need a specialised form of professional knowledge such as TPACK to support ICT integration. TPACK supports teachers by providing a framework to manage and utilise technology with pedagogy and content knowledge to ensure effective ICT integration. This initiative requires that teachers work collaboratively to design and implement technology-enhanced lessons that align with educational goals and content standards. TPACK ensures that the integration has a positive impact on student learning outcomes by focusing on alignment of content knowledge with technology. To better support the conception of TPACK, teachers' concerns on PD on ICT integration have to be considered.

Drawing from existing literature on teacher PD, this study proposes the conception of CBAM model and TPACK which provide better linkages between teachers' PD, teachers' concerns and teachers' instructions. The attempt could bring the consequence concerns in CBAM from the perceived impact on ICT integration. Refocusing these concerns when teachers need to adapt their ICT integration practices may be continuously supported by TPACK, updating their skills and strategies to meet the evolving challenges in ICT integration. Hence in this study, TPACK provides a framework that addresses the relationship between technology, pedagogy and content knowledge, while CBAM offers a lens to understand and address the concerns teachers may face at different stages of adopting ICT in their teaching practices as demonstrated in Figure 2.1.

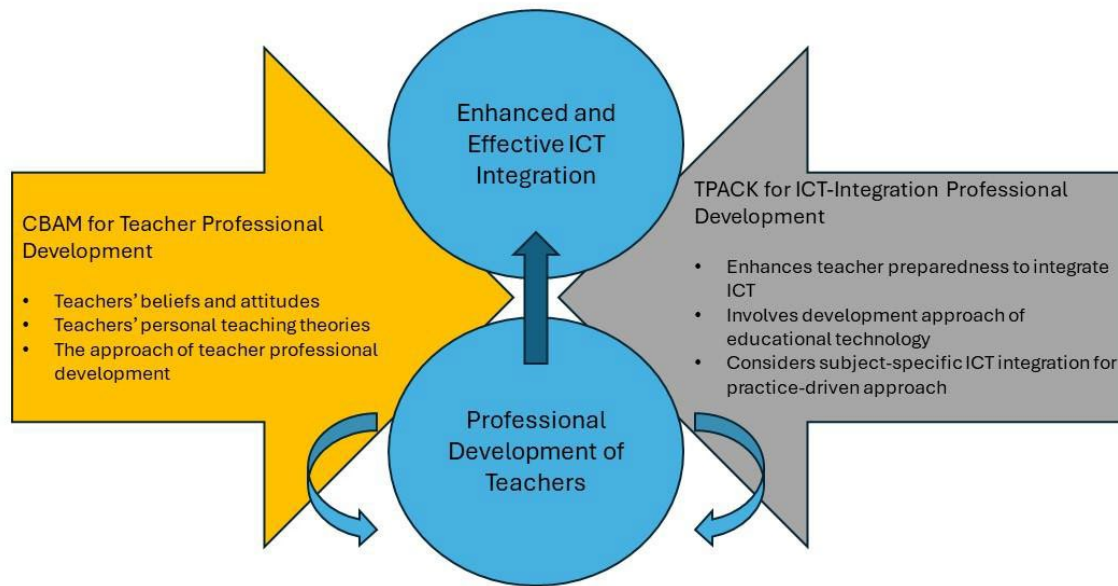


Figure 2.1: TPACK and CBAM in ICT integration

2.7 CHAPTER SUMMARY

In this chapter, literature on components of the research question, which included ICT integration and PD are discussed. It became clear that the literature and theory cannot be investigated in isolation from each other, but both need to be taken into account to give a clear indication of the research question. The review also provided knowledge about the experiences of other countries, showing that both developed and developing countries experience challenges regarding ICT integration in their education systems. Both frameworks provide opportunities to discover solutions pertaining to innovative teaching strategies using ICT and the journey taken by the implementers during the change process.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 INTRODUCTION

The literature concerning national and international PD considerations was reviewed in the previous chapter. This chapter reports the methodology used for conducting this study. The focus of the study is to explore the phenomenon of PD on ICT integration from the perspective of Physical Science teachers. The chapter clarifies the research question and explains the purpose, the research design, the study population and sample, the sampling criteria and the data collection instruments and procedures. In addition, the trustworthiness and ethical issues encountered are highlighted. A summary of the chapter is also provided.

The purpose of a research study is to inform action; it has to produce knowledge that is applicable in the world outside the study area (Creswell, 2014a; Denscombe, 2014). We need to answer the main question: 'What are the Physical Science teachers' perspectives on professional development activities on ICT integration in Lesotho?' This would uncover the opportunities and challenges these teachers encounter as they use ICT in everyday instruction. The reasons for inadequate ICT integration in secondary Science teaching are demonstrated in some studies. Therefore, sub-questions were established to elicit rich data in order to answer the research question.

The sub-questions identified to be related to the main question and the reasons for asking them are discussed:

i.) How do physical science teachers perceive the effectiveness of PD on ICT?

This question guided the researcher to establish whether the PD activities offered towards ICT integration helped teachers use ICT in their teaching practice, as stated in the ICT policy 2005 and the Physical Science syllabus.

ii) What are the views of Physical Science teachers in terms of their preparedness to integrate ICT into their everyday teaching?

The research question examined the participants' background knowledge, views and perspectives regarding using technological gadgets in their teaching.

iii) How can the perspectives of Physical Science teachers on PD be understood and explained?

To add to the literature on the research topic, the answers to this question may bring to light the best recommendations as this study aimed to bring awareness regarding the challenges and opportunities teachers encounter when implementing ICT education policy globally.

3.2 RESEARCH DESIGN

According to Creswell (2014a), a research design entails the strategies and methods of a research study and extends from general assumptions to data collection and analysis methods. Creswell and Creswell (2018) indicate that the choice of research design depends on the research question. In addition, Labaree (2013) refers to research design as the overall strategy that one selects to integrate the different components of the study comprehensively and logically. Thus, the research design interprets the approach followed in conducting the research study. Since this dissertation is concerned with answering questions regarding the perspectives, experiences and practices of teachers, the study adopted a case study research design in a qualitative research approach. A qualitative method is appropriate because the perspectives, experiences and practices are challenging to quantify. They are easy to describe in words.

The choice of a case study approach was influenced by its benefit to enabling in-depth exploration of the research question and towards understanding the issues related to the phenomenon under study (Betensky, 2020; Chere-Masopha, Tlali, Khalanyane & Sebatane, 2021). A case study research design should enable an understanding of how best to study the issue in hand. Constructing meaning is an important objective of this research. This study employed a multiple case study as Yin (2017) has explained. Therefore, understanding how the teachers' PD influences their ability to respond to 21st century teaching and learning, as stated in the ICT policy 2005, is what I seek to discover.

Case studies are hailed as helpful in understanding events or situations or a research problem in a natural context (Leedy & Ormrod, 2013). However, the way the process of investigation is done can render the method's credibility questionable. Yin (2017) posits that case study criticism reflects fears of the uniqueness or spurious conditions around a case. This study used multiple or collective cases to allow the researcher to comprehend the similarities and differences between multiple cases. Studying the four cases was a strategy to dispel criticism relating to the validity or generalizability of the study as portrayed by Leedy and Ormrod (2013).

The study occurred in a natural setting, which allowed the participants' perspectives to be considered in unpacking the research problem. The participants were from the same district to reduce travelling costs. Maseru, the capital town of Lesotho, was identified for this study because that is where initiatives are believed to start and training was held. The study forms the basis for investigations on PD on ICT integration in Lesotho. The research paradigm and research approach followed in conducting this study form part of the research design and are discussed in the following subsections.

3.2.1 Research paradigm

Maree (2016) explains that a research paradigm may be classified as post-positivist, interpretive or critical theory. A paradigm is explicated by Clark (2021) as an interpretation of reality that starts from previous investigations. Bertram and Christiansen (2014) show that a paradigm can determine the selection of questions asked, what to observe or investigate and how to collect data and interpret the research findings. The research design for this study is located in the interpretive paradigm. According to Yanow and Schwartz-Shea (2014), Denscombe (2017) and also Guba and Lincoln (1989), an interpretive paradigm aims at understanding and interpreting meaning in human conduct rather than attempting to understand generalised and predicted reasons and consequences. Hence, this study considered a paradigm for understanding the subjective world of human experiences through observations of practical classroom realities and also through semi-structured interviews.

Thanh and Thanh (2015) and also Nickerson (2022) believe that an interpretive paradigm is dynamic and considers reality changes. This paradigm allowed the discovery of reality through its ability to permit the researcher to view the world through the perspectives and experiences of the participants. Probing and asking semi-structured questions were employed to help bring to the surface the effectiveness of PD offered towards ICT integration, as perceived by Physical Science teachers. The interviews encouraged analysis, understanding and interpretation of the problem. The paradigm offered a platform for understanding teachers' beliefs, motivations and reasoning in their school setting. Understanding a phenomenon may vary from culture to culture and context to context. Hence, this type of paradigm allowed me to interpret social reality through the subjective viewpoints of the participants, as it is underpinned by using observation and interpretation (Creswell, 2014a; Nickerson, 2022). Notably, the paradigm was chosen to assist the researcher in working supportively with the participants to establish a rapport to comprehend and interpret each participant's subjective experience and practice. This collaboration was done in a way that did not affect the outcome of the data.

As Kohnke (2021) indicated, knowledge arises from the interaction between the researcher and the study participants. Maree (2016) and Cohen, Manion and Morrison (2018) maintain that the interpretive paradigm is based on the understanding that knowledge is socially constructed. Therefore, the interpretive paradigm is correctly associated with qualitative research as it helps identify the factors that hinder or support the provision of PD toward the full implementation of ICT integration. In this study the researcher and the participants are inseparable. The researcher makes the interpretations based on holistic perspectives to appreciate the complex world and the experiences of the teachers (Ponelis, 2015; Alharahsheh & Pius, 2020).

The paradigm was followed to comprehend the participants' experiences and discover 'reality' through the teachers' perspectives. Khothari (2004) outlines that this research method investigates human behaviour, including the discovery of underlying motives and desires. An interpretive paradigm directed the study into promoting an analysis of the problem, understanding and interpreting it correctly. The analysis is meant to unpack the challenges and make sound recommendations. This paradigm allowed the discovery of

a set of experiences, practices, challenges and opportunities to help the researcher construct knowledge and understanding from the reality of the teachers, as projected by the individual participant.

3.2.2 Research approach

The literature has made comparisons between qualitative, quantitative and mixed-method approaches. The literature finds that a qualitative research approach is a process that seeks an in-depth understanding of social phenomena within a natural setting (Silverman, 2020; Creswell & Creswell, 2018; Thahn & Thahn, 2015). Silverman (2020) shows that a qualitative approach can produce rich data that sheds light on human experiences and essential interactions in the social context. This dissertation is concerned with answering the research questions about Physical Science teachers' perspectives on PD activities towards ICT integration in Lesotho. A qualitative approach is compatible with a study that requires human reflection (Cohen *et al.*, 2018) and understanding the philosophy underpinning ICT integration through first-hand information from the teachers in their natural setting. As such, the rapport between the researcher and the participants was developed before data collection commenced. The researcher-participant relationship allowed the researcher to collect data at sites where participants experience the issue under study and where particular human behaviour occurs. The reason for this is because meaning is entrenched in peoples' experiences.

This study used a qualitative approach to understand the phenomena through the meaning people assign to these phenomena (Silverman, 2020; Bhandari, 2022). This approach is appropriate for determining the views and concerns of Physical Science teachers regarding their preparedness to use ICT in their teaching strategies. The qualitative approach to research considers an in-depth understanding of how teachers interpret and ascribe meaning to their experience (Yang, 2021) relating to ICT integration. Khothari (2004) explains that this method investigates human behaviour, including discovering the underlying motives and desires that may help achieve the research objectives. The researcher discovered the teachers' reality as they attempted to make meaning of their perspectives and practices. In this regard, the case study design outlines

the concerns-based model (Newman, 2014; Roberts, 2015) and extends it to try to know the intensity of the Lesotho secondary school teachers' concerns about ICT integration.

3.3 STUDY POPULATION AND SAMPLE

Gray (2014) explains population as the total number of possible units or elements in the study. Kumar (2019) defines population as a complete collection of objects, persons and groups studied. In addition, Creswell (2014b) indicates that the population is a group of individuals with certain characteristics that separate them from other groups. From these descriptions, the population may be regarded as a group of individuals of interest to the researcher because they meet the criteria set by the researcher. Within the population the target group is of interest to the researcher because it should provide the necessary data (Crossman, 2020; Mc Combes, 2019). The researcher needed to identify the sample from the target group.

The study's population sampled four (4) Physical Science teachers drawn from four (4) secondary schools in the Maseru district in Lesotho. The nature of the study required observing the teachers while they conducted their teaching practice. Two of the teachers were conducting Physics lessons while the other two taught Chemistry. The reason for the difference in subjects is the tradition in Lesotho whereby Physical Science as a subject comprises Physics and Chemistry. The study also needed teachers to provide official documents, lesson plans, schemes and records of work done, to facilitate the study. The sample size of four (4) Physical Science teachers was a practical choice, where one teacher per school selected participated in the study. The participants' experiences differed and this helped to provide data from different attributes in terms of beliefs, experiences and values about their interest in ICT integration. Spending time with each participant in their actual context, their schools and their usual classrooms, evoked details about the problem being investigated. This conducive environment allowed the researcher to capture and understand first-hand information from the participants' perspectives. It was hoped that the study sample would be able to answer the research question.

3.4 POPULATION SAMPLING

Purposive sampling was pertinent to this qualitative study (Ponelis, 2015; Kumar, 2019). Purposeful sampling was used based on its appropriateness and adequacy to represent a larger group (Creswell, 2014b). The participants for the study were selected purposely because they have the characteristics needed to answer the research question (Cohen *et al.*, 2018). The participants in this study were purposefully selected based on their experience as Physical Science teachers familiar with ICT integration and with a minimum of one PD training activity for ICT integration implementation in the previous five (5). The selection criteria further included the availability of computer labs equipped with requisite facilities in their schools.

The sample for this study was carefully selected on the basis of five (5) years of experience in a classroom context. In this regard, the selected schools would be those that had been provided with ICT resources and whose teachers received any form of ICT professional development (formal or informal) either by the project School Net SA, supported by Oracle and Microsoft (Isaacs, 2007) or the Ministry of Education or even self-acquired (Malik & Shafeeq, 2016). The effectiveness of the PD provided towards ICT integration would be evident during the classroom observations and the document analysis.

3.5 DATA COLLECTION

Bhandari (2022) explains data collection as the systematic process of gathering observations or measurements in the research. Data collection is essential to the research process because it gathers information to answer the research question. It requires the researcher to be vigilant in choosing the appropriate data collection methods to collect valuable data for the study. This section discusses the techniques, including the data collection plan and the instruments used to collect the data.

At the beginning of the data collection period, the researcher met with three of the participants when she had gone to ask for permission from the principals to conduct the study in their respective schools. The fourth participant was absent from school, but his

contact number was given to the researcher to communicate with him. In these separate meetings appointments were made to allow at least two observations per participant. This was achieved by looking at each participant's timetable, because mid-year examinations were approaching. For the fourth participant a meeting was set telephonically and only one observation was made.

Since the study is appropriately qualitative, qualitative research methods were considered for data collection, specifically semi-structured interviews, observations and document analysis. Audio recorders were also used to record, collect and to store the data (Creswell & Creswell, 2018). The key concern was about understanding the phenomenon of interest from the participant's perspective, gained by repeatedly listening to the audio to select crucial information.

The individual interviews with the four Physical Science teachers were conducted over two (2) weeks. **Appendix F** stipulates the interview guides that were used with the interviewees. As mentioned the interviews were voice-recorded to help in the analysis of data. The qualitative data from document analysis and interviews were transcribed to determine codes and themes emerging from the participants' responses. Hence, the basis for both subsidiary questions was set. The analysis enabled an in-depth exploration of the research question. The activity allowed the researcher to observe the events from the activity guidelines presented and recorded, which included the sequence of instructional activities and whether ICT tools were used. Using different qualitative data collection methods helped the researcher understand the connection between the intended objectives of the ICT policy and the reality in the classrooms.

3.5.1 Semi-structured interviews

Semi-structured interviews were regarded as efficient because they are guided and therefore would guide the data collection (Cohen *et al.*, 2018). These interviews explored specific experiences and demanded a little time from the respondents. Semi-structured interviews facilitated a more focused topic exploration (Newman, 2014; Statham, 2020). Hence, in this study, the semi-structured interviews were used to provide valuable insight

into the Physical Science teachers' views on PD towards ICT integration. Consequently, the data generated enabled the four participants to answer the research question (Maree, 2016). The participants could elaborate on their responses when the researcher felt more information was necessary (Petty, Thomson & Stew, 2012). With this purpose in mind, an interview guide with twelve open-ended questions was prepared. Some questions included were designed to elicit strategies that may presumably be translated into practice that used ICT effectively in these Lesotho secondary schools.

The participants in the study were telephonically informed about the study and were assured that their identity would be kept confidential. The relationship between the researcher and the respondents was built through a two-way communication (Petty *et al.*, 2012). The established rapport allowed a further follow-up on specific issues that emerged during the preliminary visit that stimulated participants' flexibility in giving essential data on the issue under investigation. The safe environment removed any reluctance to listen or provide answers and necessitated that shared and open views be expressed by all the participants (Bouma, Ling & Wilkinson, 2012).

However, Yin (2017) opines that poor recall, bias or articulation are common problems in reporting the responses. The audio recordings made during the interviews collected and kept data that could otherwise be lost during the transliterating of the responses (Creswell, 2014a; Isabirye & Moloji, 2019). It was anticipated that the collected data may lead to new ways of understanding the perspectives of Physical Science teachers on PD towards ICT integration (Adam, 2018).

3.5.2 Participant observation

Yin (2017) and Cohen *et al.* (2018) opine that a qualitative observation allows the researcher to interact with the participants in a social context. In this case study, a classroom is a real-world setting where teaching in a school occurs. Classroom observation was regarded for this case study to allow the researcher to experience reality and record behavioural patterns. However, it is worth noting that these classroom observations may not necessarily reflect participants' perspectives. It is used to provide

tangible insights into the practical application of acquired skills and knowledge. Each participant was observed twice to learn about their naturally occurring practices, experiences, challenges and the opportunities encountered during the lesson delivery. Observations should help the researcher understand the participants' culture and beliefs and, most importantly, develop an understanding of how ICT integration was viewed (Creswell & Creswell, 2018).

In this study, a pre-observation conference was held to establish a working relationship with each participant. This included preventing the observer's presence from influencing the teacher to alter their behaviour during classroom observation, thus ensuring the collection of quality data. A pre-interview lesson observation and a post-interview observation in two-day intervals followed the conference. The repeated observations were to observe changes impacted by the study on the participants' teaching method. However, due to the mid-year examinations being scheduled near the time of data collection, the interval between the observations was set to two days.

With the use of this instrument, teacher-learner interaction was perceived. Cohen *et al.* (2018) show that observation refers not only to looking, but it also involves noting systematically where the researcher observes events, settings and routines. The observation sessions enlightened the receptivity of ICT integration policy. In this regard, the researcher was an observer, hoping to obtain unbiased, substantial data. Creswell (2014b) indicates that during the observation the researcher may influence what the participant does or says. Participants were psychologically prepared before the observations by disclosing the purpose of the observation to the participants.

This exercise allowed the researcher to record the participants' non-verbal expressions (Bhandari, 2022). Leedy and Ormrod (2013) indicate that in a qualitative study observations are intentionally structured and free-flowing because the researcher can shift focus from one characteristic to another. However, during the lesson observation, capturing all the information was complicated and overwhelming; hence, a lot of information was missed. Audio recordings helped capture verbal information while the researcher noted the 'how' part of participants' behaviour and expressions. Data on other

aspects of the classroom setting and events were captured during the lesson observation to be used during the data analysis stage.

3.5.3 Document analysis

Kumar (2019) indicates that document analysis is an organised procedure for evaluating qualitative research documents. It was employed in this study for its efficiency in supplementing and substantiating research data collected from observations and interviews (Cardno, 2018). The documents analysed in this study are the lesson plan, schemes and records of work made by each participant. These documents were used to explore the contents of the Lesotho Government ICT policy of 2005. The documents are beneficial sources of information as they determine whether the ICT policy was implemented according to plan.

The document analysis in this study should permit data triangulation. The documents would enhance validity by approaching the same topic with different tools by creating an in-depth picture of the research problem while intensifying the knowledge emerging from the study (Nightingale, 2022). In this case, the weakness in some data could be compensated for by the strengths of other data (Nieuwenhuis, 2016). The conclusion and recommendations would be strengthened and hopefully contribute to the existing literature and body of knowledge (George, 2022).

3.6 TRUSTWORTHINESS

Cohen *et al.* (2018:268) explain reliability as “an umbrella term for dependability, consistency and replicability over time and concerned with precision and accuracy.” According to Petty *et al.* (2012), the quality of the qualitative research can be assessed based on the credibility, dependability, confirmability and transferability of the findings, and also whether the findings can be trusted or not. A research tool that is consistent, predictable and accurate is regarded as reliable (Kumar, 2019). The present study has considered reliability by ensuring that the interviews are audio recorded and the lesson

observations captured. The lesson instructions and other lesson events were noted in writing.

Validity and confirmability relate to the trustworthiness of explanations or implications (Gray, 2014). The validity of the research study was ensured by giving a guide to peers and also to the Science and Maths coordinator (NCDC) to check and comment on. Creswell and Creswell (2018) and Cohen *et al.* (2018) show that peer involvement enhances the accuracy of research findings. The collected information was transcribed after the interviews. The participants were given copies to guarantee the exactness of the information they had provided.

The multiple data collection methods in this study should ensure data triangulation, permitting comparison and convergence of perspectives so as to identify confirming and non-conforming accounts of the research issue (Bhandari, 2022).

3.7 GENERALISABILITY

Cohen *et al.* (2018) show that generalisability is the degree to which the conclusion of a study may be applied to the whole population of the study. The explanation considers the results generalisable if they can be applied more generally in other contexts or groups with comparable characteristics. The qualitative approach to the study is to enable comprehension of the phenomena in similar and comparable situations and extend this understanding to further research projects.

3.8 DATA ANALYSIS

The earlier discussion of research design, sampling and data collection had implications for this study's data analysis. Data analysis is the method for handling data to ensure that the research question is answered (Creswell, 2014b). According to Maree (2016), data analysis means drawing inferences from what the researcher finds from the collected data once it is summarised and examined. Accordingly, the qualitative data analysis used in this study was based on an interpretive philosophy (Maree, 2016; Cohen *et al.*, 2018). In

qualitative data analysis the researcher is engaged in interview transcriptions and field records enabling data to be organised into significant patterns and themes (Rossman & Rallis, 2012). The data analysis should progressively explore the data and compare and contrast different data patterns to develop a more refined understanding while more data is gathered and reviewed.

Qualitative analysis uses different types of data analysis, such as coding and categorising data patterns and identifying the patterns of similarities and differences (Creswell, 2014b). A thematic analysis was applied in this study to help the researcher sort the data according to different categories called themes (Gray, 2014) to understand the phenomenon under study. Chetty (2016) indicates that this method presents the experiences, events and realities within a society.

Content analysis was discussed in sub-section 3.5.3 and found to be a reliable source of information to provide insight and background to the phenomenon under study. The documents highlighted in sub-section 3.5.3 will be read and thematic analysis recognition of emerging themes will be treated similarly to the interview transcripts (Clarke and Braun, 2013). The interview data and document analysis data collected in this study will be analysed through the analytical steps presented in CBAM, the six-phase guide for conducting thematic analysis, as illustrated by Braun and Clarke (2006).

The step-by-step guide to be used in data analysis stands as follows:

- Phase 1: Familiarising oneself with data
- Phase 2: Generating initial codes
- Phase 3: Searching for themes
- Phase 4: Reviewing themes
- Phase 5: Defining and naming themes
- Phase 6: Reporting

The information in Table 3.1 will be used as a guide during the interview and document data analysis to facilitate the separating of texts and responses from the collected data.

Table 3.2: CBAM (SoC) theoretical data analysis framework

Research Questions	Data used to answer questions	Analyses of data using CBAM (SoC)
RQ1. What are the Physical Science teachers' perspectives on ICT practices on the professional development activities in Lesotho?	Semi-structured interview scripts and document analysis	Phase 1 identified the experiences and concerns of teachers
RQ2. How do Physical Science teachers perceive the effectiveness of professional development on ICT?	Semi-structured interview scripts, document analysis and observations	Phase 1 and 2 which identified the perceptions and generated initial codes
RQ3. What are the views and concerns of the Physical Science teachers in terms of their preparedness to integrate ICT into their everyday instruction?	Semi-structured interview scripts and document analysis	Phase 3, 4 and 5 where themes that highlighted the challenges and beliefs are reviewed and defined
RQ4. How can the perspectives of Physical Science teachers on professional development be understood and explained?	General collection of data.	Phase 6 for reporting on the findings and providing recommendations.

The CBAM theoretical data analysis framework will strategically analyse the data and help with the interpretation.

3.9 ETHICAL CONSIDERATIONS

Babbie (2014) says that ethics accounts for the general agreements shared by the researcher in a scientific inquiry. Sanjari, Bahramnez, Fomani, Shoghi, and Cheraghi (2014) indicate that the interaction between the researcher and the participants can be ethically challenging. Therefore, the formulation of specific ethical guidelines is necessary. Researchers face ethical challenges, arguably from the design to reporting. Trochin (2022) shows that it is the responsibility of the researcher to act in a manner that preserves the humanity, safety and security of the respondents at all stages of the

research study. Moreover, the participants in this study were not exposed to any actions of disloyalty during the research process.

Before the research data collection could resume, ethical clearance was sought from the University of the Free State. In research that involves working with people, issues such as anonymity, confidentiality and informed consent have to be considered (Sanjari *et al.*, 2014). Therefore, it is paramount that the guidelines are explicit between the researcher and the participants. The researcher wrote a letter to the Ministry of Education and Training (CEO of secondary education and District Education Manager) asking to be permitted access to the schools and teachers to collect data. The participants were informed about the study without hiding the objectives so as to establish a rapport. Participants were requested to sign a consent form to show their willingness to participate in the study. The participants were told that they were free to leave the study whenever they felt the need. The privacy and confidentiality of the participants were guaranteed to be protected at all times. Hence, their names will not be disclosed (Creswell, 2014b).

3.10 SUMMARY OF THE CHAPTER

This chapter explained the qualitative research methodology adopted for conducting this study. It served as a guide for the researcher to collect data and project its analysis successfully. It explained the interpretive paradigm employed to elicit an insightful understanding of the research problem. The qualitative research methodology was explained and the research design was outlined. The population and sampling techniques to be followed were also explained. Data collection instruments, data analysis and ethical considerations were discussed. The trustworthiness of the study was explained in a deeper consideration of the reliability and validity of the study. The next chapter will present the research findings and an analysis of the Physical Science teachers' perspectives of ICT integration PD in Lesotho secondary schools.

CHAPTER 4

DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.1 INTRODUCTION

This chapter presents and analyses the data in pursuit of addressing the research questions explored in this study. This study aims at investigating teachers' perspectives on PD for ICT integration in the teaching and learning of Physical Science in Lesotho secondary schools. The main data source consists of semi-structured interviews with four participants. For triangulation purposes, lesson observation notes and document analysis were found resourceful. The data collected included the experiences and perspectives of four Physical Science teachers in the Maseru district. In order to address the main research question an exploration of the following subsidiary research questions had led to a comprehensive response to the main research question.

- How do Physical Science teachers perceive the effectiveness of PD on ICT?
- What are the views of the Physical Science teachers in terms of their preparedness to integrate ICT into their everyday instruction?
- How can the perspectives of Physical Science teachers be understood and explained?

The main focus of this chapter is to present the data and provide analysis that leads to an interpretation of the study in relation to the subsidiary questions. The narratives of the participants are triangulated through lesson observations as well as an analysis of selected documents. The findings are presented and analysed according to the themes and codes that emerged from the data. The data was interpreted according to the TPACK theory, which represents the strengths and weaknesses of an individual pertaining to the use of technology for delivering a particular content. CBAM is adopted for the diagnosis of teachers' implementation efforts, concerns and attitudes towards the integration of ICT in their teaching.

In this section the perspectives of the participants with regard to PD towards ICT integration are unpacked. To ensure that the findings provide answers to the research

question, the data presentation will be arranged per case to better understand each participant's situation.

4.2 CHARACTERISTICS OF THE PARTICIPANTS

Four (4) Physical Science teachers from different schools in one district were selected for this study. The participants were selected purposively based on the subject that they teach, their experience and whether they had been involved in any ICT professional development in the past five (5) years.

To maintain the anonymity of the participants, they were assigned pseudo names: Leseli, Khanya, Khotso and Thabo from schools 1, 2, 3 and 4 respectively. The participants were all males. This is because Physical Science teachers in the target schools during the data collection period were male teachers. Table 4.1 provides profiles of the participants.

Table 4.3: Profile of the participants

Participant	Gender	Age	Qualifications	Teaching experience	Subjects taught	ICT Professional development in the past 5 years (formal or informal)	Technology use. (never, rarely or often)
Leseli	Male	38	BSc + PGCE	15 years	Biology and Chemistry	Formal and informal	Often
Khanya	Male	42	Dip. Ed +B.Sc. Ed	14 years	Math and Chemistry	Formal and informal	Often
Khotso	Male	28	BSc Ed	5 years	Math and physics	Formal and informal	Often
Thabo	Male	46	Dip. Ed + BSc Ed	17 years	Math and physics	Formal and informal	Often

The table shows that the participants were only males. The participants were all Physical Science teachers; 2 teaching Physics and two teaching Chemistry. The participants' profiles indicate that the teachers received formal and informal ICT professional development and they often used ICT for teaching.

4.3 DATA PRESENTATION

This section discusses the findings from document analysis, lesson observations as well as individual semi-structured interviews. The data presentation and interpretation are done per case, as the narratives of each participant are unpacked. There were two observations per participant. However, owing to the time of the year in the academic calendar only one observation was effective teaching while the other was a revision lesson. The challenge encountered during the data collection period was a lack of normal observation with Khotso because he was already revising with his learners. Data collection was done when June examinations were already approaching. This setback did not appear to have an adverse impact on the quality of the data. Descriptive questions, including how the daily interaction with the learners was enacted to achieve a learner-centred classroom through the use of ICT were asked to give a picture of teacher-learner interaction. This allowed for sufficiently rich and thick descriptions of each participant.

Each case description commences with some background on a participant's biography.

4.4 CASE STUDY 1: THE STORY OF LESELI

This section presents the findings with respect to Leseli's views on PD towards ICT integration in the teaching of Physical Science. The presentation starts with a background of Leseli, followed by his experiences as a Physical Science teacher that might have an influence on his perspectives on PD.

Leseli is a Biology and Physical Science teacher in his late 30s. He teaches in school 1 where he has been a teacher for the past 9 years, teaching grade 8 to grade 11. He started teaching in 2008 at another school in a rural area and transferred to the current

school that is closer to his home, even though he is employed on a temporary basis. When he started teaching he was not yet a professional teacher. He had graduated with BSc (General) and later completed a Postgraduate Diploma in Education (PGDE). Explaining his first experiences as a Physical Science teacher, he laughed a little and said: “Mme ke u joetse (let me tell you this) teaching was a big challenge during those days. The biggest challenge was to prepare for a lesson and to interpret the syllabus.” He explained further how this challenge affected him:

I didn't know how deep to go. I would look and read the learners textbooks and find them too shallow. [...] I would go deep on content. I realised I was giving the learners too much content because the exam questions did not require the detailed depth I had provided to the learners. I was always running to my colleagues with the syllabus.

The statement indicates that Leseli experienced a challenge of not knowing how to interpret the syllabus. This led to him providing learners with too much content for their level. On reporting whether he is still experiencing the same problem, he said: “I am now a qualified teacher and teaching to me is no longer a nightmare.” Leseli narrated how he got help on this problem:

It was a stressful situation that I wanted to quit. [...] Our head of department (HOD) realised my struggles and provided me with support by sharing ideas about how to teach certain concepts with me and initiated that we do team teaching. It really helped to ease the burden and the pressure on me.

The excerpt shows that Leseli had not been trained in teaching before his first teaching position. He indicated that this first experience was difficult and almost made him quit teaching. Su and Wang (2022) agree that teaching demands ongoing education to enhance educator quality and develop knowledge and skills in the field. Leseli shows that he had entered teaching because there were no vacancies for someone with his qualifications and that he needed to survive. He said: “I nearly lost hope in life because I had spent two years without employment. [...] this was when I decided to go to school to market myself.” Later on he enjoyed teaching after he had worked together with his HOD. He became attached to the learners and enjoyed what he was doing. Hence, he enrolled for PGDE. He goes on and narrates:

I started seeing teaching differently, learners seemed to enjoy my classes and started understanding and passing my subject and I told myself that I have to be a better teacher for them when I went back to school.

The quote indicates that mentoring equipped him with the techniques and strategies to cope and better connect with what he needed to teach. He commented: "I was also equipped with the hand-outs the HOD got from workshops on teaching Maths and Science and creating learner-centred lessons." One of the challenges that Leseli encountered was the ability to write a lesson plan and also to complete a scheme and record of work. He further gave an account on how his HOD and colleagues assisted him:

Another thing that made my work easier was the Friday afternoon departmental meetings where we would sit and help each other on different concepts and I was helped with writing a lesson plan and completing the scheme and record of work.

This description shows the importance of mentoring, as well as the significance of training. The interventions helped him perform his daily duties at work. The mentoring ensured that Leseli became confident in his daily teaching activities. He indicated that he taught in a manner that engaged learners with different learning abilities and styles and hence increased the learners' enthusiasm to learn. He said: "The hand-outs and the departmental meetings helped me be versatile in class and use different teaching methods to accommodate diversity in my class". The statement is corroborated by Lin *et al.* (2021) who indicate that mentorship entails meetings between a competent and experienced person with a person and less competence and experience, so as to provide PD, personal guidance and support in career development.

4.4.1 Professional development on ICT integration

The effectiveness of PD on ICT integration is discussed in a theme addressed by the research question: How do Physical Science teachers perceive the effectiveness of professional development on ICT integration? The question is answered through the themes and codes emanating from the data.

When asked whether he was aware of the ICT policy 2005, Leseli said, "I have never heard of such a policy, I don't know about the education policies. I normally do what I am told to do." He provided details on why he uses technology in his teaching:

Our principal told us to teach with technology after the lab was refurbished with computers. However, it was a surprising call because there is no Wi-Fi connection

there. I use ICT tools for teaching because I believe it is what needs to be done in this technological world.

It appears from this extract that Leseli was aware that ICT needs to be used for teaching. It shows that Leseli believed that ICT integration is what needs to be done since the world is changing with regard to technology. Habibi *et al.* (2020) corroborate with this statement when they indicate that teachers need to have leading roles in ICT integration for instructional activities due to technology shifting 21st century education. Leseli's interest in ICT intensified the need to know how he uses ICT in his teaching activities. When asked if he received any form of training on ICT integration, Leseli said: "[...] I never got any formal ICT integration training, I acquired computer skills from the university and from the colleagues who went for the training on ICT."

The statement indicated that Leseli received his PD on ICT from computer courses at university and from colleagues who had attended training at ICT workshops. This informal training offers technology skills, but does not necessarily facilitate the flexibility needed for a learning environment (Schleicher, 2020). Leseli shared the following:

The training I got at the university and additional training from colleagues played a major role in my knowledge and application of ICT in my lessons. [...] On seeing that I could not use some new software applications I used Google and watched YOU-tube videos on how some things are done. I found the use of ICT easy after the hands-on training offered by colleagues.

The extract shows that Leseli is quite versatile and ready to learn to change in a way that would help him improve the quality of his teaching. He says: "On seeing that I could not use some new software applications, I used Google and watched YOU-tube videos..." He appears to believe that there is a direct relationship between the quality of education and the quality of teachers. Kaya and Godek (2016) indicate that to reach success in the education system one should aim to be 'a good teacher' not just a teacher. Leseli requested hands-on training from his colleagues. He is adamant that advancing the use of technology in teaching requires technological skills and knowledge to adequately meet the needs of 21st century education. It appears that he perceives ICT integration in teaching as a crucial issue that needs to be considered to ensure a quality teaching and learning interaction. This is in line with Alghamdi's (2020) and Muweesi *et al.*'s (2021) statements that there are many opportunities teachers can use to introduce technology

into their classrooms. These opportunities may lead to enhanced teaching abilities as well as teachers' creativity.

4.4.2 Training on knowledge and use of ICT

In this section training on the knowledge and use of ICT in education is presented from Leseli's perspective. When asked if he did get any formal assistance or training regarding ICT integration, Leseli replied:

I don't remember getting any formal training involving ICT integration. The workshops I attended were about how best a certain concept can be taught, how to engage learners to have a learner-centred lesson and never on ICT integration.

This statement, "...I don't remember getting any formal training involving ICT integration..." shows that Leseli claims that he never received training specifically on ICT integration. However, he had already indicated that he acquired training on computer skills provided by the university and colleagues. It may be argued that this suggests a lack of training for ICT integration. Ghavifekr *et al.* (2016) argue that ICT integration support would help teachers use ICT in teaching. The training workshops Leseli attended were based on pedagogy. When asked if he uses ICT tools in his teaching he said: "I use ICT tools for teaching because there is a projector that I can use and we were told to use it." The statement indicates that he understood that he had to use ICT. However, it is not stated in the syllabus and in the school policies how ICT has to be integrated. He stated: "I use ICT in class because I am acquainted with it, it is not a problem for me to use Microsoft word and project PowerPoint." The quote portrays that he has a positive attitude towards ICT integration in education and he shows that he uses ICT even though it is not stipulated how he should use it. Providing ICT pedagogical training for teachers rather than simply training them to use ICT tools would convince the teachers to use technology for effective teaching and learning (Ghavifekr *et al.*, 2016).

The lesson observed did not portray what he claims he does in his class. There were no ICT tools used in the class or any ICT integration observed. The lesson corroborated with the lesson plan and the scheme and record of work, but showed no trace of ICT tools used, or in fact any in the previous lessons. This shows that if the claim made by Leseli

is correct, then ICT tools may only be minimally used. After the lesson Leseli was asked why he did not use ICT in his lesson and he explained that the implementation of ICT integration in his school is as follows:

I do integrate ICT in my teaching, but not always. It happened when I had asked for permission from the office to allow learners to bring their smartphones. This is normally done when a new concept is introduced. It is however not easy to use ICT every time because of poor Wi-Fi coverage.

He added to this statement by answering the comment as to why ICT integration is not visible in his lesson plan and in the scheme and record of work done when he said: “Because this attempt fails in many cases I do not even show it in my record of work.”

When he says: “I do integrate ICT in my teaching, but not always.” It shows that ICT integration implementation in school 1 is not easy. There are challenges prominent in the story of Leseli. He was asked to elaborate on his use of technology in teaching and he said: “I normally use the internet for information gathering and sharing, and giving learners work to do on WhatsApp or finding information to answer questions.”

This information tells us that he has courage to use ICT in his teaching activities but is confronted with challenges that he has little or no control over. He has a positive attitude towards ICT integration. This is shown in the statements “I do use ICT; I normally use the internet.” The statement that “... it is not easy to use ICT every time because of poor Wi-Fi coverage”, demonstrates his concrete understanding that lack of resources for ICT integration hinder the provision of quality education through ICT integration. The Lesotho ICT policy (2005: 24) suggests that;

“...- educational institutions must play a major role in improving teaching and learning mechanisms that would help a society that is ICT literate.

- ICT literacy be part of the core curriculum

- ICT should be used to improve the quality of education...”

The policy is corroborated by the Physical Science syllabus that “*concerns the understanding of scientific and environmental phenomena in terms of physical, economic, [...] and technological development that seeks to promote knowledge, skills and values pertinent to Physical Science and technology.*” (NCDC & ECoL, 2019: iii). The documents call for the need for technology use for improved quality of education, but do not stipulate

any guidelines to follow for ICT integration. They also do not consider the provision of ICT resources. This implies that the responsibility to use ICT in any teaching activity lies with the individual teacher and individual school policies.

4.4.3 ICT integration in teaching practice

It emerged that Leseli viewed PD towards ICT integration in teaching as a crucial activity towards the efficient implementation of ICT integration in curriculum practice. When asked about his competence in ICT integration, he responded: “I really can’t say I am competent in ICT integration, I have already mentioned that I still need some training because I can’t use all computer applications confidently”. This suggests that a lack of competency in the use of computers lowers his confidence in using ICT for teaching activities. Bingimlas (2009) opines that the presence of all components desirable for ICT integration increases the possibility of excellent ICT integration in teaching and learning opportunities.

When asked how PD on ICT affected his teaching, he said: “The technology skills I acquired have equipped me with skills to apply ICT in my teaching.” The statement shows that Leseli is able to use ICT in classroom activities. He explained further how he uses ICT.

I enjoy teaching with ICT tools and finding valid information from the internet. I sometimes ask the principal to allow learners to bring their mobile phones to be used in a particular lesson where we will exchange materials or the learners find answers to problems on their own. [...] I sometimes use the application called flipped classroom or zoom with those [referring to learners] who can have data. It is helpful because I became an administrator there. We are able to conduct our lessons from anywhere.

The extract shows that Leseli enjoys teaching with technology which happens to help him gather valid information from the internet. The data shows that in school 1 the learners are not allowed to bring their smartphones to use them for a lesson. Leseli has to ask for permission from the principal. In this extract Leseli also indicates computer platforms that he uses for teaching, such as flipped classroom or zoom. It shows that he considers these platforms very convenient for him and the learners. With their use learning occurs from anywhere. Luhmya *et al.* (2017) approves of Leseli’s statement that ICT integration brings about a powerful learning environment for learners to experience self-directed

learning. However, in the two lessons I observed, Leseli did not use any ICT. His lessons indicated a learner-centred classroom with learner-learner interaction and learner-teacher interaction and a reliance on the learner's notebooks as reference material.

The lessons indicated that Leseli dwells on pedagogies he learnt in training although he says: "I use some technology applications in class ...". He indicated that, "the syllabus does not state how it has to be integrated, therefore I do it my way." The freedom to use technology when it suits him was evident in the lessons observed because there was not a trace of technology.

4.4.4 Beliefs and attitudes

Beliefs and attitudes are said to influence how well teachers conduct their lessons. Leseli exhibited his firm belief in PD towards innovation. When asked why he was eager to get a lot of training on ICT tools, he responded thus: "It is difficult to implement any change in education if you are not competent and aware of such change." Kaya and Godek (2016) opine that teachers must be prepared to provide technology oriented learning opportunities for their learners.

Leseli holds a strong belief that ICT integration is a way to go in the 21st century. He retorts: "Honestly, we are living in the 4th Industrial Revolution, the world has become a village due to technology." He gave his opinion on whether ICT integration improves the quality of education. He said:

This says ehlile (I strongly say), the ICT incorporation in learners' education is vital because it is expected that computer literacy be the skill that every learner acquires. [...] I am of the opinion that without ICT integration or use, learners find it difficult to comprehend some of the scientific concepts.

The emphasis from the transcription demonstrates that Leseli recognizes ICT integration as a way to improve the quality of education when he indicates that "...without ICT integration, learners find it difficult to comprehend some of the scientific concepts." He also pointed out that, "[t]eaching learners who are inclined to technology has to be through technology since the current learners are born in technology." This demonstrates that Leseli strongly believes that when learners are taught with ICT or from ICT tools they

understand better because they are able to see the concepts unfolding and in a way that involves multiple senses. The statement is supported by Avisteva's (2019) findings that teachers view the use of ICT as a more effective process suitable for different learning styles. Leseli continued his explanation by saying that "[t]he traditional methods which were used in our time no longer operate in this era. [...] learners have to see what they are learning because they have materials at their disposal." On this note Leseli seems to regard ICT integration as a solution to learning problems and Avisteva (2019) also indicates that the majority of teachers acknowledge benefits from the use of ICT.

The quotations demonstrate that Leseli strives to use technology-based teaching strategies to engage learners. Henderson (2020) indicates that the use of technology in education augments quality teaching and enhances the effectiveness of learning. Leseli shows that he employed traditional methods of teaching, which might deny learners the opportunity to be engaged in their learning. The statement corroborates with the findings of Arkorful *et al.* (2021) that a positive attitude by teachers would enhance ICT integration adoption. The next section will discuss from Leseli's perspective the value of ICT integration in teaching and learning.

4.4.5 Significance of ICT integration

When talking about the benefits of ICT integration Leseli has observed, he said: "[...] I am struggling with content delivery because talking too much to me is a problem. I stutter. I sometimes project the notes of the lesson where they will read for themselves as I talk. This makes my work easy and interesting." On the issue of making work easier, he remarked: "I would also give learners work to do at home in preparation for the next class on WhatsApp." The explanation indicated that the flexibility of the innovation makes his work easy-to-do as learners listen and read at the same time. They also come to school prepared for his lesson.

He added: "Since I acquired skills in using technology and used a projector here and there for watching videos, I have seen a great difference in the learner's content retention." This statement illustrates that Leseli teaching has improved because of the use of technology.

Henderson (2020) argues that ICT integration allows learning at the learners' pace and therefore creates opportunities for the learners to actually learn. Leseli made the statement:

Remember, these learners learn differently. In Lesotho I have realised that we are far behind other countries in the use of technology in education. In some countries Covid-19 did not affect teaching and learning adversely as it did here, because learners could learn from the comfort of their homes.

His concerns in the above excerpt suggest that in Lesotho ICT integration is still behind and that does not allow any improvement in education. He compares the state of Lesotho education to that of other countries during Covid-19 and indicates that in some countries education was not under as much pressure because education systems could mitigate the effects through ICT. Sengai *et al.* (2022) corroborate with this statement when they indicate that Lesotho showed a level of unpreparedness on the integration of technology into teaching and learning.

4.4.6 Barriers to ICT integration

ICT integration is a journey with its own challenges. Classroom practices are influenced by various factors and to further understand Leseli's ICT integration I posed a question about what the challenges that he encounters while integrating ICT in his lessons are. Leseli explained his challenges as follows: lack of resources, poor Wi-Fi coverage, lack of training and lack of stakeholders' support.

4.4.6.1 Lack of resources

On this note Leseli blamed the management of the school as well as the MoET on two accounts. He commented that, "[...] the limited coverage is very annoying because there is no network in the computer lab. I have to use my own data to download materials." He further indicated:

However it becomes challenging as some learners do not have smart phones and they have to group on the other learners' phone when the lesson is conducted in

the classroom. Sometimes I use my own laptop to project the videos and simulations.

The response he gave showed that he has a positive belief about ICT integration and the determination to make it work for him. However, a poor Wi-Fi range to the computer lab challenges his endeavour. He added that, “sometimes we do not get access to the lab when Mr so and so is not at school.” Accessibility to the lab is also a challenge as only authorised persons are responsible for its opening and closure.

4.4.6.2 Lack of training on ICT integration

When asked what his concerns about PD on ICT integration are, he cited a lack of training as a hindrance to ICT integration. He stated: “There are other applications I would like to use such as using all the Microsoft excel functions.” The response shows that as much as Leseli seldom uses ICT for his teaching, and is competent in other functions, he is still incompetent and uncertain with some computer applications. The research indicates that PD is an essential part of every teacher’s development towards improving his knowledge and skills so as to positively affect the learners’ engagement and the classroom environment (Wakefield *et al.*, 2018). When asked to elaborate on the applications that he uses in class, he emphasised: “I mostly use simulations and videos as well as the information that I gather through the internet.” This statement indicates that the most convenient use of ICT in teaching instruction that he uses is to project videos and do simulations. He considers the information he gathers from the internet as helpful for his lessons. He continued his explanation:

I still believe that there is a need for workshops or an induction programme to formally train the in-service teachers on ICT integration when schools are closed. Apart from that teachers should be provided with materials or manuals to help them use ICTs confidently.”

The statement indicates that Leseli regards training as an important integral part of ICT integration. His suggestion is congruent with what the research indicates, which is that PD is an essential part of every teacher’s development to improve his knowledge and skills (Yalley, 2022). Lack of training is regarded as bringing resistance to change and negative attitudes from some teachers. He indicated that manuals are necessary to

eliminate incompetence by teachers as teachers opt not to use ICT due to lack of technological knowledge and skills. Providing technological pedagogical knowledge training for teachers is a critical issue because it can help convince the teachers of the value ICT can bring to their teaching. However, proper implementation depends on the support one can get from stakeholders (Avisteva, 2019).

4.4.6.3 Lack of stakeholders' support

When asked what could be done to support teachers to be more effective in integrating ICT in their everyday teaching, Leseli indicated:

My school does not support ICT integration. If the school wanted us to use ICT in teaching, the Wi-Fi band would have gone as far as the classrooms and the computer lab there.

This statement shows that he associated lack of ICT integration with lack of support from the administration. This statement implied that Leseli believed that, if the administration needed ICT to be integrated in daily teaching activities, the school would have made the Wi-Fi connection accessible.

When asked what he thinks about how the DoE is capacitating teachers when a new venture has to be implemented, his opinion was that, “[t]he ministry trained some teachers with the hope that they would disseminate the training to others, but it is not doing enough to help to integrate ICT.” Malik and Shafeeq (2016) assert that for successful ICT integration in education, one-time training or a workshop is inadequate. When asked to elaborate on his opinion, he commented that: “The inspectors do not care about whether it is done or not. There is no follow-up during school visits concerning ICT integration.”

His views on the matter seem to be congruent with what I observed from the documents. There was no trace of ICT integration and this shows that the authorities never considered the use of ICT and is not doing enough about ICT integration. Leseli suggests that if teachers were meaningfully supported by those in authority they could become fully engaged in ICT integration. Sharma (2022) argues that the use of ICTs in the classroom is very important for providing opportunities for learners to learn and operate efficiently in the 21st century. Providing technological pedagogical knowledge training for teachers is

a critical issue because it can help convince the teachers of the value ICT could bring to their teaching. Research indicates that the innovation may challenge teachers to rethink their role, teaching and vision for the future (Das, 2019).

4.4.7 Summary of Leseli's story on ICT integration professional development

The story of Leseli shows the opportunities for PD for ICT integration and the challenges of using ICT for teaching. Data show that Leseli received PD towards ICT integration mainly from colleagues who were trained in ICT integration and also practising it. The technology skills that he acquired helped him to use ICT in his teaching activities such as projecting videos and simulations. However, the actual ICT integration was not evident in the lessons observed and in the documents that he provided for analysis. Leseli uses ICT on his own accord, but he does not record this use even though materials and resources used or found useful in a particular lesson were to be recorded. He mentioned that the use of ICT helped him as an individual. His opinion is that ICT improves the learners' interest and participation in his class.

The data demonstrated Leseli's positive attitude and strong belief about ICT integration and he sometimes uses ICT in his teaching instruction amidst the challenges that he encountered. The case study evidence revealed that there are barriers to his ICT integration. For instance, a lack of support from the administration leads to poor Wi-Fi coverage that hinders the use of computers in the lab. This resulted in Leseli using his personal data to 'hotspot' his laptop in class. Lack of availability of ICT equipment also results in poor ICT integration. The laboratory is regulated by certain personnel making the computers unavailable when they are needed. The school policy suggests that learners should not take their smartphones to school and this is also identified as a challenge. Adding to these challenges for ICT integration, Leseli indicated that he needs more training on the use of certain computer applications, so that he can be more confident with ICT integration. Despite the prevailing challenges, Leseli still attempted to occasionally use ICT.

4.5 CASE STUDY 2: THE STORY OF KHANYA

In this section, I present the findings providing Khanya's perspectives of PD on ICT integration. My first meeting with Khanya was on the day I was meeting with the principal to ask for permission to collect research data from her school. Khanya showed interest in the study and asked questions regarding the purpose and objectives of the study. Without hesitation he signed the consent form to participate in the research study.

Khanya is a male teacher at school 2. He started teaching in 2009 at another school situated in another district. When he started teaching he was a Diploma holder. He then furthered his studies at the University specialising in Maths and Chemistry, both of which he now teaches from grade 8 to grade 11 to mixed ability learners. He pointed out that due to the inclusion policy learners with special needs are admitted in his school and they are mostly from a disadvantaged background.

When talking about ICT policy 2005, Khanya said: "I have never seen or heard of such a policy. [...] I only know that I have to use technology in my teaching from what my principal said." From this statement it is clear that Khanya's principal has highlighted the issue of ICT integration to his staff. Hence, Khanya is aware of the need to use ICT for teaching.

4.5.1 Professional development in ICT Integration

Khanya shared his experiences regarding his PD towards ICT integration. When asked what he understands PD towards ICT integration to mean, he responded as follows: "It's about the training I got on ICT use in class." This statement suggests that he understood what PD is. Teacher PD is any form of continuing education to improve skills to ensure quality education (Alghamdi, 2020). It can happen either in a formal or an informal setting. A detailed account of the training he received to use ICT is provided in the next subsection.

4.5.1.1 Training on knowledge and use of ICT

When talking about how he received training to be able to use ICT tools in his teaching, Khanya said:

I am a treasurer in the national committee of Lesotho Science and Math Teachers Association (LSMTA). This has granted me many opportunities to attend several training workshops organised by the MoET. I attended training workshops organised by the Ministry of Communications, Science and Technology under a project called Thakakhoale.

He also indicated: “The project taught us many things on computer use. I am now able to prepare slides and simulations for my teaching. I can also use computers to create graphs.” The extract above explains that Khanya had acquired skills from training workshops such as Microsoft Office and that he had produced his own simulations. It indicates that Khanya has been involved in several training workshops organized by the DoE, as well as other stakeholders in ICT. He was then asked how many teachers attended the workshop and he said:

They took one teacher per association as they were training people from different departments to go and train their colleagues. At this point I am one of the teachers in LSMTA whose responsibility is to see that Science and Maths are effectively and efficiently taught in both primary and secondary schools.

This statement made me understand why Khanya claimed to be the one responsible for training other teachers. This suggests that being in the LSMTA committee opened a platform for him to attend workshops on ICT training so as to be a trainer of other teachers. The statement portrays his obligation to see that Maths and Science subjects are effectively and efficiently taught in schools.

The PD that he received has put him in a better position to implement ICT integration in his teaching activities. He stated: “[...] the training equipped me with the use of many applications of the computer and I use those skills in my teaching activities.” This declaration indicated that the PD that Khanya received from training enabled him to be more competent in the use of ICT for teaching. An effective teacher-trainer needs to be knowledgeable of ICT pedagogical approaches to expose ‘student-teachers’ to diverse techniques in their teaching (Su & Wang, 2022).

Khanya is entrusted with training other teachers to ensure better Maths and Science results in the country. To achieve this mandate he said,

[...] we (referring to the committee) used to organise ICT workshops for Maths and Science teachers and recently there was one that was held by the ministry at one school in Maseru. I was there as a facilitator. It was about training teachers in flipped classrooms and scratch.

He was later asked to elaborate on how teachers are invited to such workshops, the attendance and the ease at which teachers flow from the training. He indicated: "I represent LSMTA therefore we (the committee) take responsibility for only LSMTA member schools."

His response disclosed that only those schools who are members of LSMTA are eligible for their ICT training. The question was posed to understand whether the training covers a large area of the country due to the criteria they use to invite teachers. I further inquired the objectives and outcomes of these ICT integration workshops. He narrated the story on the ICT workshops as follows:

Actually, the workshop was held here in Maseru last year to capacitate our association member schools on ICT use. We invited one teacher per school. [...] We had to first introduce most teachers to computer use because teachers mostly use their mobile phones to search for the information. They still need to be trained on the basic skills of computer use to gain more technology skills.

It was evident from this extract that the training was not open for every teacher because it was organised by LSMTA not by the government. The statement revealed that it has come to the point where the stakeholders in education realise the need to use ICT for teaching and learning. Khanya also found out that most teachers lack basic computer skills which are a prerequisite for ICT integration. He encourages training of teachers for effective ICT integration when he shows that "...they still need to be trained on the basic skills on computer use." The statement "We want teachers to use ICT for their teaching as we have seen its results," indicates that he sees ICT teacher PD as a way that will assist LSMTA to achieve its goal of improving performance in maths and science through ICT integration. The discussion above shows that Khanya's competence and belief in ICT led to his confidence in using ICT for his teaching as well as for training his colleagues.

4.5.1.2 Application of ICT integration

When elaborating his concerns on ICT integration, Khanya said:

Technology illiteracy is a source of concerns that teachers have when they have to implement ICT in teaching. I believe that for one to be able to use ICT in teaching, one has to be knowledgeable about the use of computers and other ICT tools in education.

His opinion is that teachers need to be competent in ICT use to be able to use technology in their instruction. Khanya believes that, if teachers are not confident in implementing ICT integration they simply avoid its use. He is aware that ICT integration requires that teachers be trained in ICT integration. He added:

Teachers should be made competent on the use of ICTs in the classroom to create that atmosphere which is conducive for learning which creates learner-centred strategies. As of now the training that I received and that I am giving to other teachers is on computer skills and not on how to integrate it in teaching, hence there is still room for improvement.

Khanya's opinion is that the use of ICT creates a positive environment for learning. This statement is supported by his comment: "[...] to create that learning environment conducive for learning which creates learner centred strategies." This gives the impression that the training geared towards ICT integration should involve activities that help in ICT integration. Khanya indicated that PD has to be an on-going process as he indicated that there is room for improvement. His views about ICT integration in his school were as follows:

Here some of us use ICT but some don't. I think it has to be made mandatory that we all use ICT. There is an ICT laboratory in my school. It is fully wired and connected and there is a projector too. The Wi-Fi ranges to teachers' houses so much that I use ICT to plan for the next day's lessons; so there is no problem. The challenge is that learners are not supposed to bring their smartphone so it is difficult to use ICT if the lab is double booked. However, it is only a few individuals who use the ICT lab for teaching.

The statement shows that school 2 has ICT resources, a furnished lab and free Wi-Fi. Khanya is content about the resources for ICT integration. However, he indicates that teachers are not cognizant of the ICT policy. Khanya considers personalities, experiences and ICT knowledge amongst teachers to affect ICT integration. He considers school 2 to be not fully supporting ICT integration if learners are still not

allowed to bring their smartphones to schools. This is supposedly a hindrance to ICT integration or use of ICT as a resource in classrooms or anywhere during school hours.

4.5.1.3 Training offered

Khanya indicates that he received training or support through the government. The training offered by this project seemed very helpful. He indicated: “They showed us how to prepare the slides and how to come up with simulations as well as make graphs.” He said: “I don’t know what happened to the project but it was our mandate to continue and disseminate the information to other Science teachers.” Khanya’s response indicated that he learnt a lot from the training that he had received. He is able to organise simulations and draw graphs. He said that the training sessions that he offers are only for LSMTA member schools.

He was then asked whether he sees ICT integration being done by all Lesotho secondary schools. He stated: “That one is beyond me, but I can offer such training to my capacity.” It became evident that he sees the need for the training of teachers but he is not capable of training all the teachers.

The training of teachers in this endeavour will not be towards the accomplishment of exploring ICT policy objectives because not all schools are members of the LSMTA. This lack of clear support mechanisms towards ICT integration shows the dearth of collaboration between the leaders, school managers and the teachers. He further showed his belief in ICT training when he said: “If a certain percentage of teachers can be trained, it will help teachers accomplish the curriculum practice. One will learn from the other.” However, this is still not adequate to develop improvement strategies on ICT integration.

4.5.2 Integration in teaching practice

When addressing his views on ICT integration, Khanya said that, “ICT integration means teaching with ICT ... isn’t it? That movement is a change that is needed by our education system.” This statement indicated that Khanya’s perception of ICT integration points to

the fact that it could be the change that our education system requires. He continued to give his opinion:

Learners nowadays are technologically oriented; they use technology for communication and for doing their applications. Technology-related applications are at their finger-tips; hence teaching learners through technology could be enticing to them. Being interested in their own learning may bring good results because they may be responsible for their own learning.

Khanya's opinion indicated that teaching learners with technology might excite and motivate the learners. Khanya demonstrates that when learners are motivated to learn, they easily take responsibility for their own learning. On this point, Yang (2021) opines that all stakeholders in education should realise the need to use ICT for education. This suggests that ICT integration may bring good results. The statement implies that Khanya believes that teaching and learning through ICT enhances education. On this issue, he was asked whether ICT integration is effectively implemented in his school. He mentioned that some of his colleagues do use ICT for teaching but others do not. He said:

People believe that technology is for young generations but they refuse to be trained on ICT use. Others are just reluctant to use it because they are stuck in their traditional ways of teaching.

This suggests that Khanya has observed some ignorance and reluctance to change amongst his colleagues who are often trapped in traditional ways of teaching.

When asked how he manages to use technology during his lessons, he explained:

I started using ICTs after the computer lab was furnished with computers and connected to Wi-Fi. I then applied my knowledge of computers such as the use of Microsoft Word to organise concepts for teaching and to look for the current information from the internet.

Khanya uses Microsoft Word and the internet to look for information. He indicated that the skills that he acquired helped him to be able to efficiently use technology in his teaching activities. He reported as follows: "I know lots of stuff on the computer that I feel confident to use in my teaching." Khanya provided details on how the skills that he acquired enabled him to integrate ICT in his teaching. He said:

I am able to use a projector for the learners to see notes on the wall as I teach and they would ask questions on the spot when they do not understand. This makes my work easy because there is no time wasted on writing the notes. Learners take notes as we go along.

According to Khanya ICT training enhances teaching strategies and has made it possible for him to integrate ICT in his teaching instruction. Sharma (2022) encourages training of teachers for effective ICT integration. Khanya's perception of ICT PD appears to be positive because he emphasised that ICT integration made his work easy. He mentioned that time was also saved as he would not have to write notes. The benefits of ICT integration that he outlined portray evidence in transforming the classroom situation. However, both lessons observed did not show any evidence of ICT. The lessons showed a reliance on text-books by the learners. He explained this observation: "I do not use ICT in every lesson. For instance, the ICT lab is being used for ICT education practical now." This statement shows that a lack of resources is a hindrance to ICT integration. Normally, accessibility of ICT resources does not necessarily mean successful implementation of ICT use. Das (2019) argues that teachers' attitudes to the contribution of ICT in the classroom and their confidence in ICT integration affects the use of technology for teaching. Khanya has demonstrated technology-enabled learning where the use of ICT is seen to support meaningful learning as shown by Albion *et al.* (2015).

The scheme and record of work substantiate the provision of ICT use as he has stated. The record of resources in the scheme and record of work indicate the use of certain websites for materials to use, such as 'save my exams' for question papers and worksheets. Khanya stated in the record of work done that, the online questions and content are very helpful in his teaching as shown in Figure 4.1.

10/04	Distance-time graphs	3	Save my exams	
17/04	Plotting distance-time graphs	3	Save my exams	learners were struggling with the plotting graphs.
24/04	Calculating the gradient from distance-time graphs.	1	save my exams	learners struggled to use graphs so I had to use square root
01/05	Plotting speed-time graph	3	Work sheets save my exams	
08/05	Calculating acceleration from speed-time graph.	1	Worksheets	lesson went well but one lesson was missed because of open day

Figure 4.1: Khanya's record of work done

The use of technology tools seems not to be recorded anywhere in the documents that he provided. When talking about how he decides in which lesson he uses technology, he explained:

I normally use technology at the beginning of teaching a new concept. This is to make learners understand the concept and in the lessons that follow I test the understanding of the concept. I normally use materials from the internet to help me with questions and up to date content in the subsequent lessons.

In this excerpt Khanya emphasises that he does not use technology for all his lessons, but only with lessons when new content is introduced. He indicates that he uses questions from the internet to help in assessing learning on the content he has covered. This confirms what I observed in the scheme and record of work that 'save my exams' is the most used source of questions.

4.5.2.1 The use of ICT tools

Khanya mentioned the use of cell phones at home for research and the computers in school for teaching and learning. He explained the engagement of ICT by saying: "We use ICT tools such as smartphones to increase the learners' interest and to create a flexible environment for learning. However, this is done with only the external classes

because the learners in these classes are responsible people now.” He explained the school policy:

[...] Learners are not allowed to bring phones to school for so many reasons. For the external classes I report such phones in the office and after class I collect them for safekeeping and give them out after school.

This response supports the fact that Khanya does not use ICT in all his lessons. He mainly uses technology in teaching external classes. He indicates that the school policy does not allow learners to bring phones to school, but on request they are allowed to. In such cases the teacher takes responsibility for the learner’s property.

4.5.2.2 Beliefs and attitudes

When addressing the issue of whether he sees ICT integration improving the quality of education in Lesotho, he remarked:

It is improving the quality of education in those schools where it is effectively employed. I say this because in my school the results are improving and we also have learners getting A in Physical Science. It shows that ICT use benefits the learners. The WhatsApp use also appears to be helpful because the learners come to school prepared for the lesson and their readings are in their hands.*

This demonstrates that Khanya is aware that ICT integration positively influences the way learners perform in Physical Science. He shows that he acquired helpful materials from the internet. Khanya also claimed that, “[he has] also realised their interest when they learn through technology [...]” He has used ICT to capture the learners’ attention and interest in class. Khanya’s handling of ICT integration makes it recognisable that he is enthusiastic about ICT use. His beliefs seem to be that there is increased time for learning when ICT is used, as learners are able to learn from home when he shows them that, “their work is in their hands.”

He said, “Whenever I come across important content I send it to the group and discuss it further there. This is the easiest way of learning from anywhere [...] that seems to involve even the introverts.” He appears to maintain that ICT integration gives him and the learners some flexibility to be open with their questions, especially for those who are reluctant to talk in class. They are able to type their questions for clarification on a

WhatsApp group platform. Khanya seems to have a positive attitude towards ICT integration as he understands the notion of ICT integration and its benefits. Henderson (2020) argues that what takes place in the classroom is mostly influenced by the belief and attitude of the teacher. Data provided show that, despite the obstacles that Khanya encountered, he insisted on using technology in different forms which can imply that this use makes information and its delivery convenient.

4.5.3 The significance of ICT integration

When replying to a question about the benefits of the ICT training he had received, Khanya had this to say:

With the training that I got, I had to use ICTs because the learners are currently technology oriented and confident. Using the internet or technology for teaching has aroused learner interest and readiness to learn. They learn with the tools that they like the most, the smartphones and the computers. If they all had smartphones, teaching would be easy and enjoyable.

Khanya shows the importance of ICT integration that he established from using ICT for teaching and learning. The narrative suggests that Khanya observed a positive impact on learning from the use of technology for teaching. He observed increased interest to learn when he claims that: "...this aroused learners' interest and readiness to learn." This statement shows that learners are more motivated to learn when they use technology and especially in an environment that is flexible we see that participation increases. Luhmya *et al.* (2017) confirms that technology use in the classroom brings a powerful learning environment for learners to experience self-directed learning. The extract indicated that the use of ICT has proved to provide easy access to content at that particular time and place. However, there are challenges encountered that hinder the exploitation of ICT benefits.

4.5.4 Barriers to ICT integration

When talking about whether he is able to integrate ICT in all his lessons, Khanya stated: "It is not possible to use ICT in all my lessons because sometimes I teach from the

classroom where there is no ICT equipment. Sometimes the lab is doubly booked and my preparation fails and learners are not always allowed to bring their smartphones; this could help if it were allowed to happen every day.” Khanya indicates that he relies on the computer lab for most of his ICT use at school. He addressed the school policy of not allowing learners to bring their smartphones to schools as a barrier to ICT integration.

4.5.4.1 Lack of resources

Khanya indicated that in school 2 ICT resources are available, although they are inadequate. He unreservedly highlighted:

We have a computer lab that is fully wired and connected to Wi-Fi. The Wi-Fi ranges within the whole school compound. In this lab there is a projector and there are speakers which make the sound audible enough since the lab is big. But the resources are not enough.

The narrative suggests that the computer lab is not enough to accommodate ICT integration for all the subjects on a daily basis. He explained the challenges as follows:

Double booking of the lab also becomes a challenge. It shows that all classrooms need to have a projector fixed there. Moreover, physical science has no double lesson [...]. The fact that learners are not allowed to bring their mobile phones also makes it difficult to use ICT in the classrooms.

Khanya’s statement indicates that more projectors are required in schools where ICT is practised. To overcome this problem it would make it easier to incorporate ICT in the classrooms if the learners were allowed to bring their smartphones to school. Not allowing learners to bring their smartphones to school seems to be prevalent in all the schools. This shows that schools may share a common background, as they are in the same town. Khanya wanted to have a double lesson for Physical Science to have time to integrate ICT. This could be a way to counteract the ‘limited time’ problem.

4.5.4.2 Lack of ICT training

On giving suggestions as to what he thinks can help improve ICT integration in his teaching, Khanya indicates:

Training on ICT should be an ongoing process. There is still room for improvement even if I can train other teachers. This technology keeps evolving, it requires one to be up to speed. There should be a qualified ICT teacher to teach ICT to the learners who will also be tasked to train teachers in a particular school on ICT integration. This would cut the costs of taking every teacher for training or workshop as every school will have a trainer.

This statement gives an impression that Khanya believes that to close the technology gaps teacher PD on ICT can be done in school-based training workshops. It also implies that Khanya believes that further training on ICT use could encourage the use of ICT for effective teaching and not only as tools to improve classroom communication. Guskey (2014) argues that PD towards ICT integration can make a substantial difference in teachers learning if it is teacher specific and focuses on day-to-day classroom activities. Khanya indicates that it is easy to implement ICT integration if one is knowledgeable about technology: “This technology keeps evolving; it requires one to be up to speed.” Albion *et al.* (2015) argue that the use of ICTs can be successfully implemented when teachers’ knowledge and practical beliefs on ICT are developed. The implication here is that knowledge on ICT is never enough, it requires on-going learning.

4.5.4.3 Stakeholders support

Khanya spoke of the issue of support from many departments. When reporting about the support he received on ICT integration, he said,

I got support from different departments. My principal too is very supportive. She (the principal) has realised better performance in Physical Science and she is happy about the way the teachers in the department do things.

Khanya says that he has the support to integrate ICT because he received training from different government departments. Dlamini and Mbatha (2018) maintain that teachers need to be trained in the pedagogical applications of ICT skills and not only in computer literacy. Khanya also stated that his principal also offers him support to integrate ICT in his teaching. He indicated “not enough resources” as one of the challenges that compels the principal to sometimes allow learners to bring their smartphones to school for use of the internet in class.

Khanya had already mentioned the need for more projectors. He says that, “[t]he full Wi-Fi coverage allows me to seek for newly researched information even in the comfort of my home.” It appears that availability of the internet makes ICT integration accessible. This suggests that ICT integration relies mostly on the availability of the internet. This is where Khanya gathers recent relevant content. However, further equipment and training are also crucial in this issue. This implies that the education sector stakeholders distributing computers to schools should also contribute by investing in the training of teachers on ICT integration.

Khanya indicated that he felt that the MoET was not doing enough to capacitate teachers when a new education venture has to be implemented. He said:

The Ministry is failing the teachers, it requires that teachers to employ the new innovation in the education sector through being trained by other teachers. From there they never come for support, assistance or inspection. One thing that the ministry did was to merge Thakakhoali into LSMETA, which did not reach all the teachers, as the training was a once-off thing.

Khanya indicates that the Ministry of Education has not done enough on training teachers. The programme or the group that trained the representatives of teachers’ associations did a once-off training that had no follow-up. The implication is that education inspectors are not doing enough to see the endeavour succeed. Alkahtani (2017) opines that ICT resources and infrastructure are necessary but the teachers and learners need also to be inspired and supported in the ongoing knowledge and application of ICT.

4.5.5 Summary of Khanya’s story on ICT integration professional development

The findings presented show that Khanya had been involved in several PD encounters on ICT. The training enabled him to be able to train other teachers as well as to integrate ICT in his teaching instruction. Khanya reported that the training that he received on ICT enhanced his teaching strategies, saved time for learning and improved the learners’ interest. He testified that his ICT integration commanded improved performance in Physical Science. However, in the observed lessons, there were no traces of ICT tools, as he had indicated that he uses ICT in his teaching. The element of ICT in use was

observed in his scheme and record of work that showed the use of materials from the internet.

Khanya has a firm understanding that to improve education through ICT integration teachers need to be trained to be able to use the resources provided in their schools. Reluctance and negative attitudes towards ICT integration are perceived as a result of a lack of knowledge and competence in ICT. Khanya perceives ICT integration PD as a crucial step towards realising quality education. This matter seemed to be aroused by the fact that the world is rapidly changing and learners are more inclined towards technology.

On the basis of the data presented, Khanya had also encountered challenges in teaching activities when he used ICT. He found the time allocated for Physical Science to be a limiting factor, mainly because there are no double lessons. He also reported limited resources in the laboratory as a hindrance when attempting ICT integration in the classroom. He considers the matter to be aggravated by the fact that learners are not allowed to bring their smartphones to school. Khanya also seemed to be concerned and blamed school inspectors for a lack of support and for the lack of any follow-up on ICT integration.

Khanya believes that what takes place in the classroom is mostly influenced by the belief and attitude of teachers. He commends ongoing PD of teachers as a necessity that needs to be followed by support from the school inspectors. He also finds that training for ICT trainers in each school to be the best method of information dissemination that would be cost effective and can reach more teachers. However, support and follow-up needed to show determination for this innovation have to be provided.

4.6 CASE STUDY 3: THE STORY OF KHOTSO

Khotso is a male teacher who is in his early thirties. He started teaching in 2019 and had five years teaching experience at the time of the study. Khotso majored in maths and Physics in his degree programme. He teaches from grade 8 to grade 11 in school 3. His school is in the centre of Maseru district and is known to admit visually impaired learners. Khotso's approach to teaching was not observed because learners had started revising

for their mid-year examination. The interview continued as planned. He narrated his story on the experiences he had encountered since he was a teacher:

Ever since I started teaching Physical science, I have noticed that the learners are struggling. Science seems too abstract for them. They do not understand Science as a reality. Then it becomes difficult for them to understand its concepts.

When addressing the issue of whether he uses ICT for teaching, Khotso responded in the following manner: “I do use ICT tools when teaching.” This statement indicates that Khotso does use technology in his lessons. He clarified on how he uses ICT tools as follows: “There is an ICT lab here that has about twenty computers and free Wi-Fi. However, ICT use is not binding. It depends on an individual’s keenness.” This suggests that Khotso had decided to use ICT out of his own free will. When he was asked if the training he had received at the teacher training centre empowered him to manage ICT integration, he responded: “I used ICT tools in the university and did the course on ICT in my first year. The knowledge from this course helped me use some of the computer applications throughout my university studies.” This gives the impression that Khotso can use some technology tools because of the knowledge he gained in his first year and his use of technology during his university education.

On the question of ICT integration, in the light of his declaration, Khotso was asked if he is aware of the use of technology in teaching and he said: “Some schools around town here use technology for teaching. I think maybe they are well trained and have enough ICT resources. I use it but there are many challenges encountered.” The statement indicates that Khotso is aware that schools around school 3 use ICT for teaching. However, this remark reveals his opinion that teachers from these other schools must have had ICT-related training and because of this they encounter few challenges in ICT integration.

The next subsection explores how PD towards ICT integration shaped the teaching instruction of Khotso. The discussion focuses mainly on the training that he had received and how it had helped him to integrate ICT in his teaching instruction.

4.6.1 Professional development in ICT integration

When discussing the training towards ICT integration that Khotso had received; that is whether it was formal training or informal assistance, he said:

Ever since I was a teacher I have never got any form of training or workshops from the ministry. The only training I have acquired is from the university and from colleagues through the sharing of skills as they showed me how this and that are done. I have also equipped myself with other computer skills through reading and research over the internet.

It is evident from Khotso's remarks that teachers' knowledge on many aspects of teaching is insufficient. Dumlao (2020) indicates that the knowledge teachers' gain at training centres has little relevance to what they need in the classroom. Khotso's knowledge on the use of ICT also came from his colleagues and from his own research. As a new teacher he has never been equipped with the necessary skills and knowledge needed to adequately carry out ICT integration, but says that he can use some ICT tools in his teaching. Khotso's opinion is that effective ICT integration can transform teaching activities and ensure improved quality learning. UNESCO (2014) shows that success of ICT integration in teaching and learning requires a change of focus from computer literacy for teachers to further understand ICT integration in education from the pedagogic perspective.

On this note, Khotso indicated that he needed preparation for ICT integration: "The skills that I acquired are not enough for me to integrate ICT to standard because I am still learning some applications." This statement shows that there are instances when Khotso fails to use some computer applications for teaching. It is not easy for him to use computer applications that he is not competent and confident with. He explained the reason for his use of ICT tools in his teaching instruction as follows: "I use it [ICT] because I needed something that can help me deliver the content better to make learners understand." The statement implies that Khotso considers ICT use as good pedagogical practice for effective learning.

What Khotso says echoes the findings of Ghavifekr and Rosdy (2015) demonstrating the need to train teachers in pedagogical practices rather than only training them to use ICT

tools. When there are new innovations and approaches to teaching teacher training is essential.

4.6.2 ICT integration in teaching practice

When asked about what he uses in his ICT integrated lessons, Khotso responded as follows: “I mostly use simulations, sometimes I use downloaded videos from the internet. I project these videos or simulations in the ICT lab to enhance learners’ understanding.” This information suggests that Khotso uses the internet to download and project videos and simulations to try to improve the quality of content delivery for improved understanding of the concepts. Khotso perceives ICT integration as an effective way for achieving better and quality teaching and learning.

Khotso is teaching in school 3 where the policy call for investment in digital infrastructure is embraced. However, applicable use of this infrastructure does not appear to adequately facilitate teacher effectiveness, especially because of the established regulations controlling lab use. Security for the lab and the range of the Wi-Fi seem to be a hindrance when considering the full use of ICT necessary to create an appropriate learning experience for learners in this school. Kohnke (2021) opines that ICT resources and infrastructure are necessary, but the teachers and learners need to be supported in the use of ICT for teaching and learning. Khotso was asked whether ICT integration is properly implemented in his school and he answered as follows: “ICT integration is not properly implemented in my school, because it is not binding. Only a few individuals are interested in ICT integration and so far we have seen improved results. This statement indicates that Khotso is one of the teachers in school 3 who uses ICT. He has seen improved performance from using ICT in teaching.

He added that there is ICT education in his school when he said: “However, learners do go for computer studies in the lab and are interested in learning the technology skills.” The statement indicated that the ICT lab is used for ICT integration as well as for ICT education. This indicated that Khotso has observed that learners are interested in learning ICT skills and this suggests that learning with and from technology would also excite them.

When asked what his views on ICT integration are, Khotso said: “I really like to use ICT for teaching these kids [referring to the learners] because learners nowadays are more into technology and that would arouse their interest to learn.” He indicated that he uses ICT in classes because he believes that ICT integration could change the way learners approach their learning. His view is based on the fact that learners are already interested in technology and it follows that teaching them through what interests them may arouse their interest to learn. He mentioned what influenced him to use technology as follows:

As I was reading scholarly articles and doing my research on how best I can teach in this technological era, I found ICT integration to be more recommended. Those articles provided more advantages of ICT integration. Abovementioned, the government provided our school with a furnished computer lab which we had to make use of. The Wi-Fi coverage is also good and ranges around the ICT lab and nearby classrooms.

The statement suggests that Khotso needed to change the way he teaches and move towards better pedagogical practices so as to suit the skills needed in the 21st century. It is evident in the excerpt that he did his own research and found out ICT integration to have the advantages that could improve teaching and learning. Khotso also indicated that the provision of a furnished ICT lab by the government implies that ICT resources need to be used. He therefore decided to use ICT for his teaching instruction out of interest. This is consistent with the finding that effective ICT integration to support existing teaching knowledge and practice depends on teachers’ motivation, personal ICT knowledge, experience, confidence and also the availability of resources (Albion *et al.* 2015).

When asked to describe his concerns, he said:

ICT use can benefit the education system because it would make our work easier and also learners will be eager to learn. However, lack of training on ICT integration is a problem because there are some applications that I would like to do but I can’t, such as creating my own simulations. I have tried but I haven’t been successful.

This shows that Khotso is not fully content with the professional advances he had made with ICT. It demonstrates that he regards the lack of training as a concern for ICT integration because he cannot use technology without restraints. He believes that training to address such issues is necessary. This is corroborated by Avisteva (2019) when he indicates that “... [t]here is a relationship between obstacles of lack of accessibility and

lack of competence.” This implies that teachers’ willingness to integrate ICT in their teaching is also influenced or conditioned by the resources available to them.

4.6.2.1 Use of ICT tools

When asked to elaborate on how the use of ICT affected his teaching, he said:

To be honest, the use of ICT changed the way I teach and plan for the lesson. It has provided me with vast recent information that makes my work easier. It has enhanced the way concepts are clarified because learners see what I am talking about.

This statement expresses the satisfaction Khotso feels with the use of ICT. It implies that Khotso as a teacher benefits from ICT integration. His work is now easier and concepts are more easily clarified for the learners, in a way that reduces complexity as learners ‘see’ what they are learning. Khotso indicated: “The ICT tools I mostly use are my laptop and computers in the lab as well as the projector.” The tools that he has mentioned indicate that he downloads and projects materials. He does not talk about applications such as PowerPoint and Microsoft Word. This might indicate that Khotso is unfamiliar with many computer applications.

4.6.2.2 Beliefs and attitudes

Khotso has shown a positive attitude towards ICT integration because he knows the benefits of ICT integration from experience. He said: “Regardless of the lack of adequate training it is my responsibility to see that effective learning takes place in my lessons. So I try my best to use ICT in teaching.” This statement indicates that Khotso admitted that it is his responsibility to see that there is effective teaching and learning in his lessons, hence he uses ICT in teaching instruction. Khotso has shown a positive attitude towards ICT implementation. The belief that ICT integration would change the way learners approach their education drove him into doing his best to use technology amidst the challenges that he encountered in his teaching. His attitude towards ICT integration is a view corroborated by Aslan and Zhu (2016) who believe that attitudes towards technology use affect frequent incorporation of ICT in teaching instruction.

4.6.3 Significance of ICT integration

When talking about the benefits of ICT integration that he has observed, Khotso indicates that if effectively implemented, ICT integration could improve the quality of education and increase the learners' retention of the content. He says that, "[t]he use of technology captures the interest of the learners and this makes them interested in their school work." According to Khotso ICT integration increases learners' diligence towards learning. On the issue of how ICT integration plays a role in learning, Khotso explained: "Using ICT helps me to cover a lot of content within a short period of time." This implies that ICT use saves time. He continues: "When I use simulations and the videos learners are able to see directly what I am talking about and in that case the concepts are easily clarified." This statement shows that Khotso had experienced a better teaching strategy in ICT use, as he demonstrated that "concepts are easily clarified." This statement shows that for him learning is improved with ICT use.

Khotso was asked to give his opinion on whether ICT integration would improve the quality of education in Lesotho and he responded as follows:

ICT would definitely improve the quality of education in Lesotho if employed. I would not say it does because it has not been obligatory in secondary schools. It would enhance teaching and learning because the traditional way of teaching is not working anymore since the learners are used to technology. Bringing the use of laptops or tablets will excite them because they are interested in such things.

Khotso believes that ICT integration would enhance interest to learn when he says: "It would enhance teaching and learning because this traditional way of teaching is not working anymore [...]." This statement shows that when learners are interested in what they are learning and how they learn, that will change their attitude towards their school work. He was asked about the impact of ICT integration on his teaching, and he answered:

Using ICT tools or technology enhances the learners understanding of concepts. It helped me to easily access the internet and source valuable information there. It makes my work very easy. Preparation is no longer channelled to one old textbook with outdated information.

This indicates that ICT integration impacted positively on Khotso's teaching. Easy access to recent information makes his preparation for the lesson easier. The information that

emerged in this regard shows that Khotso uses ICT integration for its benefits in education. He clarified what led him to take the decision of using ICT:

The learners would keep quiet and look at me when I talk, engaging them became a problem... I read that ICT integration appeared to be a solution. Using ICT helped me to attain the learner-centred lesson like I always wanted to. Even those that never participate in an ICT integrated lesson are engaged.

The excerpt indicates that Khotso achieved a learner-centred lesson through using technology in his teaching. It indicates that even those learners who are introverts were able to express their views and participate in class. However, the data reveals that challenges were encountered in his ICT integration expedition. The discussion that follows looks into how Khotso's ICT integration was affected by these challenges.

4.6.4 Barriers to ICT integration

The act of integrating ICT in teaching activities is a complex process. One may encounter challenges that may make it difficult for its use and to achieve the objectives of ICT integration. These challenges are often out of the sphere of control of the teachers.

4.6.4.1 Lack of resources

When talking about the barriers to ICT integration in his school, Khotso seemed to perceive lack of infrastructure and resources to be a hindrance to ICT integration. Commenting on this, he said:

My school has a computer lab that is fully wired and has free Wi-Fi. However, these are not enough. The Wi-Fi is restricted to the ICT lab and yes some of the classes around it also have coverage. But this becomes a problem if one wants to use ICT and teach in a classroom without Wi-Fi coverage. It also appears that the administration is not taking measures to rectify this problem.

This shows that Khotso is concerned that there is only one ICT lab and limited Wi-Fi coverage range. These two factors hinder ICT integration in classes far away from the lab. All teachers who need to use ICT should be able to do so. It implies that the lab may be doubly booked, thus leading to a shortage of resources. Khotso is also concerned with

how the administration is handling the use of ICT. The measures needed to rectify this problem do not seem to be a priority.

4.6.4.2 Lack of training

Khotso mentions that his level of preparedness to fully integrate ICT is not up to standard. He says: “I am not fully competent to integrate ICT, but I do use it. This is because the training I got from colleagues is not enough for me to confidently employ other computer applications on ICT integration. I just use ICT tools for teaching.” He feels that there is room for improvement when it comes to his ICT knowledge. The training and knowledge that he acquired from colleagues seems to be inadequate. He says: “I still believe that professional training would do me good and that there are better ways to integrate ICT. For instance, I rely on already made simulations, but I’m still learning how to do it from colleagues.” Khotso indicates that professional training on ICT integration is what he needs to boost his competence and confidence for ICT integration. He further indicated: “These learners are computer literate and some of them are already IT technicians. I do not like to blunder in front of them.”

The above discussion suggests that Khotso’s competence on ICT integration is quite poor because of a lack of knowledge of many computer applications. He attributed his incompetence to a lack of professional training. This indicates that the training that people acquire informally is not enough to allow efficient integration of ICT in teaching instruction. Dlamini and Mbatha (2018) validate his response when they indicate that a lack of training leads to a lack of confidence and continued incompetence in ICT integration. Teachers who are not competent with the use of ICT tools may feel anxious about failing in front of the learners. Khotso just sticks to the uses of ICT he is conversant with.

4.6.4.3 Stakeholders’ support

When asked if he thinks the DoE is doing enough to capacitate educators when a new education venture has to be implemented, he responded as follows: “I for one, think it is

necessary that we have professional training because some of these people who train us still need some training.” The statement indicates that Khotso is not content with the training that he received from colleagues. His statement implies that he found incompetence amongst these teacher-trainers, hence his need for a professional trainer. He added that, “[t]eachers won’t be interested in using ICT if they lack the knowledge and competence in ICT integration.” Arkorful *et al.* (2021:3777) support Khotso’s opinion that, “[w]hen teachers are insufficiently trained, they will not be adequately confident with the integration of ICT in their teaching.” Khotso indicates that teachers’ ongoing PD has to be regarded as a crucial step to compensate for the changing needs of education. Kaya and Godek (2016) and also Dlamini and Mbatha (2018) assert that teachers’ PD is a persistent and compelling challenge that requires priority attention. Khotso added to his concerns about MoET support: “The first thing could have been the provision of resources and infrastructure.” His expectation seems to be that the government should build ICT labs in schools and furnish them. However, he had already indicated that the government had provided his school with twenty computers, which are still inadequate for proper ICT integration in the school.

At first Khotso seemed to be unaware of the ICT policy that he even mentioned that he uses ICT out of his own volition. He responded: “As I was reading through scholarly articles, I found ICT integration to be the best way to teach in this technological era.” He indicated that, “[t]here has to be a school ICT policy which is in line with the national ICT policy to reinforce ICT use and ensure that the resources are appropriately allocated and used.” The restricted Wi-Fi was a hindrance to ICT integration, especially when he wants to use ICT in other classes. He further indicated a lack of support from the principal when he said that, “Wi-Fi should have been made available to all the classes because we are many; most teachers use ICT in their respective classes and encounter a problem of lack of internet and projectors.” This statement gives the impression that he considers the principal’s decision to restrict Wi-Fi coverage as a hindrance to ICT integration. Razak *et al.* (2019) argue that school management is a substantial catalyst for effective ICT integration and resistance to integrate ICT may also be due to a lack of support from the stakeholders.

4.6.5 Summary of Khotso's story on ICT professional development

Data presented on Khotso's perspectives on PD for ICT integration show that he appears to have a positive attitude towards ICT integration. He is keen to use ICT-based instruction in his teaching. He indicated that the use of ICT in his school is not binding; he uses ICT because he realised that ICT integration is a good pedagogical practice to use in this technological era. This indicates that Khotso perceives the role of ICT integration as an effective way of achieving better and quality education.

On the basis of PD on ICT integration, Khotso indicated that in addition to his university course on ICT, he received training through self-education from the internet and also from the training offered by colleagues. He specified that the training is inadequate because he still lacks some ICT skills such as creating his own simulations. He reported that this incompetence channels him into using only those skills that he is competent and confident to use. Khotso indicated that there is a need for ongoing PD for ICT integration.

Khotso's interest in ICT integration emanated from the need to change the way he teaches to include pedagogical practices to improve learning and the skills needed in the 21st century. He uses technology tools such as computers or his laptop and a projector. He indicated that he is more inclined to use a projector for the learners to watch videos or simulations. He clarified that the use of these videos and simulations helps him to reduce the complexity of Physical Science concepts and to improve teaching and learning. ICT integration has shown significantly positive results in Khotso's lessons. This activity has helped the learners to be more interested and diligent with their school work. He reported he has noticed an improved performance in Physical Science since he used ICT in his teaching. He also reported that ICT integration has helped him achieve more learner-centred lessons as well as effective learning. That allowed him to improve content coverage. Despite his enthusiasm for ICT integration, there were challenges reported.

Insufficiency of resources was observed as a hindrance to Khotso's ICT integration. The fact that Wi-Fi is restricted to the ICT lab affects ICT integration in other classrooms. He indicated that this situation compels ICT integration to be implemented only in the lab or

in classes around the lab. In this regards, he indicated that the learners often struggled with diagrams. This situation portrays that the administration is dedicated to seeing ICT integration properly implemented in school 3. He regards a lack of support from the MoET as another barrier to ICT integration; his incompetence in some ICT applications results from a lack of professional ICT training. Khotso indicated that the training he needs to effectively and efficiently integrate ICT should be based on ICT pedagogical practices and not only computer skills.

4.7 CASE STUDY 4: THE STORY OF THABO

Thabo is a male teacher in his mid-forties. He is teaching Physical Science at a secondary school in the capital town of Lesotho. He majored in Maths and Physics for his diploma and BSc Ed degree. He started teaching Physics in school 4 in 2006. The first communication with Thabo was by telephone. He was nominated by the principal to be the best candidate for this study but he was absent from school on the day I visited. The principal indicated that Thabo is the teacher who deals with ICT issues in the school.

Thabo discussed his first experiences as a Physical Science teacher: “I first started teaching Physics in this school in 2006. I was the only Physics teacher therefore I had to teach only Physics in all the classes.” He indicated that he taught Physics in all the streams because he was the only teacher who had specialised in Physics. He said,

It was tough teaching Physics because there was no equipment in our lab to conduct practicals. There were also no books provided by the government back then to assist learners in learning. Therefore, I had to be always photocopying materials. This annoyed our principal.

Thabo looked back on the journey he took in teaching Physics and was able to see the opportunities that ICT integration could bring if effectively implemented in his school. Thabo’s teaching of Physics had not been easy due to a lack of resources such as books or the equipment necessary to conduct experiments. He indicated that photocopying diagrams and materials from the books was the best solution for this problem back then.

When asked what he knows about the ICT policy of 2005, he said: “I don’t know much about it. What I remember is that it showed that the world is changing fast due to the fast

changing technology. Therefore, the education sector should make sure that learners have computer skills.” He indicated that he had an idea of the contents of the policy when he said that, “[i]t showed that the education system has to change with the changing world in technology.” On this issue he was then asked whether the training that he received from teacher training college and university was enough to empower him to manage these transformational education policies. He answered as follows: “In respect to the ICT policy, it was not a problem at all for me because when I was at the college I took computer studies as an elective course from the first year to the third year.” Thabo showed his interest in ICT education from his college days. This shows an entangled relationship between the teachers’ social environment and their perspective on PD on ICT.

4.7.1 Professional development in ICT Integration

When asked about his views on PD towards ICT integration, he said: “PD of teachers towards ICT integration is a necessity because one cannot just use ICT for teaching if he or she is not knowledgeable on the basic applications of computers.” The statement shows that knowledge and competence in ICT skills may lead to confidence in integrating ICT into teaching instruction. This statement is supported by Alghamdi (2020) who confirms that through PD teachers acquire life-long learning that would help them cope with the challenges of the changing technological world.

4.7.1.1 Training on knowledge and use of ICT

When addressing the issue of whether he got formal or informal PD towards ICT integration, Thabo elaborated on the training he received on ICT as follows: “I think I got all forms of PD towards ICT use in my lessons. First and foremost, I already did computer studies at college and was already computer literate when I got to work.” Thabo indicated he acquired computer skills from a course he studied. He is therefore conversant with computer applications. However, this did not prevent him from seeking continuous PD from other platforms. He clarified on his further training on ICT as follows:

I went for ICT training in 2008. This training was provided by School Net SA. It was on Microsoft Office, e-mailing, a little bit of programming and how to use Microsoft Excel. They also provided us with exercises on how to use ICT for teaching. Our schools were then each given five (5) computers to start ICT education.

This shows that Thabo had received ICT training on the first training that was designed to integrate ICT education into the curriculum. He became informed about different computer applications, which made him confident and competent to use ICT in his teaching activities. Such a training process is believed to help teachers improve their teaching and fosters learning (Habibi *et al.*, 2020). When asked if the training capacitated him adequately to integrate ICT into his everyday teaching instruction, he indicated: “The training was not necessarily for ICT integration, it was meant for us to go to teach learners ICT education. But it helped me to also be confident enough to use ICT to teach my lessons.” Even though the training was offered towards ICT education, the skills that Thabo acquired there enabled him to use ICT for teaching. He confirmed that he was trained on how to use ICT in his professional work as he stated: “I was trained to create a master timetable for the school, design mark sheets as well as school candidate’s reports.” Thabo’s description implies that the training provided him with skills other than the use of ICT for teaching only.

He added that he also received another form of technical training from associates and this added to his computer skills. He said: “It happens that I have colleagues who are IT specialists. They also taught me how to fix a technical problem on a computer. So with this knowledge I am competent in the use of computers or any technology device.” This excerpt demonstrates another skill Thabo has acquired during his ongoing PD on ICT. It shows that he can also fix certain technical problems with computers. This skill helps him in ICT integration and he does not have to wait for a technician if problems arise.

4.7.1.2 Application of ICT integration

When asked about how the training on ICT affected his work, he specified:

The training I got equipped me with skills to teach ICT education confidently. It has made my work easy as I easily get information through the internet and arrange it to suit my lesson needs. I sometimes teach using the ZOOM platform if I don’t make it to school or leave some work for the learners on WhatsApp groups. It has

also increased the learners' enthusiasm to learn and to participate in class activities.

The extract indicates that Thabo has obtained PD on different platforms. This increased his confidence and competence in ICT integration. He indicates that ICT use has provided him with the possibility to exchange of ideas on a teaching platform, irrespective of the distance. He indicates: "I normally have a WhatsApp group with the external classes where we communicate and I clarify concepts on their request or I leave exercises for them to do as assignments." The use of ICT in education has made work easy for Thabo as Sharma (2022) confirms that ICT has a mass of information that may be tapped and used. It has been reported in the literature that the use of ICT for teaching increases the learners' interest for learning (Gavifekr & Rosdy, 2015). When talking about the concerns that he has about ICT integration, Thabo indicated:

I am highly motivated and optimistic about it [ICT]. It provides easy access to valuable information at the disposal of both the teacher and the learner. When taught with the help of ICT learners showed more interest and the rate of submission of assignments increased. However, poor infrastructure and lack of support are disappointing [...].

He shared his observational concerns for other teachers as well when he said: "For other teachers, ICT integration requires training on the use of computers and other technology devices because lack of knowledge of the basic skills on computer use may lead to failure to use ICT for teaching." Thabo believes that ICT integration enhances teaching and learning. However, the integration of technology into teaching and learning activities depends on teachers' knowledge (Habibi *et al.*, 2020). He also indicated that learners in this era are technologically inclined and teaching them with the use of technology does not only enhance learning but improves their interest to learn.

When asked whether ICT was properly implemented in his school, he said his concern was that for ICT to be effectively implemented there have to be adequate resources such as Wi-Fi connection, projectors and computers. He commented: "I had to train my colleagues when I was from that training, if we (the school) had enough resources such as more computers, projectors and a fully connected lab, we (teachers) would effectively implement it [ICT]." He also pointed out that "teachers need to be constantly trained because new technology keeps emerging." Thabo indicated that PD has to be an ongoing

process because information and technology keep on changing rapidly (Jogezai *et al.*, 2018). He had also indicated earlier that teachers learning from each other would be another way to increase ICT integration. He shows that ICT training may boost confidence in the teachers to employ technology in their teaching when they are competent in its use.

The above discussion suggests that Thabo has a strong belief about ICT integration because he has used it and seen the effect on his teaching. He attributed the increased rate of submission of assignments to increased inspiration to learn. Ghavifekr and Rosdy (2015) confirm that ICT encourages learners to communicate more and this increases learners' confidence to actively participate in class. The next session looks at how Thabo uses ICT in teaching practice.

4.7.2 ICT integration in teaching practice

The literature informs us that reforming pedagogical practices to better meet 21st century challenges through ICT integration has been on the agenda of many countries. When asked if he uses technology in his teaching instruction, Thabo said: "I use technology in teaching the external classes only." He explained further how he integrates ICT in his teaching of external classes:

I use PowerPoint because it allows me to use notes as well as videos for the learners to have a clear picture of what we are talking about. Sometimes I use YOU-tube videos or simulations to demonstrate and summarise the lesson. Sometimes I share the information on the WhatsApp platform with the learners. [...] I use zoom to teach when I am absent from school on a few encounters where I arrange with another teacher to help me set up for the learners to be in my class at a certain time.

It is evident from this extract that Thabo uses different pedagogical practices for ICT integration. It was necessary to further understand how ICT integration affects his teaching. He replied as follows: "I started using ICT for teaching because I enjoy using ICT tools and I became aware that learners enjoy the use of computers too because I teach them computer studies." This statement indicates that Thabo is computer literate and he is entrusted to teach computer studies because he was trained for ICT education.

4.7.2.1 Use of ICT tools

On explaining why he was not seen using any ICT tools in the lessons observed, he says that,

[t]here are no projectors in the classrooms this shows that for proper and effective implementation of ICT there has to be a projector in every classroom. [...] The observed lessons were not done in the lab because the lower classes are using the lab for their practical computer education. They go there in groups.

Even though Thabo was positive about the use of ICT, it is evident that there are constraints to the effective use of ICT in his school. This implies that he may use ICT for teaching but he is only able to do so during a few lessons. Thabo also explained the way he integrates technology in his lesson. He was of the opinion that integrating ICT effectively requires one to be conversant with the complexities of technology. He narrated that,

[s]ince we (the school) do not have enough of the necessary resources for the use of technology, I normally divide the class into groups. [...] For example, if they have to watch a certain video on one laptop, one group goes for one lesson and the other for the next lesson. I do this because knowledge is retained when they have seen. Sometimes these computers have technical problems, I have to fix that before I can use them for class.

Responding to the issue of time for syllabus coverage, he stated that, “[w]hen some students are busy watching the video on the laptop the other group is doing something else.” He continued:

Because for ICT to be fully implemented in a school there is a lot of equipment required, for example, we need to have more than one projector and have at least 20 computers. Now we only have five and there is no Wi-Fi coverage in the lab. This is why I would download the video from home that the learners have to watch later.

This narrative provided by Thabo indicates his feeling that ICT integration is bound to enhance the teaching and learning of Physical Science in secondary schools. He fostered ICT use even though the resources were scarce. His statements point to the convenience and opportunities that ICT integration provides for the learners in his class. He appreciated how ICT integration played a major role in saving valuable time. He appreciated the convenience and the ease that is brought by the use of ICT in teaching, even though there are challenges encountered. This suggests that Thabo’s motivation for

adopting this advance in education resulted from his belief and the convenience ICT offered. Sharma (2022) recommends that more attention should be given to promoting teachers' attitudes towards ICT integration through continuous PD.

4.7.2.2 Beliefs and attitudes

The literature has shown that many countries want to improve the quality of education through the use of technology. However, there has been a record of many challenges towards innovation. They include, amongst others, reluctance to change from traditional teaching methods (Habibi *et al.*, 2020).

When talking about his views on ICT integration, Thabo said: "I use ICT because I believe that it may change the way teaching and learning occurs for better results. I was never told to use it for teaching my Physics lessons. I used it because I realised that it could help learners to understand Physics better." Thabo disclosed the opportunity to shift his belief and understanding about ICT integration into his teaching activities. He shows that his decision regarding the use of ICT was influenced by his perceptions on the use of ICT for Physics teaching. He added:

Due to inadequate equipment in the lab and the shortage of the learners' Physics books in class I used my laptop to show them the equipment such as venire callipers and I also found information on how that instrument is used. This act opened my eyes to see that the use of technology can play an important role in my teaching activities.

The statement here indicates that Thabo has a positive attitude towards ICT integration. He is of the opinion that the use of ICT can present many opportunities for the learners to learn Physics by providing pictures as well as information on apparatus not found in the Science laboratory. He presents the usefulness of ICT integration in making learning effective and meaningful. He demonstrated being motivated to use ICT in teaching activities when he indicated: "The value of the training I got on ICT allows me to use ICT in my lessons because of the skills that I have acquired and the benefits I have seen so far."

The data here reflects Thabo's level of interest in ICT integration to be influenced by many factors such as his belief and attitude towards ICT integration. He is motivated to use his laptop and other ICT tools to teach the learners because he has been trained on the use of ICT, which helps him to conveniently explain the concept with diagrams or pictures and the content provided. However there are challenges he encountered in his pursuit to integrate ICT. These challenges are discussed in the next subsection.

4.7.3 Barriers to ICT integration

Accommodating new developments prompts social change. The change can sometimes be easily accepted but sometimes resistance to change occurs. Resistance to change may occur due to the challenges encountered when an innovation has to be implemented. Thabo is of the view that ICT integration can still be achieved if enough resources are provided. However, there are challenges that he encountered in ICT integration as explained in this section.

4.7.3.1 Lack of resources

When asked about the challenges that he encountered while integrating ICT in his lessons, Thabo points out:

I have to use my laptop and hotspot because free Wi-Fi has been made to range only within the offices and the staffroom, [...] above that the number of computers is also limited, hence I teach students in turns because I have to divide the learners into groups in each class that increases my load.

He reveals challenges that he faces when using ICT in his daily teaching instructions. He shows that a lack of resources is a hindrance to effective ICT integration in school 4 because he has to use his own money to buy data to hotspot his computer to be able to conduct an ICT-based lesson. This shows that Thabo is dedicated and is so convinced about the results of ICT integration that he does all he can to use it even under difficult circumstances. Lack of teaching materials in school 4 also adds to his reluctance to teach other teachers to integrate ICT into their teaching. This puts a heavy load on the teacher

who has to teach learners in groups and even go an extra mile to see that ICT integration takes place in their lessons.

Thabo shows concern about the way ICT is handled and says that, “[a]chieving the integration of ICT in [his] school is painful and heart breaking because ICT integration is not a concern to the management, which is the one that gives that the financial provision for ICT is limited.” The statement indicates that the management in school 4 is not responsive towards resolving the issue of lack of resources and poor Wi-Fi coverage. It portrays a lack of commitment by the management towards successful integration of ICT. This is consistent with the findings of Razak *et al.* (2019) that schools become unsuccessful in effectively integrating ICT due to inadequate ICT resources.

4.7.3.2 Issue of training on ICT integration

When talking about training on ICT, Thabo indicated that he is confident and competent to use technology-based instruction in his teaching activities. He shared his experiences in ICT training: “On top of the formal training I acquired, there was also informal learning on how to fix computers from my IT specialist colleague, I cannot stop using ICT because of technical problems.”

The statement shows that Thabo is trained on ICT use as well as its technicalities. The scenario may provide a sustained use of ICT for him because if technical problems arise he will be in a good position to fix them. Arkorful *et al.* (2021) posit that the successful integration of ICT into teaching and learning depends on the ICT training the teachers have received. Malik and Shafeeq (2016) indicate that teachers need both technical training and PD for improved instruction. Hence training on ICT seems not to be a hindrance to ICT integration in his case. This indicates that teachers need appropriate ICT skills to effectively integrate ICT in their teaching instruction. This finding implies that teachers’ readiness and skills in using ICT play a major role in technology-based teaching and learning.

4.7.3.3 Stakeholders support

Thabo had been involved in training that was organised by the ministry towards providing teachers with computer confidence to train other teachers and teach ICT education in their schools. He perceives the support from the ministry as responsive to the needs of the education system. Commenting on the type of training that was offered towards ICT education, he stated:

I received this training on two occasions both lasting for two weeks. The training was designed to equip us [the trainees] with a full computer course to be competent to teach computer education in our respective schools. It showed that the MoET was equipped to prepare teachers for ICT education because we were hands-on there, doing practical work and having supervisors.

This response shows that Thabo seemed fulfilled by the training because the support was beneficial, as it included hands-on activities to enhance competence and confidence for the teachers on ICT. Arkorful *et al.* (2021) argues that effective ICT integration depends on the level of training and support given to teachers. In this respect, Thabo regarded the DoE as doing enough to capacitate teachers on ICT use, as he stated that “[o]ne training was held at one school in Maseru while the other training was held in another school in the Leribe district to reach different geographical regions of the country.” He understands that the training was meant for one teacher per school to accommodate and reach all schools and help to provide them with a computer lab and an ICT trainer. He appeared sceptical about reaching the entire country as he remarked: “Certainly not those schools in the mountainous regions because of poor infrastructure and lack of electricity.” His statement indicates that the training was intended to reach the entire country provided there was an accommodating infrastructure. The training was intended for one teacher per school so that the teachers who had been trained would train other teachers in their respective schools.

On the other hand, Thabo’s principal appeared not to be very supportive of the initiation to have ICT education in her school as well as ICT integration by the teachers. He attributed poor Wi-Fi coverage in the school to lack of interest and support to ICT integration by the principal. He comments: “She is not interested in ICT because she does not know it. This is why she restricted it within the offices.” This statement indicates that Wi-Fi is there in the school but it is not directed to where it can benefit the learners.

However, meaningful education through technology should be able to provide feasible results through support and guidance given to the teachers (Sharma, 2022).

4.7.4 Summary of Thabo's professional development on ICT integration

The data presented revealed that extensive ongoing exposure to ICT training enabled Thabo to be able to use ICT in his teaching. It emerged from the data that the ICT training that he had received was intended for ICT education. However, the skills that he acquired were wide enough to enable him to use ICT for teaching. He became more competent and motivated to integrate ICT in his teaching activities. Thabo experienced an improved quality of teaching and learning from the use of modern technology. This indicates that the PD acquired through training workshops led to the development of appropriate pedagogical practices to assist Thabo in ICT integration. The data indicates that the use of ICT in education made Thabo's work easier because he could find vast amounts of information quickly from the internet.

There were factors that affected how Thabo used ICT for teaching. The poor Wi-Fi coverage that only ranged around the office block and the staffroom was seen as a hindrance to ICT education. Despite this challenge, Thabo continued to integrate ICT into his teaching. On occasions when he needed to integrate ICT into his teaching, he would buy data 'to hotspot' his laptop for learners to watch videos, simulation or PowerPoint slides in groups. This did not affect his work negatively because he shows that preparation time to be used for the next lesson was used to prepare for the group A's new learning outcome.

This situation shows that a lack of resources hinders the provision of opportunities for teachers' competence in ICT integration. Lack of resources in this case is seen to emanate from school administrators having a lack of computer expertise and interest. This gives the impression that the lack of a strategic vision and the shortage of ICT support inhibits a school from recognising the intended education objectives.

4.8 SUMMARY OF THE CHAPTER

The chapter discussed the characteristics of the participants. It provided the presentation, analysis and interpretation of the findings from the qualitative research. The data presented in this chapter pursued an answer to the main research question: “What are Physical Science teachers’ perspectives on ICT practices in professional development activities in Lesotho?”

The subsequent research questions, as well as the codes and themes that emerged from the analysis of the data were also presented. The key findings of this study suggest that the teachers have a positive attitude towards ICT integration. The rate at which these teachers are learning or employing ICTs is not the same pace as the rate at which technology is changing. The three teachers indicate incompetence in ICT integration which would result in reluctance for the use of ICT. Ottenbreit-Leftwich *et al.* (2017) indicate that a lack of information and training among teachers leads to reluctance to use ICT.

The use of ICT may make a significant contribution towards change in education practices. However, the input factors that can work towards the right impact of ICT in education are necessary. Sharma (2022) supports the idea of PD of teachers because the provision of the necessary skills and knowledge is essential to adequately carry out their duties. The data presented here has shown that all the participants have been engaged in PD in ICT. Leseli and Khotso gave an impression that the PD activities that they acquired were not adequate to allow them to competently and confidently integrate ICT in their lessons. They indicated there is room for improvement. They still need professional training for ICT integration. On the other hand, Khanya and Thabo had PD activities aimed at ICT integration and ICT curriculum teaching. They demonstrated competence in ICT integration because they had acquired meaningful and engaging training. However, the observed lessons did not show any ICT integration that the participants claimed to practise in the classroom. All the teachers gave the impression that they encountered challenges in ICT integration due to limited resources such as the number of computers, projectors and restricted Wi-Fi.

All the participants emphasised that ICT integration is a crucial step towards realising quality education. However, integrating ICT into teaching and learning is a challenging process as indicated by Ghavifekr *et al.* (2016). The four teachers presented their views on the significance of ICT integration and they all realised improved participation from the learners and a shift towards learner-centred lessons as well as improved performance. They all indicated that their teaching became easier irrespective of the challenges that they met.

CHAPTER 5

SUMMARY OF FINDINGS, CONCLUSIONS, RECOMMENDATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

5.1 INTRODUCTION

This chapter presents a summary of the findings concerning the aims and objectives of the study. The chapter conveys a brief background of the study. The chapter also discusses the meaning of the findings presented in chapter 4 and the conclusions that disclose the value of the study drawing on the literature reviewed on teachers' perspectives of PD on ICT integration. The chapter recommends PD of teachers towards ICT integration and presents suggestions for further research.

5.2 BACKGROUND AND SUMMARY OF THE STUDY

The study's main objective was to explore Physical Science teachers' perspectives on PD activities on ICT practices in Lesotho secondary schools. Integrating ICT into teaching and learning environments has attracted the focus of many countries and the efforts of teachers in recent years. Tondeur, Forkosh-Baruch, Prestridge, Albion and Edirisinghe (2016) argue that PD is necessary for education change. Teacher knowledge of ICT integration is crucial for effectively applying technology to enhance learning. Hence, the researcher perceived that there was a need to explore the perspectives of Physical Science teachers on PD activities for ICT integration. The need for ICT integration in education is stressed in the ICT policy (2005) and Muianga *et al.* (2019) when they indicate that the education sector must prepare learners for the changing technological situations in work environments. The Lesotho Education Sector Strategic Plan 2005-2015 supports this statement with the following objective: “... *To progressively achieve the equivalence, harmonisation and standardisation of the education and training systems nationally, regionally and internationally...*” This statement emphasises the need for transformation and advances in education that can be achieved through ICT use.

5.2.1 Restatement of the gap

As reported in examiners reports, low performance in Physical Science may indicate a limited knowledge of teaching practices that could enhance the learning of the subject. This explains why the researcher explored the perspectives of Physical Science teachers on PD activities towards ICT practices to expose the need for support for ICT integration. The study aims to close the gap in PD related to ICT integration in Physical Science teaching. Lubalee (2015) and also Alkahtani (2017) indicate that ICT is important in teaching and learning because it enhances comprehension of the subject matter and provides quality education. However, ICT integration in school curricula remains significantly unconventional in developing countries like Lesotho. Khoro (2013) highlights that the technological advancement in Lesotho is in a dire situation with limited or no access to ICT devices and teachers with limited ICT skills. Hence, investigating the perspectives of Physical Science teachers on PD of ICT integration expanded on the specific challenges and opportunities in integrating ICT into the curriculum. These perspectives are not well covered in the literature.

5.2.2 The framework of the study

The study uses the TPACK framework to understand teachers' technological instruction to enhance learning. A lack of technological competence implies inadequate use of technology in teaching and learning activities (Lisene & Jita, 2018). The training of teachers should focus on integrating technological knowledge with pedagogical content knowledge. The CBAM model investigated teachers' concerns about PD activities. The model helps to establish the correlation between their preparedness and acceptance of ICT integration and their PD. This study has presented four case studies of Physical Science teachers in four secondary schools in Maseru district. A case study design and qualitative data collection methods were employed. The data collected related to the effectiveness of PD on Physical Science teachers' ability to teach using technology. One observation was not possible because the mid-term examinations were approaching and learners had been allowed revision time.

This chapter also presents the aim and objectives of the study, followed by the findings organised in respect of the objectives. The conclusion and recommendations are at the end of the chapter. The research gap the study addresses for future research are also discussed at the end of the chapter.

5.3 DISCUSSION AND SUMMARY OF KEY FINDINGS

The key findings presented answers for the research questions that guided the study. They answer the main question “What are Physical Science teachers’ perspectives on professional development activities on ICT integration practices in Lesotho secondary schools?”

In addressing the aim of the study, the following objectives were considered:

- To investigate the effectiveness of PD on ICT integration as perceived by Physical Science teachers.
- To determine the views of Physical Science teachers towards their preparedness to use ICT during instruction.
- To figure out and describe the perspectives of Physical Science teachers on ICT professional development.

5.3.1 Findings of the study based on the first objective

- To investigate the effectiveness of PD on ICT integration as perceived by Physical Science teachers.

5.3.1.1 *The effectiveness of professional development on ICT integration*

Teachers in the 21st century are facing new challenges as a result of expanding opportunities for ICT integration in teaching and learning (Albion *et al.*, 2015). ICT integration in the teaching of Physical Science improves the comprehension of many concepts. However, ICT integration depends mainly on the direction provided by the

teacher. The correct pedagogical beliefs and attitudes of teachers are essential in using ICT in instruction. Providing educational training on ICT integration for teachers is more important than the training for teachers to use ICT equipment (Habibi *et al.*, 2020). The innovation requires explicit content knowledge and the technology to construct clear explanations of the concept. This section discusses the data presented from the four cases studied. The exploration of the first research objective addresses the effectiveness of PD on ICT integration as perceived by Physical Science teachers.

5.3.1.1.1 Ineffective teacher professional development on ICT use

The first significant finding of this study is that the inconsistent ICT professional development teachers have received affects ICT integration differently. Some teachers reported that their PD towards ICT integration enables them to fully use ICT in their lessons. On the other hand, some teachers revealed that their ICT PD could have been more effective. Hence, they need more training to use ICT in their lessons. Leseli and Khotso reported receiving PD from their university studies and also mostly from their colleagues. They specified that training did not offer knowledge on ICT integration, but rather for ICT skills. On the other hand, data emerging from this study has demonstrated that Khanya and Thabo received training as trainers for other teachers. Khanya was involved in ICT integration training to promote Maths and Science teaching and learning from the Thakakhoali club under the Lesotho National Commission for UNESCO projects. Khanya is one of the teachers mandated to train other teachers after receiving substantial ICT integration training. The 'train the trainer model' was the best cost-effective information dissemination method. The model was intended to reach the majority of teachers. In Khanya's case, the training of teachers was unsuccessful due to a need for more resources, limited time and the lack of basic computer skills. Being an under-resourced school might have contributed to ineffective PD on ICT use in many secondary schools.

School-Net SA trained Thabo for him to offer training to other teachers. They attempted to introduce ICT education in the country. This training offered many computer applications that made it possible for Thabo to sometimes use ICT for teaching his

external classes. Khanya indicated his willingness to train other teachers under the LSMTA umbrella and to disseminate ICT integration ideas. As mentioned in the above discussion, Leseli and Khotso believe that schools that use ICT for teaching see an improved academic performance. They had updated their technological skills to increase their PD effectiveness in teaching through ICT. The initiation demonstrated that they consider ICT integration as a crucial issue that needs consideration to ensure quality education. However, they reported the need for more experience in some computer applications such as Microsoft Excel. The literature indicates that challenges to the anticipated ICT integration in schools emanate from a need for consistent professional learning processes for teachers (Dlamini & Mbatha, 2018; Kaya & Godek, 2016).

Yalley (2022) argues that PD is an essential part of the development of every teachers. Accordingly, Habibi *et al.* (2020) and also Lubalee (2015) indicate that inadequate preparation to use technology for teaching inhibits the recognition of the importance of ICT in instruction. Fullan (2006) argues that improvement is only possible if PD activities motivate people to put in effort, individually or collectively. Das (2019) provides the insights that technological pedagogical knowledge training may challenge teachers to rethink their adoption of ICT in teaching and to diffuse the technology vision needed for the future.

5.3.1.2 *ICT integration in teaching practice*

Data presented from the three cases observed indicated little trace of ICT integration. The three participants, Leseli, Khanya and Thabo whose lessons were observed, showed similar presentations. However, Khanya's scheme and record of work showed that he uses the Internet for information gathering. The fact that the observations of Leseli, Khanya and Thabo happened when they were not using ICT for teaching could mean they had similar backgrounds concerning the availability of ICT resources and a similar schedule on the school calendar. However, their explanations for the lack of ICT in the observed lessons differed. Leseli maintained that he sometimes uses ICT for teaching. "I use some technology application in class. The syllabus does not state how it has to be

integrated, therefore I do it my way.” Leseli indicates the liberty to use technology, even though the syllabus has no guidelines for how to do this.

Khanya also uses ICT for teaching and says that, “[he] normally use[s] technology at the beginning of teaching a new concept. This is to make learners understand the concept...” Khanya believes that ICT integration enhances the ability of learners to understand concepts. Thabo shares the same belief when he indicated that he uses ICT for teaching the external classes. He believes it will help enhance the understanding of concepts and bring quality education. The teachers use applications such as Microsoft Office; PowerPoint and the projection of simulations and videos. The question: “Why was there no ICT integration in the lesson?” were differently answered and the response indicated that the teachers shared the same sentiments.

The findings show that teachers use technology to find information to enhance the understanding of concepts and to improve their instruction. They find information and send it to learners to consume. Leseli and Khotso indicate that training in a first year university course emphasised basic ICT skills rather than ICT pedagogical integration. They had updated their technological skills to increase teaching effectiveness through ICT and also to create a conducive learning environment. Dlamini and Mbatha (2018) suggest that workplace PD may also enhance professional skills. Researchers assert that PD interwoven into pre-service training may also improve ICT practices. This idea is consistent with what Alghamdi (2020) and Sharma (2022) consider as creating opportunities for teachers to learn using ICT to enhance their teaching abilities.

The respondents show a positive attitude towards ICT integration in teaching and learning. However, Leseli needs to gain the skills to allow effective ICT integration. Ghavifekr *et al.* (2014) argue that besides ICT skills and knowledge, teachers’ attitudes towards ICT will affect ICT integration for teaching and learning purposes. Singh and Chan’s (2014) study proves that the attitude of teachers toward the use of ICT varies with the level of knowledge of ICT.

5.3.2 Findings based on the second objective of the study

- To determine the views of Physical Science teachers about their preparedness to use ICT during instruction.

The second research objective seeks to examine teachers' views about their preparedness to use ICT during instruction. The findings have shown that teachers' preparedness and competence in instruction signify the degree of integration in teaching practice. Teacher quality is a critical factor in education. The following segment highlights the findings concerning Physical Science teachers' preparedness to integrate ICT into their teaching.

5.3.2.1 Teachers' preparedness to integration ICT in teaching practice

The findings show that teachers' ICT knowledge and expertise affect teachers' preparedness to integrate ICT. The study finds a direct relationship between the quality of education and the quality of a teacher. PD improves the skills and knowledge of the teachers to enhance the quality of education. Lack of adequate PD poses a challenge of resistance to change. Based on the data presented across all cases in this study, the teachers find that ICT provide the conveniences for meeting 21st century education objectives. However, some teachers reported they are prepared to use technology in instruction, while others explained their inadequate preparedness to fit in the use of ICT to enhance their traditional methods. Leseli indicated that, "[he] never got any formal ICT integration training [and he] acquired computer skills from university and from colleagues who went for ICT training." The PD Leseli received was focused on computer skills, but needed to offer the flexibility of using ICTs in instruction.

Khotso also specified that, "[t]he skills [he] acquired are not enough for [him] to integrate ICT to the standard..." His statement indicates that there are instances when Khotso failed to use ICT for teaching and learning purposes because of inadequate knowledge and lack of confidence in technology use. The inadequate knowledge of using some computer applications shows unpreparedness for the use of technology. This inhibited effective ICT integration in instruction.

On the other hand, Khanya and Thabo seem to be adequately prepared to integrate ICT into instruction. Khanya indicated: “The project taught us many things on computer use. I am now able to prepare slides and simulations for my teaching.” He indicated that his training enabled him to integrate ICT confidently and effectively. Thabo opines that PD for teachers helps to improve their teaching strategies. Moganashwari and Parilah (2013) and also Hero (2020) show that a critical factor in making ICT programmes successful in schools is upgrading teachers’ ICT pedagogical knowledge levels. This could make it easier for teachers to employ technology in their instruction. Yalley (2022) shows that PD is essential for the development of every teacher to improve his/her knowledge and skills. Singh and Chan (2014) identified aspects of adequate PD as including ICT use in teaching and learning and transforming how learners deal with knowledge. Teachers believe that, to meet the demands of the 21st century, they need to be adequately prepared to integrate ICT into their teaching and learning processes. Amparado’s (2018) study finds that teachers are enthusiastic about using technology because it makes the school more efficient and improves education.

The unpreparedness of teachers to integrate ICT is evident in the observed lessons, which presented an educational setting dominated by traditional methods characterised by textbooks and the use of the chalkboard. The teachers indicated using simulations and watching videos occasionally to improve the quality of their instruction. The indication is that their unpreparedness for ICT use in the teaching and learning process inhibits further ICT integration. It is reasonable to say that providing ICT pedagogical training for teachers rather than simply training them to use ICT would improve their preparedness to integrate ICT into instruction. UNESCO (2014) shows that the success of ICT integration into instruction requires a shift of focus from computer skills to ICT pedagogical practices. The existing literature laments the use of technology for teaching. Muianga *et al.* (2019) mention that teachers who participated in PD activities are more likely to engage in ICT practices. The results of this study confirm that PD has an impact on teachers’ preparedness to use ICT in instruction. It was evident in the findings that teachers used ICT for instruction regardless of their preparedness, which indicates their positive attitude towards ICT. However, their understanding of the pedagogical implications differs. Their different knowledge and skills suggest that PD is crucial for the preparedness of teachers

to integrate ICT. Muianga *et al.* (2019) and Razak *et al.* (2019) show that to effect ICT integration all teachers should have the same training opportunities, so that they may contribute to the improvement of quality education.

5.3.2.1.1 Interest in ICT integration

The study found that the interest of teachers in ICT integration led to inconsistent technology use in instruction. The teachers reported using ICT in some of their lessons, which indicates interest in ICT integration. However, this attempt is made on their own accord because even though there is a national policy on ICT there are no guidelines stipulated on ICT integration. In all the cases, the teachers indicated some knowledge of computer applications. Leseli and Khotso indicated some limitations. They indicated that the knowledge they had allowed them to use technology to some extent in teaching. This includes the use of the Internet for information gathering, WhatsApp platforms for content sharing and using a projector for showing simulations and videos. They believed that ICT activities made work more accessible and improved learners' participation due to aroused interest to learn. Thabo has been interested in technology since his school days, as shown in the statement: "... [He] did computer studies to equip [himself] with more relevant skills in the technological era." Clearly, this statement shows some promising opportunities for ICT integration. If the teacher is interested in ICT, teaching using ICT will not negatively affect the teachers' attitude.

Muweesi *et al.* (2021) and Avisteva (2019) are adamant that advanced use of technology in teaching requires technological skills and content knowledge to adequately meet the needs of a 21st century education. The use of ICT in learning must be understood in the context of SDG 4 to "*ensure inclusive and equitable quality education and promote lifelong learning opportunities for all...*" (United Nations 2016).

The literature reveals that teachers use only specific computer applications when their knowledge is limited or moderate (Singh & Chad, 2014). Teachers' unpreparedness to integrate ICT into instruction may lead to some resistance to change and reverting to traditional teaching methods. Mwangi and Khatete (2017) show that teachers require

pedagogical training on ICT integration for meaningful and effective ICT integration. Competence when using computers reduces anxiety and facilitates a positive attitude towards ICT integration (Muianga *et al.*, 2017). This indicates the need for better exposure of teachers to ICT practices. Luhanya *et al.* (2017) posit that ICT integration brings a robust learning environment for learners to experience self-directed learning. Mbodila, Jones and Muhandji (2013) found that different approaches offered by ICT transform the classroom to suit more learner-centered environments and to promote deep learning. Henderson (2020) argues that what takes place in the classroom is mainly influenced by the beliefs and attitudes of the teacher.

However, the observed lessons did not show ICT integration, which indicates that teachers need more specific guidance on ICT activities in teaching and learning within the Physical Science discipline. As already indicated, the findings from this study show that teachers are interested in technology use for teaching. Infrequent use could be related to the ineffectiveness of PD and the challenges faced such as a lack of a school ICT policy and support from their administration (Ghavifekr *et al.*, 2014).

5.3.2.2 Unveiling the challenges in the ICT integration

Another study finding is that challenges shape the insufficient and infrequent use of ICT by teachers for instruction. Teachers have shown ICT integration to be a complex process with many challenges. The perspective they presented indicates both material and non-material factors. The material factors include insufficient resources such as computers, poor Wi-Fi coverage and projectors. Non-material factors include teachers' insufficient ICT knowledge and skills and also a lack of stakeholder support.

5.3.2.2.1 Lack of teacher competence

A need for more confidence in computer applications influenced Leseli's ICT integration. He indicated: "I would like to use other computer applications such as Microsoft Excel functions..." He believed his ICT integration would improve if he had knowledge of other

applications. He could not rely only on using Microsoft Word and the projection of simulations and videos. In line with Leseli, Khotso also feels the need for further PD on ICT integration. Khotso explained his unpreparedness: “I am not fully competent to integrate ICT, but I use it. This is because the training I got from colleagues is not enough for me to confidently employ other computer applications on ICT integration.” Leseli and Khotso showed concern about their incompetence for ICT integration. The findings show that the teachers have expectations of PD to affect ICT integration in their classrooms. The teachers linked their incompetence and lack of confidence in using computer applications to how they use ICT in instruction. Abel, Tondeur and Sang (2022) identify that teachers consider ICT integration as engaging learners with software presentations without consideration of learning goals, that is, if they are not fully conversant with ICT integration skills. Leseli and Khotso said that they rely on simulations, PowerPoint and the Internet to find and present recent, valid information to learners. This renders the learners as passive beneficiaries of ICT.

Khanya and Thabo, on the other hand, have shown competence and confidence in ICT integration. The training they acquired contributed to their knowledge and skills in technology. However, Khanya and Thabo believe that PD has to be an ongoing process because technology keeps evolving. Although they show competence in ICT, their lessons did not show the use of technology, indicating other barriers to ICT integration.

The literature indicates factors contributing to ineffective ICT integration in instruction. According to Das (2019), inadequate opportunities for teachers to receive meaningful ICT training lead to teachers needing to be more competent in ICT integration. UNESCO (2007) maintains that teachers need training in pedagogical applications, not just computer literacy. Bingimlas (2009) endorses that it is essential to consider the time of training, skills learnt and the pedagogic training in how to use ICT in the classroom to ensure effectiveness of the training. Teachers may create an enabling environment that could positively affect academic achievement when they are convinced about and confident of using ICT in instruction. Dlamini and Mbatha (2018) and also Kaya and Godek (2016) advance an argument that ICT integration PD should be tailored to a

specific subject discipline to enable teachers to use a wide range of teaching strategies in specific areas.

5.3.2.2.2 *Lack of access to technologies*

Recently, the emphasis on instruction in education has shifted from traditional methods of instruction to technology-driven instruction. Hence, teachers use ICT occasionally, depending on accessibility to technology resources. The teachers in this study reported inadequate resources in their respective schools as being a hindrance to ICT integration. Leseli blamed the school administration for the lack of classroom resources and Wi-Fi coverage that did not reach the computer lab. The study revealed that secondary schools still deny learners the opportunity to bring their smartphones to school. Teachers believe that allowing learners to bring their smartphones to school would counteract the effect of insufficient computers.

These same sentiments are shared by Thabo who points out that, “[he] ha[s] to use [his] laptop and [his] data because Wi-Fi is limited to range within the offices and the staffroom.” Thabo and Leseli expressly indicated that they have to use their own data to use the Internet for downloading the materials to use for teaching. Thabo further reported that the prevailing circumstances in the school added to his reluctance to use ICT for teaching and training other teachers. Leseli on the other hand, indicated that accessibility to the lab is also a challenge because only authorised persons are responsible for opening and closing the lab. He indicated: “Sometimes we do not get access to the lab when Mr So and So is not at school.” Thabo attributed restriction of Wi-Fi to the offices to the need for more support and commitment to ICT integration from the management.

Khotso and Khanya, on the other hand, demonstrated a different scenario that in their schools there is full Wi-Fi coverage in the computer labs. However, double-booking of the lab becomes a problem. The inaccessibility of ICT resources affects ICT use. Khotso’s ICT integration is occasional because the broadband does not extend to the classes. The teachers seem concerned because they consider providing resources and infrastructure as the first step towards the success of ICT integration. The findings reaffirmed what is

said in the existing literature, that teachers use ICT to support their teaching rather than for effective learning because of limited resources (Chidozie-Anaeche & Ozofor, 2019).

Studies show that the main barriers to ICT integration are infrastructure barriers, such as broadband Internet access and insufficient computers (Ghavifekr *et al.*, 2014). Chidozie-Anaeche and Ozofor (2019) posit that the technology resources of secondary schools must be improved. Adequate resources lead to more use of ICT in instruction. Avisteva (2019) argues that using ICT in the classroom depends on the availability of school facilities. The challenges related to the accessibility of ICT resources are widespread and differ from one school to another (Ghavifekr *et al.*, 2014). Lubalee (2015) confirms that limited access to ICT in the classrooms may be due to poor management. On the other hand, Abel *et al.* (2022) argue that teachers base their decisions on whether to use ICT on whether they think ICT will help them to achieve their pedagogical objectives or not. Ertmer and Ottenbreit-Leftwich (2013) show that there is a direct correlation between sound ICT integration in the classroom and teachers' attitude.

5.3.2.2.3 Lack of stakeholders' support

The data presented earlier indicates that the MoET, through ICT policy 2005, is concerned about ICT integration in education. Thabo and Khanya indicated support by different governmental departments and ICT projects and initiatives through training on ICT use in instruction. Khotso indicated: "It showed that the MoET was equipped to prepare teachers for ICT education because we were hands-on there, doing practical work and having supervisors." Khanya also indicated getting support from his principal who has authorised full Wi-Fi coverage in his school. The scheme and record of work indicated the use of sources from the Internet, although the actual ICT use in instruction was not observed. On the other hand, Thabo indicated a need for more support from his school administration because Wi-Fi coverage only ranges within the offices and the staffroom. The limited number of computers in the lab is also not considered to be appropriate in school 4. The lack of Wi-Fi in the computer lab and the classrooms indicates that technology resources are not available to allow learners to benefit from them in school 4.

Khotso and Leseli have shown challenges in ICT integration to be caused by insufficient knowledge of ICT integration and lack of support from their school administration. Moreover, Khotso was unhappy with the PD he received from the trainers. He indicated that, "...some of these people who train us still needed some training." He mentioned incompetence in those entrusted to train teachers and opines that, "[t]eachers won't be interested in using ICT if they lack the knowledge and competence in ICT integration." The fact that Khotso and Leseli were never engaged in formal ICT integration training could make them think that the skills they acquired from trainers, their colleagues and through the Internet are not legitimate. Hence, they would consider their PD as insufficient.

Moreover, Khotso indicated: "The first thing that could have been done is the provision of resources and infrastructure." He believes that training teachers using unprepared or incompetent trainers and not providing the necessary resources for ICT integration present a dire situation. Leseli and Khotso share the same sentiments on the issue of Wi-Fi coverage. They show that their school's principal hinders ICT integration by restricting Wi-Fi. This statement implies that the principals and the school inspectors must become acquainted with the ICT policy. Leseli demonstrated that, "[t]here is no follow-up during the school visits concerning ICT integration." Hence, a lack of drive to harness the full potential of ICT in education leads to ineffective ICT use in education.

The findings of this study show that the availability of technology resources and also teachers' knowledge of ICT use in instruction, affect the use of technology in the teaching and learning process. The study also found that a lack of support from the school administration contributes to poor ICT integration. Oduro and Yalley's (2022) study revealed that low competency in the use of Microsoft Office amongst school administrators significantly impacts the provision of technology resources. Similarly, Sharma (2022) argues that learning through technology should be able to provide feasible results through support and guidance given to teachers. The available literature confirms that the lack of ICT skills and inadequate computer access hinder the provision of ICT in education (Arkorful *et al.*, 2021). Oduro and Yalley (2022) consider administrators responsible for preparing teachers for ICT integration and providing technological

resources. Dlamini and Mbatha (2018) conclude that PD should be interwoven into the existing teachers' curriculum framework because it is fundamental for promoting change in the education system.

5.3.3 Findings based on the third research objective

- To figure out and describe the perspectives of Physical Science teachers on ICT professional development.

The following section presents Physical Science teachers perspectives on ICT professional development. The teachers' preparation to adopt ICT practices is essential for regular technology use in instructional practices. It is because the teachers' preparedness influences their perspective on ICT integration (Gebremedhin & Fenta, 2015).

5.3.3.1 Beliefs and attitudes influence on perspectives on ICT professional development

The findings show that, at times, teachers' beliefs and attitudes affect their perspectives of ICT professional development towards ICT integration. The four cases perceive PD towards ICT integration as a critical step towards realising the full potential of technology in education. Leseli shows that, "teaching learners who are inclined to technology has to be through technology." He is adamant that using technology in the teaching and learning process enhances the quality of education. He remarked: "The traditional methods which were used during our times no longer operate in this era." This indicates that teachers believe that the teaching and learning process must be attractive to the learners. Learning how to captivate the learners has to be achieved through what they enjoy. The learners have their own technology gadgets at their disposal and so using them for learning would also increase their motivation to learn.

Khotso has shown a positive attitude towards ICT integration as he experienced its benefits. He said: "Regardless of the lack of adequate training, it is my responsibility to

see that effective learning takes place in my lessons.” In light of the data presented, Khotso used ICT amidst his challenges, believing it would change how learners approach their education. The enthusiasm portrayed by Khotso shows that as a teacher he looks for a teaching approach to suit his learners’ needs. The enthusiasm demonstrated by his eagerness to get knowledge from colleagues and over the Internet to enhance his knowledge of computer applications indicates a strong belief in ICT integration.

Thabo and Khanya show that the professional training they undertook motivated them to use ICT for teaching. They reiterated similar beliefs and attitudes to those of Leseli and Khotso. Khanya also indicated that the teaching content he gets from the Internet has been helpful for those learners without smartphones. He insisted on using technology in different forms, which could imply that the information he gathers and its delivery are convenient. Over and above the challenges Thabo encountered, he seemed to try by all means to use ICT in his instruction, even though he only uses ICT for the external classes. He said: “I use ICT because I believe that it may change how teaching and learning occurs for better results.” The statement shows that no matter the challenges, a good teacher will always look for a better way of teaching to enhance education for learners.

According to Guskey (2014), PD should change teachers’ beliefs and attitudes about the use of ICT in education because teachers are the essential elements of the education system. However, it was also discovered that the ICT use in classrooms focuses mainly on communicating content through WhatsApp and to support their traditional instruction through PowerPoint presentations, simulations and watching of videos online. The reason might be inadequate resources to engage every learner into using computers to find and synthesise information. However, teachers believe and perceive the presence of technology tools in the teaching-learning process to change the classroom environment to be conducive to learning. It appears that teachers are aware of the significance of ICT integration.

The study’s findings reveal that the attitudes and beliefs of teachers tremendously affect the success of ICT integration. The literature shows that the positive attitude of teachers leads to increased ICT integration. Arkorful *et al.* (2021) argue that if teachers develop a positive attitude towards innovation, policies formulated for enhanced ICT integration will

receive wider acceptance and adoption. In line with this observation, the technology use initiative fails if teachers are reluctant to accept an innovation. The findings are congruent with other studies that teachers with a positive attitude would use ICT in their instruction (Dlamini & Mbatha, 2018). However, teachers with a negative attitude towards ICT integration would avoid computer use due to anxiety (Arkorful *et al.*, 2021). This shows that there is a need for policy makers to specify educational goals anticipated on the use of ICT for all stakeholders and the teachers (Mbodila *et al.*, 2013). In the next section, a synopsis of the key outcomes of the study is discussed.

5.4 SUMMARY OF THE MAJOR FINDINGS

The first key finding revealed by this study shows that teachers' PD activities directly affect their ICT practices in teaching Physical Science. The intensity of the PD provided determines the level of ICT use in teaching practice. The participants' narratives indicated that teachers depended mainly on their trained colleagues for PD to enhance their technology skills towards ICT integration. It was also evident that the knowledge they acquired from teacher trainers needs to be improved to prepare them for effective ICT integration. However, those teachers involved in formal training of ICT offered by projects aimed towards the diffusion of ICT in education find ICT integration manageable. The findings show that the training of teachers improves the quality of education through effective ICT integration in teaching practice.

Teachers' preparedness and acceptance to integrate ICT in instruction is affected by the quality of a teacher. Adequate ICT training improved the acceptance of the tenets of ICT integration. More adequately trained teachers need help to unfold their ICT practices into their teaching activities. In contrast, inadequately trained teachers need to work on extending their ICT practices in teaching activities. More PD activities are required to prepare and equip teachers for effective ICT integration in education.

The study's most riveting finding indicates that the level of ICT integration, as a digital competence, depends on teachers' beliefs and attitudes. Teachers' beliefs influence their acceptance and attitude towards using ICT in teaching practice. The Physical Science

teachers studied show acceptance of the innovation and readiness to find better pedagogical practices for the 21st century learner. This endeavour experiences challenges such as inadequate knowledge about ICT integration and a lack of resources and support from stakeholders, which obscure effective ICT integration. Singh and Chan's (2014) study finds that teachers have a positive attitude towards ICT use in instruction, but implementing ICT integration needs improvement due to the challenges encountered. The concern and commitment of teachers to obtaining knowledge on ICT use prove a positive perception by the teachers on PD. Hence, the study drew implications that may help teachers to be more prepared to employ ICT practices in their teaching activities. These are the stepping-stones towards ensuring enhanced quality education in the 21st century.

5.5 LIMITATIONS OF THE STUDY

One of the limitations of this study is that the data collection for the study was limited in terms of the background of the teachers and gender. The study focused on schools in one district that might have shared the same background and experience. More teachers from different backgrounds; such as rural teachers, could have been included in the study to understand their perspectives. This suggests weak exploration of the perspectives of PD on ICT integration. The present study has opened the ground for similar or related research. The challenge with the data collection is that the study used only male teachers. However, the main reason for this sample is that only male teachers happened to be teaching Physical Science at these schools during the time of the study. This scenario poses some bias in the results, as it is believed that male teachers are more conversant with technology than female teachers (Tena, Almenara & Osuna, 2016). Danko, Damijana and Zorko's (2020) study adds that female teachers are more diligent in using ICT in instruction, while male teachers indicated a more positive attitude to ICT use.

Another aspect of the data collection, which is a limitation of the study is the time taken for the lesson observation. There needs to be more than two consecutive lessons to study the effectiveness of PD on ICT integration through observation of ICT integrated lessons. It would have been ideal to have observed the lessons over a more extended period for

better data triangulation. Another limitation is that the data collection could only be in the last month of the first semester. The period was the busiest academic time in these secondary schools. The teachers were teaching and preparing for the mid-year examinations at the same time. Some of those participants chosen for the sample declined.

5.6 RECOMMENDATIONS

This section outlines recommendations based on the findings of the study. The implications of these findings are presented in three areas: (a) recommendations for practice, (b) recommendations for policy and (c) recommendations for future research.

5.6.1 Recommendations for practice

Teaching Science to technology-oriented learners using traditional approaches is not a strategy to enhance quality education. Looking at ICT integration as a model and not the exception in every secondary school may enhance the quality of education. The emphasis on effective ways of teaching Physical Science through ICT would encourage the engagement and use of all learners' senses and learning styles. Poor ICT use in practice might be due to a lack of experience and training in ICT integration. On this account, there is a need to empower teachers with the necessary knowledge and skills to thrive in the technology-erupting world. Teachers need to perform their duties efficiently. Therefore, intensive training on ICT integration to equip teachers with the necessary ICT skills is a prerequisite. This study recommends that PD includes using ICT tools and testing and evaluating the training. This recommendation is plausible if the teacher's PD is compelling and becomes a priority for the MoET.

There is a need for teachers in the 21st century to be versatile to teach 21st century learners. This includes being open to any form of PD. Equally important is that Physical Science teachers carefully compare all possible technologies to enable appropriate teaching and learning technologies. Teachers must be encouraged to combine digital and

non-digital instruction practices to enable life-long learning. Teachers should be 'e-teachers', meaning they must use technology for other professional endeavours. Teachers must adjust technologically to create a new learning environment and information-rich community.

5.6.2 Recommendations for Policy

The study has several implications for curriculum developers, schools inspectors and teachers. Considering that teachers needed to learn about the ICT policy 2005, the study provides the recommendations proposed to address this challenge. The study finds it significant that the DoE supports the diffusion of the education sector's strategic plan on ICT. On this account, schools should have a clearly outlined school ICT policy that vividly states how to develop teachers' skills and support ICT integration. It is also a prerequisite to equip schools with the necessary resources for ICT integration and train the administrators on ICT. This campaign can help teachers appreciate the usefulness of this innovation that can help teachers figure out how to integrate certain technologies for particular content.

Therefore, this study recommends that teacher training institutions (TTI) must review their pre-service programmes to enable pre-service teachers to gain appropriate technology skills. Introducing an ICT interwoven curriculum in teacher training institutions may enhance the technological skills of the pre-service teachers. These skills would assist them in broadening the scope of exploration of various ICTs for each scientific based concept. The study suggests 'skills sharpening' through a short course or an induction programme for pre-service teachers. It is the role of the MoET to see that the TTI provide the teachers with the quality of training needed in the 21st century.

5.6.3 Recommendations for future research

The present study investigated Physical Science teachers' perspectives on PD activities on ICT practices in Lesotho secondary schools. This study focused on teachers in the

Maseru district, specifically in town. Hence, future research may use the country's three geographical regions. The study used only four (4) Physical Science teachers. The sample might portray minimal numbers, but the study is qualitative. Therefore, future research may consider including biology, ICT education and mathematics teachers.

The present study was based on the TPACK theoretical framework to understand teachers' technological and pedagogical activities. CBAM was used to understand the teachers' concerns on professional development. The study shows that more research is required to uncover the practical applications of TPACK in developing countries such as Lesotho. Future research may include questionnaires in quantitative studies to collect data because this study used only qualitative data collection methods.

5.7 CONCLUSION

The research explored Physical Science teachers' perspectives of PD activities on ICT practices in Lesotho secondary schools. The TPACK and CBAM theoretical frameworks guided the study, which were employed for understanding teachers' PD effectiveness in ICT practices. Teachers' PD was critical in ensuring that the needs of the 21st century learner are addressed. Gunjan's (2016) study shows that most of educational processes are still dominated by the teacher. Hence, to effectively use technology in education teachers have to be familiar with technology integration in education. The teachers' concerns were justified to affect the ICT practices profoundly, hence the need for their consideration for successful implementation of ICT integration in teaching practice. The study used semi-structured interviews to collect data from four (4) Physical Science teachers in the same district.

The study concludes that the ICT professional development of teachers affects ICT practices in the teaching and learning process. Teachers with positive beliefs and attitudes towards ICT integration could not integrate ICT effectively into instruction, indicating their unpreparedness to use ICT. Inadequate knowledge of ICT integration practices negatively affects teachers' preparedness to use technology in instruction.

Teachers' ICT integration efforts were negatively affected due to the unresolved conditions necessary for an effective ICT integration environment in schools.

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APPENDICES

Appendix A: Ethical Clearance Approval Letter



GENERAL/HUMAN RESEARCH ETHICS COMMITTEE (GHREC)

19-Apr-2023

Dear Mrs Maserialong Gladys Dlamini

Application Approved

Research Project Title:

Physical Science teachers' perspectives on Information and Communication Technology professional development in Lesotho secondary schools.

Ethical Clearance number:

UFS-HSD2023/0123/23

We are pleased to inform you that your application for ethical clearance has been approved. Your ethical clearance is valid for twelve (12) months from the date of issue. We request that any changes that may take place during the course of your study/research project be submitted to the ethics office to ensure ethical transparency. Furthermore, you are requested to submit the final report of your study/research project to the ethics office. Should you require more time to complete this research, please apply for an extension. Thank you for submitting your proposal for ethical clearance; we wish you the best of luck and success with your research.

Yours sincerely

Dr Adri Du Plessis

Chairperson: General/Human Research Ethics Committee

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Appendix B: Approval Letter from the Ministry of Education and Training



**THE KINGDOM OF LESOTHO
MINISTRY OF EDUCATION AND TRAINING**

7th March 2023

REF: ED/X/2

Ms. Maserialong Dlamini
University of the Free State
Bloemfontein
South Africa

Dear Ms. Dlamini

**RE: REQUEST FOR PERMISSION TO CARRY OUT A MASTER'S DEGREE
RESEARCH IN SELECTED HIGH SCHOOLS**

Your letter to the CEO – Secondary Education on the above subject refers.

The office has no objection to you conducting your research study in four schools of Maseru district. Nevertheless, the onus to solicit consent and permission from district authorities, principals and teachers in your sample schools or any source of information, shall remain with you.

Good luck in your studies.

Yours sincerely

A handwritten signature in black ink, appearing to read 'Jone'.

DR. JONE ANDREAS MARÓLE
CHIEF EDUCATION OFFICER – SECONDARY (ai)

Appendix C: Letter to the Ministry of Education and Training

P.O Box 235

Mafeteng 900

The District Education Manager

Ministry of Education and Training

Maseru 100

Dear sir/ madam

Re: REQUEST FOR CONSENT TO CONDUCT RESEARCH

I Kindly request consent to conduct research in some of the high schools that had privilege to receive computer labs and had teachers trained on Information and Communication Technology (ICT).

My name is 'Maserialong Dlamini, a masters' degree student at the University of the Free State. As part of my master's programme, I am to conduct research on the following topic:

Physical science teachers' perspectives on Information and Communication Technology professional development in Lesotho secondary schools.

The purpose of the research is to investigate the physical science teachers perceptions on professional development offered towards ICT integration. I intend to investigate whether the training towards ICT integration allows for changed classroom instruction and activities, describe the effects which hinder or allow the provision of ICT in secondary schools and then determine the correlation between teachers' perspectives and their professional development activities.

The study will reveal the current status of ICT integration in physical science and inform the ICT policy of 2005. The necessary recommendations could improve the quality of educational practices in secondary schools through the use of technology.

The study requires participation of four (4) physical science teachers who will be requested to provide their lesson plans in two encounters and participate in a 30 minutes semi-structured interview. Lesson observation will also be requested with each of the four participants from the following schools; Lesotho high school, St Catherine high school, Mabathoana high school and St Joseph high school. Their participation is absolutely voluntary and they are free to withdraw from the study at any point if there is a need. I therefore pledge that they will not be exposed to any harm and the information shared will not be used for any purpose outside the study while their identity remains undisclosed.

For any comments and further clarification, please contact me or my supervisor, Prof. Thuthukile Jita at JitaT@ufs.ac.za or call her +2751 401 7441.

Thanking you and your good office in advance for considering my request.

Yours Faithfully,

Maserialong Dlamini (cell: 58452615, e-mail: maserialongdlamini555@gmail.com)

Appendix D: Letter to the Principal

P.O. Box 235

Mafeteng 900

.....- 02 -2023

The Principal

.....

Dear sir/ madam

Re: REQUEST FOR CONSENT TO CONDUCT RESEARCH

I kindly request to conduct research in your school as selected on criterion that it offers physical science subject and has a computer lab. My name is Maserialong Dlamini, a master's degree student at the University of the Free State. As part of my master's programme I am to conduct research on the following topic:

Physical science teachers' perspectives on Information and Communication (ICT) Technology professional development in Lesotho secondary schools.

The purpose of the research is to investigate the physical science teachers' perspectives on the professional development offered towards ICT integration in secondary schools. I intend to investigate whether the training towards ICT integration allows for changed classroom instruction and activities for improved quality of education. The study will describe the effects which hinder or allow the provision of ICT in secondary schools and then determine the correlation between teachers' perceptions and their professional development activities.

The study will also reveal the current status of ICT integration in physical science and inform the ICT policy of 2005. The necessary recommendations could improve the quality of educational practices in secondary schools through the use of technology. Furthermore, with teachers' perspectives in mind, school administrators would make interventions towards ICT integration.

The study requires participation of four (4) physical science teachers (**1 teacher per school**) who will be requested to provide their lesson plans in two encounters and participate in a 30 minutes semi-structured interview. Lesson observation will also be requested with each of the four participants. Their participation is absolutely voluntary and they are free to withdraw from the study at any point if there is a need. I therefore pledge that they will not be exposed to any harm and the information shared will not be used for any purpose outside the study while their identity remains undisclosed.

For any comments and further clarification, please contact me or my supervisor, Prof. Thuthukile Jita at JitaT@ufs.ac.za or call her +2751 401 7441.

Thanking you and your good office in advance for considering my request.

Yours Faithfully,

Maserialong Dlamini (cell: 58452615, e-mail: maserialongdlamini555@gmail.com)

Appendix E: Invitation to Participate in Research Project

P.O. Box 235

Mafeteng 900

The Physical Science Teacher
.....

Dear sir/madam

Re: INVITATION TO PARTICIPATE IN A RESEARCH STUDY

I wish to invite you to participate in a research project titled:

Physical science teachers' perspectives on Information and Communication Technology professional development in Lesotho secondary schools.

The purpose of the research is to investigate the physical science teachers' perspectives on the professional development offered towards ICT integration in secondary schools. I intend to investigate whether the training towards ICT integration allows for changed classroom instruction and activities for improved quality of education. The study will describe the effects which hinder or allow the provision of ICT in secondary schools and then determine the correlation between teachers' perspectives and their professional development activities.

The study will also reveal the current status of ICT integration in physical science teaching and would inform the ICT policy of 2005. The necessary recommendations could improve the quality of educational practices in secondary schools through the use of technology. Furthermore, with teachers' perspectives in mind, school administrators would make interventions towards ICT integration.

You have been identified as one of the teachers teaching physical science in your school, hence, your contribution would be significant in this project. If you agree to participate, you will be required to participate in a 30 minutes interview, lesson observation and your professional books will be used in the study. In this study you are free to withdraw from the study if the need arises.

However, I pledge that you will not be exposed to any harm, and the information shared will remain confidential and be used for the purpose of this study only. Confidentiality and anonymity are guaranteed in this research project.

If you agree to participate, please complete and sign the attached consent form.

For any comments and further clarification, please contact me.

Thanking you in advance for considering my request.

Yours Faithfully,

Maserialong Dlamini (cell: 58452615, e-mail: maserialongdlamini555@gmail.com)

CONSENT FORM

Physical science teachers’ perspectives on Information and Communication Technology professional development in Lesotho secondary schools.

I (Name and surname),

- Give a free and informed consent to participate in the above mentioned research study;
- Understand what the study is about and why I have been identified and approached to participate;
- Understand the potential benefits and risks that may emanate from the study; and
- Give the researcher permission to use the information gathered from my participation for research purposes only.

Email address:

Contact number:

Participant’s signature: Date:

Researcher’s signature: Date:

Appendix F: Interview Protocol

Title of study: Physical science teachers' perspectives on Information and Communication Technology professional development

Interview Questions

1. Can you tell me about your experiences as a physical science teacher since 2005?
2. In your view, does the training that you received in the teacher training college or university empower you to manage the transformational education policies?
3. How does the implementation of ICT integration affect your teaching?
4. What factors affect the implementation of ICT in your school?
5. In your opinion, do you think ICT integration is improving the quality of education in Lesotho?
6. Did you get any form of formal assistance from the Ministry of Education and Training regarding ICT integration?
7. Describe the concerns you have about ICT integration.
8. Is ICT properly implemented in your school? Give reasons.
9. What are the challenges that you face while integrating ICT in your lessons? How do you deal with these challenges?
10. In your opinion, what could be done to assist teachers to be more effective in integrating ICT in their everyday teaching?
11. Do you have any suggestions or recommendations regarding ICT integration?
12. In your view, do you think that the department of education is doing enough in capacitating educators when a new education venture has to be implemented?

Appendix G: Document Analysis Schedule

Name: Date:

School: Class:

The purpose of the documents analysis is to search for similarities and comparisons between data collected from interviews and documents to answer the research question:

What are the physical science teachers' perspectives on ICT practices on the professional development activities in Lesotho?

A. Document analysis by a six-step guide adopted from (Braun Clarke, 2006)

Six-step guide	Lesson plan	Scheme and record of work
<i>Familiarizing with data</i> Looking for similar content		
<i>Generating initial codes</i> Identifying similar concepts		
<i>Searching for themes</i> using highlighters to mark different words		
<i>Reviewing themes</i> Adopting themes used in interview		
<i>Naming themes</i> Comparing the data with the interview transcripts and name the themes accordingly		
<i>Reporting</i> Producing a report on finalization of data comparison		

Appendix H: Classroom Observation Schedule

Classroom Instruction observation schedule

Name of school: Date:

Name of Teacher: Class:

Main research question: What are the physical science teachers' perspectives on ICT practices on the professional development activities in Lesotho?

What to look for / review section	Description/ comments
Explore the lesson implementation. Is the lesson based on what is presented on the lesson plan?	
Examine availability and effectiveness of teaching materials.	
Explore ICT integration in the lesson. Whether there is use of ICT gadgets or any scientific technology evidence in the lesson.	
Investigate the challenges and opportunities teachers have when they use ICT in their teaching.	
Observe teacher and learners' interaction and peer interaction during the lesson. Observe how the teacher facilitates when providing instruction during the lesson.	

Appendix I: Analysis Grid

Analysis Grid based on the interview questions

RESEARCH TOPIC: Physical science teachers' perspectives on information and communication technology professional development in Lesotho secondary schools

<i>Category</i>	<i>Interview questions</i>	<i>Key words</i>	<i>Research questions to be answered</i>
Background information	1.	Gender, age, qualifications, teaching experience, ICT professional development, technology used for teaching	Variables which have impact on the research question
Views and concerns	2, 7	Feelings, knowledge, planning, teaching methods, teaching and learning materials, assessment criteria	What are the views and concerns of the physical science teachers in terms of their preparedness to integrate ICT into their everyday instruction?
Effectiveness of ICT integration professional development	3, 6, 8,	Training, technology tools, improvement, monitoring and evaluation	How do physical science teachers perceive the effectiveness of professional development on ICT?
Experiences of integrating ICT into physical science teaching	3, 4, 5, 9	Challenges and opportunities, hindrances, distractions	How can the perspectives of physical science teachers on professional development be understood and explained?
Recommendations and suggestions	10, 11, 12		

Appendix J: Language Editing

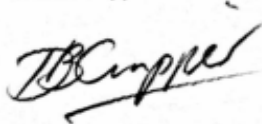
13 Union Street
Villiersdorp
6848
18 October 2023

Prof. T. Jita
Dr A. Bada
Faculty of Education
UNIVERSITY OF THE FREE STATE

**PHYSICAL SCIENCE TEACHERS' PERSPECTIVES ON INFORMATION AND
COMMUNICATION TECHNOLOGY PROFESSIONAL DEVELOPMENT IN LESOTHO
SECONDARY SCHOOLS**
'Maserialong Dlamini

This is to confirm that I have to the best of my ability edited the language of
'Maserialong Dlamini's masters thesis.

Yours sincerely
Derek Gripper



derekgripper@gmail.com

Appendix K: Plagiarism Report

Document Viewer

Turnitin Originality Report

Processed on: 19-Oct-2023 06:01 SAST
 ID: 2200408381
 Word Count: 43112
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<1% match () Williamson-Leadley, Sandra. "New Zealand primary teachers' ICT professional development and classroom practices", Deakin University, Faculty of Arts & Education, School of Education, 2015						

