INTEGRATING INFORMATION AND COMMUNICATION TECHNOLOGIES INTO THE TEACHING AND LEARNING OF SCIENCE IN LESOTHO

By

BONNQE 'MAMOLIBELI TAOLANE

Thesis submitted in fulfilment of the requirements for the Degree

Doctor of Philosophy

with Specialisation in Subject Education in Science & Technology

Faculty of Education

at the

UNIVERSITY OF THE FREE STATE (UFS)

Supervisor: Prof T. Jita

Co-supervisor: Prof L. Jita

DATE: April 2023

DECLARATION

I, Bonnqe Mamolibeli Taolane, declare that the research thesis: **Integrating Information and Communication Technologies into the teaching and learning of science in Lesotho,** that I herewith submit for the degree qualification PhD in Education (Specialisation, **Subject Education in Science & Technology)** at the University of the Free State is the result of my own investigations which has not been previously submitted for a qualification in another university or college. All sources used or quoted have been acknowledged.

I hereby declare that the copyright is ceded in the University of the Free State.

B. Taolane

BONNQE M. TAOLANE

10/04/2023

DATE: 10 April 2023

ACKNOWLEDGEMENTS

I sincerely express my gratitude to Professor Thuthukile Jita, my supervisor and coordinator of the ILCIS research group and Professor Loyiso Jita, my co-supervisor, SANRAL chair and Dean of the Faculty of Education for their unwavering guidance, encouragement and support throughout the journey of this study. I was honoured to learn a lot from the experts in this field. I would not have reached this far without your patience, coaching and mentoring.

Special appreciation is extended to the financial support of the office of the SANRAL chair and staff, for granting me the study bursary as SADC part time student in the ILCIS research cohort of 2018 at UFS, which formed the foundation to the conduction of this study. Special thanks to Christa and her colleagues in the Department of Education, Moitheri, Boitumelo and Mohau in the Prof's office, for their dedicated support and patience throughout this journey.

To the ILCIS research group and 2018 Cohort, I thank you all for the hard work, supporting and encouraging me to shape the study to what it is today. My sincere thanks to Doctors, Post-doctoral researchers in the ILCIS group and all Doctors from other research groups who were often invited to the ILCIS academic writing workshops, for guiding me refine the study. Special honour goes to Dr Letloenyane, Dr Mweli, Dr Muresherwi and Dr Nichols. who reviewed and provided feedback for specific chapters to complete the journey. Special mention also goes to Dr Tsakeni and Professor Mokhele-Makgalwa who were steadily present in most of the ILCIS academic writing workshops to enrich the study.

My heartfelt thanks are extended to Cornelia Geldenhuys for her unwavering support, navigating with me throughout the journey of this thesis, editing and encouraging me to push through. Special mention also goes to my colleagues at ECoL who also reviewed some areas of the thesis.

Special appreciation also goes to the Ministry of Education and Training (MoET) Lesotho for allowing me to conduct this study in Primary Schools. Above all, I thank the almighty God for carrying and guiding me through this journey, and for directing me to interact with all the individuals met to make the study a success.

DEDICATION

This thesis is dedicated to:

My loving husband Tsoloane Taolane. Thank you my love, for your unconditional love, support and belief in me even when I started to doubt the feasibility of completing this study.

My loving sons: Molibeli, Sehlabaka and Mahlomola. Thank you for your love, patience and understanding even when I could not be what a mother should be to her sons.

All my friends with special mention of Mabafokeng Mahahabisa, colleagues (former and current) and ECoL management. Honour to you, my dream could not have come true without your motivation, sacrifices and unwavering support.

My dear father Mohlaoli Mahamo (MHSRP), mother, Mamafankane Mahamo, granny, Malebohang Jaase, aunty Mamonyane Ranoha, all my brothers and sisters (siblings and in-laws), my dear Kamohelo Lethoko, the Leoaneka, Taolane, Hlabana and related families. It was through your encouragement, sacrifices, belief in me and prayers the thesis sailed through.

Kea Leboha Matebele le Bakoena. Molimo a mpolokele lona.

ABSTRACT

Information and communication technology (ICT) integration in Basic education has been regarded a struggle in some countries, even though the value of technology in education is globally appreciated. Scholars recognised the underutilisation of ICT and many schools in developing countries either have no ICT infrastructure or conditions do not match those where training on ICT integration was held, Lesotho included. This qualitative multiple case study investigated how teachers use ICT in science, currently referred to as Science and Technology at Basic Education in Lesotho, from the interpretive perspective. Three purposively selected Grade 6 - 7 teachers were studied through the Technological Pedagogical Content Knowledge (TPACK) theory, supported with the High Possibility Classroom (HPC) model with their principals engaged in exit interviews. The study reveals the discourses that inform teachers' ICT integration practices in Lesotho and document classroom practices of ICT integration into the teaching of science and technology in the reviewed curriculum. Lastly, it accounts for the way teachers integrate ICT into teaching of science in Lesotho.

Findings from content analysis of interviews, classroom observations and policy framework revealed some interesting factors that contribute to the way teachers integrate ICT in Lesotho. Specifically, the study highlights the status of teachers' exposure to productive discourses motivating ICT integration. It further reveals the selected teachers' patterns of classroom practices of ICT integration, incorporating assessment of learners' 21st-century skills and how contextual constraints to ICT integration were confronted. The study highlights pointers of ICT integration in the Policy frameworks and gaps in Curriculum and Assessment Policy, 2009 and the Science and Technology curriculum for Grade 7. The study recommends Continuous Professional Development for teachers to strengthen their ICT competences and pedagogy; teachers taking responsibility for improving their careers to fit into the global world; support for experienced ICT-integrating teachers to become model teachers for ICT pedagogy and developing Communities of Practice on ICT integration. The study proposed the model for effective ICT integration in primary schools that could inform the education system, curriculum developers, teachers and policy makers especially, of ICT policy for education in Lesotho currently at draft stage. The study further suggests direction for future studies.

Keywords: Information and Communication Technology (ICT); ICT integration; Discourse; Science instruction; Technological Pedagogical Content Knowledge (TPACK) framework; The High Possibility Classroom (HPC) model; Classroom practices; Basic Education; In-service teachers; Teaching and Learning.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF LESSON SEGMENTS

ACRONYMS

CAP:	Curriculum & Assessment Policy
CK:	Content Knowledge
CPD:	Continuous Professional Development
HPC:	High Possibility Classroom
ICT:	Information & Communication Technology
ISTE:	International Society for Technology in Education
LCE:	Lesotho College of Education
LECSA:	Lesotho Evangelical Church in Southern Africa
LGCSE:	Lesotho General Certificate of Secondary Education
MICST:	Lesotho Ministry of Information, Science and Technology
MOET:	Lesotho Ministry of Education & Training
PCK:	Pedagogical Content Knowledge
PK:	Pedagogical Knowledge
PS:	Primary School
STEM:	Science Technology Engineering & Mathematics
STIC:	Science Technology Innovation Centre
TCK:	Technological Content Knowledge
TK:	Technological Knowledge
TPACK:	Technological Pedagogical Content Knowledge
TPK:	Technological Pedagogical Knowledge
UFS:	University of the Free State
UNESCO:	United Nations Educational, Scientific and Cultural Organisation

CHAPTER 1: BACKGROUND AND ORIENTATION TO THE STUDY

1.0 INTRODUCTION

Emerging technologies require teaching and learning experiences to shift from traditional teaching to constructive learning by engaging learners in technology-oriented, scientific, inquiry-based teaching and learning (Ghavifekr & Rosdy, 2015; Guzey & Roehrig, 2009). The present study investigated how Grade 6 - 7 Basic Education teachers in Lesotho integrate Information and Communication Technologies (ICTs) into classroom practices. Follow up data collection with one participant teacher was conducted in Grade 6 in another year, where he was currently placed for Science and Technology. Scholars argue that the effective integration of ICTs into instruction has the potential to help improve learning and teaching (Aikins & Arthur-Nyarko, 2019; Jita & Akintunde, 2021).

Research trends on ICT integration since the 1980s have uncovered teachers' multiple uses of technology in classroom practices, highlighting ICTs' potential to improve teaching and learning. The main barriers to successful integration were mainly the lack of infrastructure and teachers' computer literacy skills (Msila, 2015). The studies further exposed more obstacles such as teachers' access to resources, lack of confidence and competence skills (Chigona, 2018), as well as the beliefs and attitudes of individual teachers towards the use of technology for teaching and learning (Günes & Bahçivan, 2016; Mishra & Koehler, 2006). Innovative digital technologies emerged in the 21st century, which required of teachers to shift from traditional teaching instruction to technology-oriented instruction and develop learners' ability to implement 21st-century skills (Davies & West, 2014).

To facilitate effective ICT integration, different countries have developed ICT policies that guide the integration process through reforms which have been implemented. However, it is clear that in many cases the intended ICT integration policy plan and the actual integration process are frequently out of synchronisation (Cohen, 1990). Thus, more research is needed to focus on understanding teachers' ICT integration practices in greater depth.

In order to motivate the use of ICTs in teaching, many countries have identified projects to train teachers on ICT pedagogies and have even supplied schools with

some ICT infrastructure (Kalanda & De Villiers, 2013). George and Ogunniyi (2016) argue that the effective integration of ICTs into teaching provides opportunities to engage learners in conceptualising the sometimes abstract science content. There is growing literature that explores the actual classroom practices of ICT integration of teachers in depth. For instance, Williams and Otrel-Cass (2017) engaged six science teachers in a case study. The teachers were trained on how to implement learner-centred approaches where the learners take responsibility for their own learning process.

What is surprising is that, even though the literature reveals that there has been an improvement in teachers' ICT competences over time, teachers continue to underutilise the acquired skills in their classroom practices (Brinkerhoff, 2006; Chai *et al.*; Tsai & Tan, 2011; Guillén-Gámez & Mayorga-Fernández, 2020; Padayachee, 2017). On the issue of underutilisation of ICT skills, Ke and Hsu (2015) contemplate that there is usually a gap between teachers' ICT classroom practices and expectations about how they should integrate ICT into teaching and learning; hence, the critical need to assist teachers in coping with teaching using technology. Ke and Hsu (2015) and Mishra and Koehler (2006) further emphasise that when teachers have well-developed Technological Pedagogical Content Knowledge (TPACK), they can design and implement innovative technology-oriented instruction in their classroom practices.

Existing studies on the use of technology in teaching and learning mainly focus on barriers to ICT integration, professional development training, the beliefs and attitudes of individual teachers, and the role of leadership in the ICT integration process (Gaible & Burns, 2005; Howard, Chan & Caputi, 2015; Koh, Chai & Tay, 2014). Some studies also provide brief accounts of the ways in which ICTs are used through self-reporting surveys and interviews (Hinostroza, *et al*., 2011). For instance, Hayes' (2007) qualitative study explored six public schools in Australia giving a brief account of teachers' ICT integration classroom practices using classroom observations and interviews. Each school nominated teachers who were innovative and were considered experts on the use of technology in learning and teaching. The growing body of qualitative studies in South Africa also highlights the emerging constraints to ICT integration in schools' contexts (Chigona, 2018; Jita & Munje 2020; Msila, 2015; Tsakeni & Jita, 2019). The studies highlight the limited literature available that focuses

on subject-specific classroom practices. The implication is that more studies are required to gain deeper insights into teachers' actual ICT integration practices in specific subjects. Thus, the present study intended to reveal classroom practices of ICT integration in the Science and Technology subject in Basic education through triangulation of data on teachers' ICT integration strategies in the Lesotho context. Qualitative studies accessed mostly used interviews and/or observations without much triangulation with document analysis. The present study hopes to contribute to the literature on ICT integration practices, informed by classroom observations in Lesotho.

1.1 BACKGROUND TO THE STUDY

The study was undertaken within the Lesotho context. Lesotho has announced the 10 years of basic education as compulsory for all Basotho children. A new, integrated curriculum was developed (MoET, 2009) and has gradually been implemented from primary school since 2013. In the new curriculum, the subject Science has been replaced with an integrated Science and Technology learning area and the curriculum is divided into five learning areas. The redesigned basic education curriculum intends to provide learners with scientific and technological knowledge and skills that will enable them to function socially, economically and technologically in the global world. MoET (2009) echoes that learners will build excellent communication skills using ICTs as part of the Science and Technology curriculum. The redesigned syllabus was rolled out in Grade 7 in 2017. Regarding basic education, I assumed that primary schools are now better established with adaptation to the new curriculum; hence, my intention to investigate teachers' ICT integration classroom practices in Grades 6 - 7 in Basic Education.

Lesotho is no exception to the problem of low levels of ICT integration into subject teaching (Baller, Dutta & Lanvin, 2016; Kalanda & De Villiers, 2013; Makuru & Jita 2022). While reforms have taken place, for instance, the training of teachers on ICT integration through Microsoft School of Technology Innovation Centre (STIC) project since 2007, it is still not clear, however, what the results are in terms of changed classroom practices pertaining to the integration of ICTs into science teaching. Lesotho, like other countries, is committed to international protocols such as Sustainable Development Goals (SDG)s, Education for All (EFA) and the SADC

protocol, which encourage development of Science and Technology and promote a curiosity for teaching and learning of science and technology (Lesotho Science and Technology Policy, 2005). Moreover, Lesotho has its own policies, such as the National Vision 2020, a National ICT Policy of 2005 (MICST, 2005), the Lesotho Education Sector Strategic Plan, ESSP of 2005–2015 (MoET, 2005), a MoET Curriculum and Assessment Policy (MoET, 2009), the Lesotho National Strategic Development Plan (2013–2017), the Lesotho Country Working Document (2017), the Education Sector Plan of 2016–2026 (MoET, 2016) and the Integrated Primary Curriculum which guide the integration of technology into education in general, even though Lesotho does not have an ICT policy for education specifically. The Lesotho National ICT policy framework recommends that learners be empowered with technological and entrepreneurial skills to prepare them for social, economic and technological challenges.

In addition, the new Curriculum and Assessment Policy has introduced a Science and Technology curriculum. The curriculum requires of learners to appreciate and apply scientific and technological knowledge in effective communication using ICT. Learners are expected to appreciate the use of scientific and technological knowledge as well as skills for promoting personal and social development, interaction within an environment in a sustainable way, good health and healthy living and production, especially by using locally available materials (MoET, 2009). Additionally, since 2005, projects such as the School Net Lesotho, Microsoft School Technology Innovation Centre Project and the NEPAD e-School have benefited many secondary schools in Africa, including Lesotho, with ICT skills (Jita & Akintunde, 2021). Moreover, in 2006, Lesotho undertook a national study investigating the training needs of teachers for mathematics, science and technology curriculum-effective delivery (Mokuku *et al*., 2013).

The limited studies in Lesotho on the use of ICT in the classroom collectively show some evidence of ICT integration practices among teachers in specific subject areas (Bohloko *et al., 2019*; Jita & Akintunde, 2021; Lisene & Jita, 2018). A quasi-experimental study by Bohloko *et al.* (2019), for example, examined the integration of YouTube videos into the learning and teaching of LGCSE chemistry curriculum. The study reaffirms what has been indicated in literature, namely that the use of ICTs such as YouTube improves learners understanding of abstract scientific concepts.

Similarly, an action research evaluating ICT integration in the science classrooms of Lesotho secondary schools has been documented and established that teachers were optimistic about the use of ICTs (Kalanda & De Villiers, 2013). However, Lisene and Jita's (2018) quantitative survey emphasises teachers' inadequate use of developed ICT skills in the learning and teaching of physical science at LGCSE level (Grade 11). This science curriculum at senior secondary level in Lesotho requires of teachers to empower learners with ICT skills as they prepare to transit to tertiary levels. On the other hand, Jita and Akintunde (2021) explored teachers' perceived confidence of ICT integration by surveying pre-service teachers from the National University of Lesotho (NUL) and the LCE in their final-year programme of science education studies. It is evident from their study that the teachers in Lesotho are at best only moderately integrate ICTs in science lessons, and that it is necessary to have mechanisms in place to support them with ICT pedagogy. On the contrary, Ralebese's (2018) study focuses on teachers' instructional and assessment practices at primary schools in Lesotho for the recent curriculum of MoET (2009). However, the study is silent about teachers' use of ICT resources in the classroom practices. The present study therefore focuses on exploring the actual ICT integration into classroom practices of in-service teachers at primary schools to inform the research community about these practices within the context of Lesotho.

The small pool of existing studies suggests the need for future research to focus on classroom practices in order to gain deeper insights into how technology is integrated into instruction. What seems to be missing in the studies is lessons from practices of teachers who are experts in ICT integration, focusing in particular on the requirements of the new Science and Technology curriculum in Lesotho (MoET, 2009). Hennessy *et al.* (2010) argue that teachers with good ICT integration, classroom practices can be studied to inform the body of research about effective ICT integration strategies; hence, my interest in investigating how science teachers, within the context of Lesotho, use ICTs for instruction in their classrooms.

1.2 RESEARCH PROBLEM

Literature shows that many teachers have developed a range of useful ICT skills, even though there is still inadequate ICT integration into learning and teaching (Chai *et al.*, 2011; George & Ogunniyi, 2016; Jita & Munje, 2020; Sang *et al.*, 2010). Many

countries have developed policies and strategic plans to facilitate effective ICT integration into schools. They have invested in reforms to provide infrastructure for schools and empower teachers with ICT skills. For instance, Vallance (2008) documents how Singapore developed the master plan for IT in Education policy. It is through the strategic plans from this policy that all schools in Singapore were equipped with ICT infrastructure and internet by 2002. The aim of the policy was to encourage communication and collaboration between teachers and learners. Lesotho has also developed the National ICT policy and the Education strategic plan to motivate ICT integration in all sectors. These policy documents were developed to facilitate innovation, creative thinking, leadership skills and lifelong learning. Lesotho engaged in initiatives capacitating both in-service and preservice teachers with ICT pedagogy and in some cases, with computers also, which benefitted some primary and secondary schools. What is not clear is why after initiatives such as the School Net Lesotho, STIC Project and the New Partnership for Africa Development (NEPAD) e-School there is still inadequate ICT integration in schools (Jita & Akintunde, 2021; Kalanda & De Villiers, 2013).

Although many countries have developed national ICT policies for effective integration of ICT into teaching and learning, there is a gap between the intentions of ICT policy and science teachers' ICT integration practices. This could be due to reasons such as teachers' sense making of the policy, possibly differing from policy makers' intentions and context-related factors (Cohen, 1990; Moffitt, O'Neill & Cohen, 2023). It is not surprising, therefore, that some researchers have called for more exploration of actual cases of ICT integration into classroom practices in order to develop models of good practices, as most previous studies have not explored ICT-oriented instruction in depth (Prestridge, 2012). When emphasising the need to explore teachers' ICT classroom practices, Finger and Finger (2013) refer to teachers' ICT integration classroom practices as a "black box of technology integration", as not much is known about how teachers go about integrating ICT into learning and teaching. Additionally, Kalanda and De Villiers (2013:1664) accentuate this need when they argue,

> Contextual and localised research is needed on e-learning, particularly on the progress of ICT integration in the science classrooms, since science teachers were among the early adopters of the new technologies.

The implication from the quote is that research will inform the education system about what is happening on the ground regarding the use of ICTs in learning and teaching. A study by Juanda, Shidiq and Nasrudin (2021) in the era of Covid-19 further stresses the need to ensure teachers development of TPACK and readiness for ICT integration to cope with emerging pandemics. Thus, the present study sought to investigate the ways teachers integrate ICT into science and technology instruction at the basic education level to understand how teachers cope with ICT integration and to inform teachers about a range of practices on the use of ICTs for instruction in Lesotho classroom situations. The study has the potential to contribute to the ICT Policy for Education in Lesotho, which is currently in draft stage and the reviews of Lesotho Basic Education Curriculum policy which informs the review of curriculum.

1.3 LITERATURE REVIEW AND THEORETICAL FRAMEWORK

Teaching science through an inquiry approach has the potential to engage learners in higher order thinking skills, especially when integrating ICTs into such learning circumstances. Emerging technologies have the potential to improve science instruction (Donnelly, McGarr & O'Reilly, 2011; Guzey & Roehrig, 2009; Sang *et al.*, 2010). Different models of ICT integration have been developed to explain ICT integration in schools. Donnelly *et al.* (2011) argue that some teachers integrate ICT for assessing learners, while others use it for learning purposes, shifting from a teacher-dominant instruction to a learner-centred instruction. On the other hand, Starkey (2010) has presented a digital-age matrix that can be used to explain how teachers utilise ICTs in teaching and learning. The matrix highlights the levels of learning and expectations such as presenting and processing information and communicating using technology. It provides one important way to frame and understand the integration of ICT into teaching and learning.

On the other hand, Oyier *et al.* (2015) argue that emerging technologies assist in managing instructional practices and recording students' learning progress in schools. The authors further emphasise that classroom instruction is changing rapidly with ICT integration, as chalk and blackboard are gradually replaced by devices such as smartboard, notebooks, memory cards, flash disks and overhead projectors in a technology-oriented instruction classroom. On the other hand, Capuk (2015) points out different ways of ICT integration, including integrating ICT, as a stand-alone

subject in which learners are taught technology content, or ICT integrated into curricula in different ways in a variety of subject disciplines, including the virtual laboratory. However, most commentators discourage the integration of ICT as a stand-alone subject matter, which the current study also underwrites.

What is clear from previous research is that teachers cannot simply integrate ICT; they need to have special knowledge of technology to integrate it into lessons. Mishra and Koehler (2006) have established that teachers manage to utilise technology tools in instruction if they have what is called Technological Pedagogical Content Knowledge (TPACK). This is an extension of Shulman's (1986) model of Pedagogical Content Knowledge (PCK) (Koh & Divaharan, 2013). Shulman (1986) established the knowledge base for teachers with one of the constructs as Pedagogical Content Knowledge, which is critical for teaching effectively. The researcher emphasises that apart from content knowledge, a teacher needs this special professional knowledge in order to deliver the lesson effectively. The TPACK adds the pedagogy of technology to the PCK model by Shulman, incorporating teachers' knowhow of delivery of instruction using ICT tools. The TPACK has seven knowledge areas, also referred to as constructs. They are Pedagogical Knowledge (PK), Content Knowledge (CK), Technological Knowledge (TK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), Pedagogical Content Knowledge (PCK) and Technological Pedagogical Content Knowledge (TPACK). The definitions of these constructs by Chai *et al.* (2011) are demonstrated in section 2.9.1 of the literature review.

However, according to Mishra and Koehler (2006), the TPACK framework has a gap; it describes the sources of knowledge underlying ICT integration expertise but does not indicate how the knowledge can be strengthened, especially through instructional practices. In extending the TPACK framework, Koehler, Mishra and Cain (2013) emphasise the role of contextual factors in science teachers' TPACK and encourage future research to validate the model. Koh *et al.* (2014) further justify the significance of context in teachers' strategies of ICT integration, and they refer to the model as TPACK in action. Rosenberg and Koehler (2015) further emphasise the contribution of contextual factors to TPACK, shaping ICT integration across schools. However, the scholars stipulate that qualitative studies on the impact of context on TPACK do not often analyse the factors in depth; hence, the need for further research in this regard.

A variety of ICT integration models are established in literature in addition to the TPACK framework. Examples of such models are the Teacher ICT Integration Model and the teachers' ICT-integration support model. The Teacher ICT Integration Model was used to establish orientation of different types of teachers while integrating ICT in classrooms. It was revealed that some teachers utilise ICT for assessment purposes, while others use it for learner centred teaching (Donnelly *et al.*, 2011). The teachers' ICT integration support model highlights the support teachers require to use laptops effectively in teaching using ICT-incorporated instruction (Howard *et al.*, 2015). The researcher further indicates that the relationship between teachers' ICT integration and subject-specific areas depends on the overall support, the technical support and the professional development that influence teachers' beliefs and readiness to use laptops in their classroom instruction. The model has a number of self-reflective scales used to measure teachers' competences in the use of ICT in the classroom.

The current study draws from the contextual TPACK model to allow me to gain deep insights into how individual teachers instruct learners by using technology in the classrooms in a variety of school contexts. The TPACK model is appropriate for this study, since teachers who have advanced TPACK knowledge are likely to be innovative and can manage technology-oriented activities. Such teachers usually have the skills to develop authentic assessment tasks (Graham *et al*., 2009) and the TPACK framework will thus allow me as a researcher to collect valuable data on the teachers' classrooms practices in a technology-oriented instruction. The TPACK is supported with the High Possibility Classroom (HPC) model to find finer details of teachers' classroom practices of ICT integration. A more elaborate discussion of these models is presented in Chapter 2 of this study.

1.4 RESEARCH QUESTIONS

The study answers the following main research question:

> How do teachers integrate ICTs into the teaching of science in basic education in Lesotho classrooms?

The following sub-questions unpack the main question:

1. What are the discourses that inform ICT integration practices of teachers of science in Lesotho?

2. How do teachers across different school contexts in Lesotho practise the integration of ICTs into the teaching of science renamed science and technology in Grades 6 to 7?
3. How can a (theoretically and empirically) sound account be constructed of the teachers' integration of ICTs into the teaching of science and technology in Lesotho?

1.5 RESEARCH AIM AND OBJECTIVES

The aim of the study was to:

> Investigate how teachers integrate ICTs into the teaching of science in basic education in Lesotho classrooms.

Basic education in Lesotho comprises the first 10 years of schooling, from Grades 1 to 10. At Grades 5 - 7, "Science" has been replaced with "Science and Technology" in the current curriculum. In 2005, no significant professional development programmes for teachers on ICT-oriented instruction existed in Lesotho, but from 2006, the number of trained teachers gradually increased (Kalanda & De Villiers, 2013).

The specific objectives of the study were to:

- Explore how the discourses inform science and technology teachers' ICT integration practices in Lesotho.
- Document the actual classroom practices of teachers across different primary schools in Lesotho who integrate ICTs into the teaching of science and technology in Grades 6 - 7.
- Construct a theoretically sound account (and explanation) of why the integration of ICT into the teaching of science and technology takes place the way it does in Lesotho.

1.6 RESEARCH DESIGN AND METHODOLOGY

A qualitative study approach was used to explore and understand how teachers integrate ICT into the teaching of science and technology. The study employed an exploratory multiple-case design from an interpretive perspective to develop an in-

depth analysis of science teachers' ICT integration into classroom practices. Cohen, Manion and Morrison (2018) postulate that interpretivism enables the researcher to undertake small-scale research from either an insider or an outsider perspective. Moreover, the researcher was able to understand, interpret and explain the observed actions and meanings rather than focusing on causes of the actions. On the other hand, Johnson (2014) affirms that a multiple-case study enables the researcher to explore different cases of the same phenomena within limited resources in their natural settings. In this case, I selected specific schools where integration seemed to be happening and investigated how teachers integrate ICT into the teaching of science in Lesotho schools and then limited the findings to specific school contexts.

1.7 DATA COLLECTION

I collected data from an outsider perspective (McMillan & Schumacher, 2010). I collected data for a period of five to seven weeks until the data collection reached saturation point. McMillan and Schumacher (2010) further argue that valid data are achieved when events unfold naturally, with participants ignoring the presence of the researcher. Moreover, the initial plans for data collection usually change as they are reviewed after selection of the research site and when mapping the field, as experience with data collection suggests new directions of interviews and observations. To support this idea, Saldana (2011) stipulates that in qualitative studies, data collection should be regarded as an evolutionary process where pre-planned data collection methods can be changed to secure the required data if the existing plan does not work.

The study employed document analysis, observations, and interviews for data collection. The content analysis of policy framework documents and lesson plans revealed how the documents informed teachers about integrating ICT into science teaching. I requested such documents from the Ministry of Education and Training (MoET) Lesotho, the principals, and the participant teachers at the research site. The principals were also requested to provide a school policy that guides ICT integration into teaching even though, only one participant school had the policy. In the study about ICT school policy, Tondeur *et al.* (2008) suggest that future research may focus on investigating how the informal policies affect formal policies and ICT integration into schools.

It was planned that the three teachers from different primary schools would be observed teaching two 80-minute lessons each per week for about three weeks. However, I had to be flexible at each school, as I depended on schools' arrangements of the use of ICT in instruction. McMillan and Schumacher (2010) argue that intensive observations reveal verbal, tacit knowledge and non-verbal words people usually demonstrate by actions or use of objects. The lessons were video recorded. After observing their lessons, in-depth interviews were conducted with the teachers for about one hour. To triangulate the results, the principals were also interviewed afterwards to get a sense of the context and expectations. The audio-recorded interviews enabled the researcher to collect intensive data on a small sample (Creswell & Creswell, 2018). Ritchie *et al*. (2013) emphasise the critical role of the researcher for a successful interview.

1.8 SAMPLING

The target population was Lesotho Basic Education schoolteachers of Science and Technology in Grades 6 - 7. Grade 7 is the exit into junior secondary education level in Lesotho. Purposeful sampling of participants within my reach (Cohen *et al.*, 2018; Creswell & Creswell, 2018) was used to select three science and technology teachers and their principals for exit interview from schools of different contexts. The teachers' expertise in utilising ICTs and their experience with the new science and technology curriculum were the criterion for selection. The teachers were identified through a process of nomination, including self-nomination. The teachers were also selected by multiple recommendation by the principal and local school inspector.

1.9 DATA ANALYSIS, INTERPRETATION, REPORTING AND QUALITY ASSURANCE

The qualitative data were analysed inductively by coding, categorising and interpreting (McMillan & Schumacher, 2010). Combination of narrative and content analysis was used to analyse data (Creswell & Creswell, 2018; Guzey & Roehrig, 2009). Individual teachers' cases were coded, and categories established from their ICT integration classroom practices. Patterns were developed to offer in-depth descriptions of ways teachers use ICT tools in science teaching from emerging themes. Saldana (2011) further states that similar codes are grouped together under a named category;

however, different researchers can code the same data differently. Additionally, the author stipulates that researchers need to establish how the categories interact and interplay in order to explain and understand the emerging issues about the phenomena under study effectively. NVivo was used to analyse the collected qualitative data.

To ensure reliability of the results, consistency was maintained when collecting data so that valid conclusions (Johnson & Christensen, 2014) could be reached. The interpretation of results was further supported by adequate evidence from observations of video records. To ensure the validity of the results, there was evidence that the selected teachers are experts in the utilisation of ICTs in teaching. Issues of trustworthiness such as triangulation of instruments, member checking, thick description, prolonged time spent in the field, an external auditor and clarity on bias were considered in this study (Creswell & Creswell, 2018).

1.10 VALUE OF THE PROPOSED RESEARCH

ICT integration into science education is meant to improve teachers' technology pedagogy and to use specific ICT tools to improve teaching and learning (Hinostroza, *et al*., 2011; Jita & Akintunde, 2021). The present study will inform the education system about the possibilities of improving technology integration into science classrooms. Like other studies, there are limitations and delimitations (Beglar & Murray, 2009) to this study. The purposive sampling employed could not enable generalisation of the findings to the participants' population. Some schools are in regions of Lesotho that are very difficult to reach and expensive for the researcher to engage due to limitations of time and funds. I sampled teachers from schools of different cultures and contexts within my reach in one district out of ten in the country.

1.11 ETHICAL CONSIDERATIONS

Ethical considerations were applied throughout the research stages. I adhered to the principles of informed consent (Flick, 2014). The teachers took part in the study on a voluntary basis and could withdraw from the study at any time (Morrell & Carroll, 2010). The participants were further provided with a feedback report. From the beginning of

the study, I sought ethical clearance from the University of Free State and the Ministry of Education in Lesotho for permission to collect data at selected schools.

1.12 DEFINITIONS OF KEY TERMS

The following are key terms in this study: Discourse; TPACK; ICT; In-service teachers; ICT Integration; Science Instruction; The High Possibility Classroom (HPC) model; Classroom practices and Basic Education; Teaching and Learning.

Chai *et al.* (2011:1185) define **Technological Pedagogical Content Knowledge (TPACK)** as "knowledge of facilitating students' learning of a specific content through appropriate pedagogy and technology".

Jita (2016:73, 74) defines **Information and Communication Technologies (ICT)** as "both hardware, software and other digital applications technologies such as computers, laptops, software programmes, mobile technologies, online tools and such e-platforms".

In-service teachers are teachers working within a school context of which majority have completed their teacher training before becoming part of the education system.

Davies and West (2014) define **Technology Integration (TI)**, which is also referred to as ICT integration, as "the effective implementation of educational technologies to accomplish intended learning outcomes". In the present study ICT integration refers to use of the educational technologies such as computers, mobile phones, soft wares or any other available ICT resources in classroom practices to improve teaching and learning. Mobile phones are also considered in this study, since their penetration in the country is significant. The 2016 International Telecommunication Union (ITU) survey of 10 African countries stated Lesotho at 107% mobile penetration, while the After Access survey of 2017 ranked Lesotho at 79% (Gillwald & Mothobi, 2019).

Bagiyan (2014:9) presents multiple definitions of discourse and concludes that it is a multi-faced phenomenon. For instance, **Discourse** is defined as a difficult communicative phenomenon including not only the text, but also the extra-linguistic factors, essential and necessary for the full understanding of the text. It is also defined as a thin contacting surface which pulls together language and reality, mixing lexicon and experience. Discourse can be written or spoken (Fairclough, 2013). ICT discourse

in this study are the spoken and written discourse that drive the use of ICTs in classroom practices.

Hunter (2017) indicates that the **High Possibility Classroom (HPC)** model is a conceptual framework extending the TPACK using research on exemplary teachers' expertise of ICT integration.

Koehler *et al.* (2013:13) define **Teaching** as "a complicated practice that requires an interweaving of many kinds of specialised knowledge". For instance, the specialised knowledge areas could be "knowledge of student thinking and learning, knowledge of subject matter and increasingly knowledge of technology". Research shows that incorporating technology in teaching is complicating teaching further when teachers encounter challenges with new technologies (Koehler *et al*., 2013)

Harel and Koichu (2010:115-116) argue that learning is multi-dimensional and multi-faced with many definitions in literature. The authors define **learning** as "a continuum of disequilibrium-equilibrium phases manifested by (a) intellectual needs and psychological needs that instigate or result from these phases and (b) ways of understanding or ways of thinking that are utilized and newly constructed during these phases.

Classroom practices in this study refer to teachers' actions when conducting an instruction in this case, the science and technology instruction.

Basic Education in this study refers to Grade 1 to Grade 10 level of education in Lesotho, where Grade 1 to 7 is Primary school level and Grade 8 to 10 is Junior Secondary education level.

Science Instruction in this study refers to teachers' delivery of a prepared science lesson.

1.13 LAYOUT OF CHAPTERS

Chapter 1 elaborates on the current situation of ICT integration at schools and its impact on the teaching and learning of science at primary schools. The challenges and the successes are also indicated, as well as how they motivate the current study.

Furthermore, the gap of ICT integration globally and in the Lesotho context is justified in this section.

Chapter 2 covers literature on ICTs in the teaching and learning of science and the teachers' pedagogy for ICT integration. Teachers' use of ICTs in classroom practices of science and the ICT integration models discussed in the literature will be discussed in this section, justifying the choice of the TPACK model for this study. The chapter will also reveal what the literature says about teachers' use of ICT-incorporated instruction in different contexts. A brief account of current Lesotho teachers' ICT integration classroom practices and the current ICT tools status in Lesotho context will also be given qualitatively, with highlights of the country's initiative reforms that motivated the use of technology in learning and teaching in Lesotho.

Chapter 3 discusses the qualitative methodology, the exploratory multiple-case research design employed, the purposive sampling techniques and the instruments which collect data in the present study. The benefits of the design, the classroom visits, interviews, content analysis and observations that would be undertaken and the purposive sampling involved are described in this chapter. Furthermore, the characteristics of participants, the instruments used in the study, and the data collection and analysis plan are elaborated on in this section.

Chapter 4 presents the narrative of cases of the three participant teachers and content analysis of policy documents. Emerging themes from the qualitative data analysis will form the basis for cross-case analysis in Chapter 5. Data will also be analysed, and presentations given with the aid of NVivo software.

Chapter 5 presents the cross-case data analysis and interpretations of the three cases of the study, the discussions, recommendations, conclusions, limitations, and significance of the study. It assists to answer the last research question which requires the construction of meaning of why teachers integrate ICTs the way they do in Lesotho context. The chapter points to the evidence of the new knowledge contributed by this study to the body of research and to the Lesotho Education System in particular.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

Chapter 1 introduced the background and overview of this study, which is an investigation of science teachers' classroom practices of ICT integration into teaching and learning at the basic education level within the Lesotho context, post the introduction of the new Science and Technology curriculum at this level. Globally, a number of studies have examined integration of ICTs into learning and teaching as a necessary requirement for education (Chai *et al.*, 2011; Ghavifekr & Rosdy, 2015; George & Ogunniyi, 2016; Jita & Munje, 2020). Moreover, scholars also emphasise that institutions for training of pre-service teachers should empower them with the necessary ICT skills to cope with effective ICT integration into classroom practices (Jita, 2016; Sang *et al.*, 2010). The main problem centres on the persisting rather insignificant use of ICTs in instruction. The study aims to reveal discourses about ICT integration in schools, the teachers' practice of ICT integration and how teachers' classroom practices on the use of ICTs can be understood within a Lesotho context at Basic Education level. It is believed that sensitising the Education system about the experiences of teachers' practices on the ground, regardless of existing contextual challenges could motivate other teachers to use ICTs effectively in their school contexts.

This chapter gives an overview of existing literature on ICT integration into classroom practices, its challenges, the successes of ICT integration and the exemplary pedagogies of good classroom practices pertaining to ICT integration. The chapter also positions this study in the ongoing qualitative studies using the TPACK framework to add knowledge about teachers' practices of ICT integration in Lesotho context. The chapter commences with the setting for the study and standards for the teaching and learning of science in the 21st century. It proceeds to studies on the integration of ICTs into education in different countries internationally and in Africa, including Lesotho, especially into science classrooms. I then continue to introduce the TPACK model as the theoretical framework for the study. Next, I provide trends of the TPACK framework as it evolves in different studies to include issues of context that encourage qualitative studies about the framework, up to the extension to the HPC model with which I also engage in this study. The chapter concludes by identifying the gaps in literature

regarding ICT integration into classroom practices and motivates the focus of the present study.

2.2 THE SETTING FOR THE STUDY

The study was undertaken within the Lesotho context. Three science teachers from primary schools in one district of Lesotho with evidence that they integrate ICT into the learning and teaching of science participated in this study. The principals of the targeted schools also participated to validate the findings. The target group was Grades 5 to 7, depending on availability, after negotiating access to the research field.

2.2.1 Background – the country

Lesotho, the Mountain Kingdom, is entirely surrounded by South Africa. According to the Education Sector Strategic Plan (ESSP, 2016–2026), Lesotho has a population of about two million people. It is categorised as a developing country. Like other countries, Lesotho's education system development is guided by the Millennium Development Goals, the Education for All, and other policy frameworks which ensure that learners are prepared to fit into the global society. Therefore, Lesotho also sets targets for its education system to achieve the agreed-upon goals and objectives. However, Lesotho's schools are still challenged in respect of a conducive learning atmosphere for all, especially with regard to a lack of infrastructure at many schools, in particular for using ICT tools. Moreover, in 2005, no significant professional development programmes for teachers on ICT-oriented instruction existed in Lesotho, but from 2006, the number of trained teachers has gradually increased (Kalanda & De Villiers, 2013).

2.2.2 The Lesotho education system

The Government of Lesotho is committed to ensuring quality education for the children of Lesotho. The Ministry of Education and Training is responsible for the implementation of policies geared towards achieving the goals concerning education. Formal education comprises 10 years of basic education and two years of secondary education. The 10 years of basic education consist of seven years of primary education (Grades 1 to 7) and the first three years of junior secondary education (Grades 8 to 10), while two years are allocated to senior secondary education (Grades 11 to 12). Integrated Early Childhood Care and Development is provided for children from 0 to 5 years of age, usually referred to as pre-school, before learners proceed to

Grade 1 to start formal education (MoET, 2009). After completing their senior secondary education, learners can transit to the tertiary level to further their studies for about four to six years. This depends on whether they just want to obtain a degree or diploma or wish to proceed to postgraduate tertiary education.

Lesotho has introduced 10 years of compulsory basic education for all Basotho children. The national objectives of the Lesotho Education System are, amongst others, to ensure that all Basotho children obtain a basic education to develop their social and individual competencies. Moreover, the educational programmes are expected to focus on the development of learners' competency in scientific thinking, problem solving and entrepreneurial and technological skills to enable them fit into the global world. Additionally, it is also expected that Lesotho should have integrated curriculum and assessment strategies to facilitate the accomplishment of these education goals. Basic Education specifically aims to empower learners with the knowledge, attitudes and skills that will enable them to respond to socio-economic and technological changes. It also aims to facilitate the development of scientific, social, entrepreneurial and technological skills to promote independent and critical thinking skills that would contribute towards solving socio-economic problems. This means that at the end of 10 years of basic education, the acquired skills will assist learners to survive in the global society. According to the new curriculum, from Grade 9 onwards, learners will select either an academic or a vocational educational stream to prepare them for the world of work.

2.2.3 The new Lesotho Curriculum

A new, integrated curriculum was developed (MoET, 2009) and has gradually been implemented from primary school upwards since 2012. The new curriculum has five learning areas, namely "Linguistic and Literacy; Numerical and Mathematical; Personal, Spiritual and Social; Scientific and Technological; and Creativity and Entrepreneurial" (MoET, 2009:4-5). The learning areas are intertwined with the aspects of the curriculum that address the challenges the country has. These aspects include, "effective communication; awareness of self and others; environmental adaptation and sustainable development; health and healthy living; and production and work-related competencies" (MoET, 2009:4). The expectation is that the integrated curriculum aligns the learning areas with the daily challenges of the country.

The new curriculum has already been rolled out up to Grade 9. The current study thus focuses on the integration of ICTs into the scientific and technological learning area to investigate teachers' classroom practices to equip learners with the technological skills to fulfil the aim of that learning area.

2.2.3.1 The Lesotho Science and Technology Curriculum

In the new Lesotho curriculum, the subject Science in Grades 5 to 8 is now referred to as Science and Technology. Aligned with the curriculum aims, the attributes of the Science and Technology curriculum should enable learners to:

- apply scientific and technological knowledge and skills and use ICTs to communicate effectively;
- use scientific and technological knowledge and skills to understand and appreciate oneself and others and promote personal and social development;
- apply scientific and technological knowledge and skills to respond to environmental challenges and to interact with the environment in a sustainable way;
- apply scientific and technological knowledge to promote good health and healthy living and appreciate the impact of socio-economic and political development on people's health; and
- apply appropriate scientific knowledge and technological skills to enhance production, utilising locally available materials (MoET, 2009:28-29).

In addition, the policy specifies that the Science and Technology curriculum is an integration of the science, ICT, technical subjects, agriculture and geography subjects from the previous curriculum. This suggests that in a science and technology lesson, one expects to see the integration of science and the indicated related science subjects with ICT, instead of computer education taught separately, as used to be the case before the implementation of the curriculum informed by MoET (2009). The expectation is also that teachers should prioritise developing learners' competencies in ICT to achieve the indicated goals of the curriculum. However, according to Agyei and Voogt (2011), it is teachers who are technologically competent and have access to ICT resources who can integrate ICTs effectively into classroom practices. This is

further attested to by Almerich *et al*. (2016), who stress that ICT competencies are critical for teachers use of ICT resources in classroom practices.

2.2.3 Clarification of key concepts

ICT integration is a complex activity teachers are confronted with in order to teach effectively the 21st-century learners. It is complex, because technology keeps evolving and the teachers need to keep pace with it to remain relevant in the education system. The main challenge is that teachers tend to teach todays' learners the way they were taught. The recent curricula require teachers to teach otherwise. As teachers are struggling with coping with ICT integration, learners seem to be advanced in manipulative skills of ICT devices. Bhasin (2012:137) defines ICT integration as a comprehensive process of applying technology to the educational system to improve teaching and learning". Ghavifekr *et al*. (2014:25) stress that "ICT integration and implementation is a complex process which requires strategic planning by the policy and decision makers". The implication is that policies on ICT integration are guiding teachers on how to use ICTs effectively in instruction. Moursund (2005:50) argues that

> The needed teacher ICT knowledge and skills can be learned on the job by an appropriate combination of in-service education, observing and helping a computer teacher or other classroom teachers.

Jita and Munje (2020:108) observe that

> the improvement of quality teaching using ICTs is urgent as South Africa seeks to improve performance in science subjects, where traditional methods of teaching have not produced the desired results across subjects.

The implication is that there is persistent use of traditional teaching approaches to date that require attention. Koehler *et al.* (2013: 14) stress that

> there is no one best way to integrate technology into curriculum. Rather, integration efforts should be creatively designed or structured for particular subject matter ideas in specific classroom contexts.

The use of ICTs in instruction contributes to shifting teaching to learner centred approaches which contributes positively to development of learners 21st-century skills. In an ICT integrated lesson, learners are actively engaged in discovering and sharing

educational information, while the teacher is facilitating the lesson. Ghavifekr *et al*. (2014:25) further stress that

> the foundation and basic skill of ICT should be introduced into the primary school curriculum, to equip children with 21st century skills in their early learning environment due to the rapid growth of global information.

The implication is that primary school learners are also expected to develop competencies that enable them fit into the global world. In the present study, ICT integration is used to mean use of available ICT resources for the purpose of meaningful learning of content such as science in classroom practices.

Discourse is a complex activity with multiple definitions, according to different scholars, which point to communication among the people beyond the sentences representing it. Discourse talks to the interactive communication among the people in an institution such as education or specific context such as school, incorporating the facial expressions and accompanying gestures displayed during the communication. The implication is that the discourses can be documented, for instance, in policies, or they can be established when people in different contexts express their feelings about issues that concern them. Sherboboevna (2022:127) defines discourse as "an interactive activity of the participants of communication, information sharing, influencing one another, using different communication strategies, their verbal and nonverbal embodies in communication practice".

In the 21st century, the emerging technologies have increased the diversity of interactions and communication strategies in communities and globally. The discourses incorporated issues of ICT integration in Education. There are discourses that drive the use of ICTs in classroom practices. The discourses shape the teachers' decisions of using ICTs in instruction. Literature stresses that there are multiple definitions of discourse. For instance, discourse is considered as a social practice consisting of statements "pulling together language and reality" (Bagiyan, 2014:10). The present study focuses on discourses of ICT integration. The discourse about ICT integration is used to mean the documented communication information in Lesotho policies that informs ICT integration and the teachers' expressions of how they feel about use of ICTs in teaching and learning of science in primary schools, incorporating both written and verbal discourses.

Teaching is a dynamic complex and fast-paced activity in which a teacher facilitates learning in classroom practices. Mishra and Koehler (2006:1020) show that “it is highly complex activity that draws on many kinds of knowledge”. The teacher is expected to have content and pedagogical knowledge for the successful delivery of instruction. Todays’ learners require teaching to be conducted in a different manner from what it used to be. The teacher is expected to be digitally literate and to additionally have ICT literacy and ICT pedagogy knowledge for integrating ICT into classroom practices. The demands of the 21st-century learners are shifting the usual teaching practices. Teachers are required to utilise teaching strategies that enable learners develop 21st-century skills. The main challenge of in-service teachers is lack of exposure to ICT pedagogy during their teacher training. Another challenge is limited access to ICT resources, even for the teachers who were trained on ICT pedagogy. The teachers are confronted with the need for using ICTs in instruction to enable learners to develop ICT literacy and skills. Additionally, teaching is expected to cater for all types of learners and their varying learning styles. Use of ICTs in classroom practices contributes to multiple representation of information. It enables access to text information, listening to audio records and watching the videos on scientific content. In this study, teaching is used to mean facilitating instruction in a learner centred environment so that learners acquire 21st-century skills to fit into the global world.

Learning is a reaction to teaching. It is a dynamic activity in which learners acquire new knowledge through effective teaching. Munna and Kalam (2021:1) define learning as “change that is permanent in nature because it is brought into learners by a teacher through techniques”. The literature encourages learner-centred approaches that promote independent learning styles, with the teacher being the facilitator of the learning process. Scholars stress that learning is effective when there is development of competencies for survival in higher levels of education and in the world of work, and teaching strategies cater for all learning styles. In a classroom setting, learners all have different learning styles. There is a combination of auditory, visual and kinaesthetic learners. This is alluded to by Munna and Kalam (2021:2), who argue that teachers “must use a variety of teaching approaches depending on the learning styles of the students”. Moreover, Fu (2013:112) observes that, due to ICT,

> learning and teaching no longer depend exclusively on printed materials. Multiple resources are abundant on the Internet, and knowledge can be acquired through video clips, audio sounds, visual presentation and so on.

Furthermore, learning is expected to promote learners' 21st-century skills, such as problem solving, collaboration, communication, creativity, digital literacy and ICT skills. Scholars show that learning can be from traditional or constructivist approach (Charles *et al*., 2021). A traditional approach is characterised by teacher-centred approaches where the teacher transmits knowledge to learners who are passive and may not necessarily understand the content transmitted. Such learners usually experience challenges to apply the acquired knowledge to new situations and daily life experiences. On the contrary, the constructivist approach considers that learners are responsible for their own learning; they construct new knowledge through problem solving, inquiry, group work and others. Current trends encourage the constructivist approach, which is characterised by learner-centred approaches. The literature further shows that the infusion of ICT pedagogy in teaching and learning shifts teachers' instruction to learner-centred approaches and contributes positively to learners' development of 21st-century skills. Learning in this study is used to mean the acquisition of new knowledge and competencies by learners for survival in the global world, guided by the teacher facilitating development of 21st-century skills.

2.3 TEACHING AND LEARNING OF SCIENCE IN THE 21ST CENTURY

Research suggests that the effective teaching of science for 21st-century learners should develop learners who are equipped with the necessary technological skills to fit into the global society. Moreover, teachers can equip learners with technology skills, provided they are also computer literate. Thus, ICT integration is clearly one of the strategies that promote the effective teaching of science. On the other hand, it is argued that there are still barriers to ICT integration (Mishra & Koehler, 2006; Bingimlas, 2009; Günes & Bahcivan, 2016). These barriers have a negative impact on teachers' decisions pertaining to the incorporation of ICTs into the instructional practices. It is clear from this discussion that teachers should be empowered with technological skills and pedagogy in an ongoing process to cope with engaging

learners in technology-oriented instruction and in resolving challenges brought by persisting barriers to ICT integration.

Furthermore, teaching science through an inquiry approach has the potential to engage learners in higher-order thinking skills, especially when integrating ICTs into learning. Emerging technologies have the potential to improve science instruction (Guzey & Roehrig, 2009; Donnelly *et al.,* 2011; Erdem, 2019). Different models of ICT integration have been developed to explain the integration of ICTs into schools. The emerging technologies therefore have the potential to assist teachers in developing effective technology-oriented instruction. However, Serin (2011) stresses that affordability and accessibility of suitable software for specific instruction could be a barrier to effective ICT integration. Furthermore, the level of preparedness of the teachers has an impact on the degree to which use of ICTs can improve science instruction. This implies that ongoing teacher professional development, especially on pedagogy including the use of ICTs in education could be valuable to facilitate teachers' awareness of new trends of pedagogy as technology evolves.

2.4 PHILOSOPHY OF ICT INTEGRATION INTO TEACHING AND LEARNING

With the aim to improve the education of learners, teachers and teacher training tutors, Moursund (2006:2) stipulates the following as his philosophy about technology in education, "a set of principles, guidelines, priorities and ways of thinking that help me to make decisions as I carry out my professional work as a computer educator". Moursund (2006) believes that ICT has the potential to change in education regarding the development of arithmetic, reading and writing for about 5 000 years ago to the date of his study, utilising for instance computers, internet, cell phones, digital motion, the web and still cameras, all digital devices that store and play robots, music games and videos. This incorporated authentic content and the systematic integration of ICT into curriculum content, instructional practices and assessment methods in teaching and learning. He further emphasises that learners in the USA and probably throughout the world grow up in an environment rich in utilising ICTs in daily activities. Therefore, they need to utilise them efficiently in teaching and learning to meet the requirements of the rapidly changing and ever-growing global digital world. Drawing from this view, it can be suggested that it is necessary to exhaust available strategies that could be

used to teach and assess learners effectively using ICTs to take advantage of the available emerging and evolving technologies.

Moursund (2006) further suggests that every teacher, regardless of the discipline, needs to know some content and pedagogy on ICT. Moreover, ICT is an influential aid in instruction including problem solving in every discipline taught in schools. It is also regarded as an aid to both physical and intelligent competencies. The author further indicates that using the web to access and disseminate information throughout the world overcomes physical restrictions and saves time significantly. Education systems throughout the world should aid learners in coping with ICT systems rather than teaching learners to do tasks manually that could easily be done by means of ICTs. Additionally, Moursund (2006) contends that computing (digital computers, programming, computer tools used in problem solving) is one of the major six languages recognised globally and, in doing so, the author supports the idea of a pedagogy shift to the effective integration of ICT throughout curriculums and instruction as well as assessment. This includes assisting students to learn and solve problems independently using ICTs (Moursund, 2006). This suggests that in order for teachers and learners to fit in the global world, ICT literacy is a necessity for teachers.

This is supported by Webster (2017:27), who stipulates the following about technology in teaching and learning according to technology leaders, such as instructional technology specialists from school districts in the USA. “Technology is a tool, and technology change is inevitable and Technological optimism.” As a tool, technology is viewed instrumental for achieving educational goals. Webster (2017) further suggests that technology is inevitable, including the idea that there are changes in societies because of the use of technology that cannot be avoided or resisted. This is pivotal for schools to keep up with the rapidly evolving emerging technologies. The study makes it clear that resistance to technology change prevails in schools, even though schools are pressured to utilise technology in teaching and learning. Drawing from this view it can be argued that there are challenges with the effective use of ICTs in classroom practices due to different contextual factors. It is therefore necessary to have studies that explore practices in different contexts to improve practice.

Like other scholars, Webster (2017) emphasises that technology has the potential to improve the quality of education and to change the world positively, thus promoting

and advocating the use of emerging technologies globally. It can be argued that our education systems can no longer cope without ICT integration if we really want to overcome the challenges of poor performance and lack of interest in subjects such as science and mathematics. The implication is that teachers and learners need a paradigm shift and support from the Ministries of Education and Training to shift from their usual everyday classroom practices to technologically enriched classroom practices. One way of support could be the professional development of teachers' pedagogy, involving exposure to the effective utilisation of ICT tools. Teachers could also be supported by revealing classroom practices of exemplary teachers on ICT integration. As a researcher, I support the idea that technology is inevitable, and schools need to keep up with emerging technologies in order to assist learners develop 21st-century skills. The current study therefore endeavours to reveal the classroom practices of teachers who actually integrate ICTs into their teaching and learning of science in basic education in Lesotho, thus promoting and advocating the use of ICTs in teaching and learning.

2.5 WHAT INFORMS ICT INTEGRATION IN CLASSROOM PRACTICES

It needs to be noted that the United Nations Educational, Scientific and Cultural Organisation (UNESCO, 2011) ICT competency framework for teachers, highlights guidelines for teachers' ICT integration into classroom practices in order to equip learners with problem solving, as well as collaborative and creative skills using ICTs. It is indicated that the integration could include learners' technology literacy, in which learners use ICT for effective learning to acquire in-depth knowledge of concepts, applying them in real-life problems and knowledge creation to generate information for societal development. It is in support of this view that different countries have announced their support for ICT integration into primary and secondary schools and made initiatives to fund schools with ICT tools and programmes that facilitate teachers' professional development regarding pedagogy on ICT integration. Lesotho, the country research site for this study, though still encountering some challenges, is no exception.

On the other hand, Trust (2018) points out that the International Society for Technology in Education (ISTE) (2017) also advocates the qualities of ICT oriented pedagogical teachers. The emphasis, amongst others, is that a teacher who uses ICT

effectively in instruction is a learner continuously advancing in ICT pedagogy. The teacher is a leader guiding learners to acquire ICT knowledge and skills. He is also a citizen promoting learners' curiosity to contribute to the global world. Moreover, the teacher is also a collaborator expanding learners' knowledge and the use of ICTs.

Furthermore, the teacher is a designer creating a virtual learning environment that motivates learners to be innovative and problem solvers. Lastly, the teacher is an analyst who uses data to assess, guide and communicate educational processes. Drawing from these views, science teachers in Lesotho, as part of the global world, could be expected to use ICTs effectively in classroom practices, instilling the culture of collaboration and sharing of ideas using emerging technologies among the learners and other teachers. This means teachers should be well equipped with ICT-oriented pedagogy. Science teachers in Lesotho are no exception. Lesotho, like other countries, complies with international standards. The Lesotho teacher is therefore also expected to be of a standard stipulated by the global associations. It is at the heart of this study to find out teachers' practices of ICT integration in science and technology within the Lesotho context.

In response to the needs of 21st-century education, South Africa has also developed policies that facilitate the provision of ICT tools in schools, as well as the development of programmes that support teachers and teacher training institutions on effective ICT integration strategies. There are ongoing projects to empower teachers and learners. However, as in schools internationally, Lesotho teachers still face challenges in respect of the effective integration of ICT into teaching and learning. Like other countries, Lesotho has also developed a national policy on ICT integration (Gillwald, Mothobi & Deen-Swarray, 2017), even though the ICT policy specifically for Education is still at its draft stage to date. Projects from both Governmental and Non-Governmental Organisations (NGOs) are engaged in training teachers about ICT integration and providing schools with ICT tools for effective ICT integration process.

For instance, since 2005, projects such as the School Net Lesotho, Microsoft School Technology Innovation Centre Project and the NEPAD e-School have assisted many secondary schools in Africa, including Lesotho, with ICT skills (Kalanda & De Villiers, 2013). Six schools benefited from the NEPAD project. Teachers were professionally trained; schools were supplied with ICT laboratories; and learners had an opportunity

to use ICT tools in classroom practices. The project had an impact on the development of several policies in the country. Moreover, six schools in Lesotho also benefited from assistance by the Community Education Computer Society (CECS), the NGO from South Africa that promotes ICT literacy throughout South Africa. The literacy programmes consisted of 80-hour sessions training teachers on the presentation software, word processing, spreadsheets and others computer tools (Isaacs, 2007).

However, the main challenge in Lesotho is lack of ICT infrastructure at schools, especially primary schools. Therefore, teachers encounter problems with implementing the acquired ICT pedagogy skills within their different school contexts. Some have limited ICT tools with a large number of learners in a classroom situation, while others have no ICT tools at all. The main challenge is that ICT-related pedagogy requires practice, otherwise the skill just disappears, with no access to ICT tools. On the other hand, most survey studies about teachers' beliefs and perceptions of ICT integration reveal the persisting existence of barriers and enablers of ICT integration, mostly through teachers' self-reflection instruments. In addition, most of the qualitative studies focus on interviewing teachers about their classroom practices, without paying attention to classroom observations to confirm what the teachers have specified. The implication is the need for more studies that incorporate classroom observations to inform the literature about what happens during classroom instruction.

2.6 DISCOURSES ABOUT ICT INTEGRATION IN EDUCATION

Some studies focus on discourses about teaching and learning. McCormick and Scrimshaw (2001) stress that discourse is one of the dimensions of pedagogy, focusing on the language, culture and actions of classrooms that depend on individual teachers, subjects and schools' ways of work. The authors define discourse as the language of the classroom, including ways in which subjects and classroom cultures and behaviours are presented in speech and action in particular classroom contexts. It is further indicated that this includes the ways in which students behave and carry out activities in classroom instruction in different classrooms and schools' contexts. This implies that classroom practices that integrate ICTs also have their own classroom discourses. Drawing from this view, it could be argued that in science instruction integrated with ICT, it is expected that there is a particular scientific language enriched with technology-oriented practices and that learners and teachers

depict certain behaviours and cultures that show that they use ICT in their instruction. The teachers and learners at such schools carry out science activities in an environment enriched with pedagogy rich in ICT orientation.

Some studies focus on discourses about ICT integration. For instance, in South Africa, Bladergroen *et al.* (2012) employ a critical discourse analysis of primary school educators on the integration of ICT into classroom instruction within under-resourced school contexts. The study espouses that the dominant discourses are "globalisation, learning, determinism, liberation, productivity, and disembodiment". Moreover, some schools participated in the KHANYA project that provided basic training to tutors and basic infrastructure for ICT integration at under-resourced schools to empower schools with ICT-oriented pedagogy. Bladergroen *et al*. (2012) highlight the challenges faced by learners at such schools. It is stipulated that the learners usually have low ICT skills and no ICT devices at home, which means learners have no opportunity to finetune their acquired ICT skills. As a result, some educators decide not to incorporate ICT tools into their teaching and learning to avoid bias. The critical role of context in discourse analysis is also emphasised. In this study, Bladergroen *et al.* (2012) investigated 40 teachers, of which 20 had received MELISSA training, while the other 20 had not yet been trained. It is evident from findings of the study that teachers at these schools appreciated the use of ICT in teaching and learning and were willing to adopt ICT. However, the teachers had barriers to ICT integration and required support for effective ICT integration. The dominant discourse was the feeling of disempowerment regarding ICT integration within a teaching context. Drawing from this view, it can be argued that the training in pedagogy on ICT use in classroom practices could be more relevant if teachers are trained at a school context level to enable the suitable development of skills aligned with available ICT tools at their schools.

Like other studies, in a critical review of literature about ICT in education, Fu (2013) supports the argument that there are several benefits of ICT integration, expanding access to education, though barriers to ICT integration at schools still exist. It is also indicated that research studies largely support this idea. Moreover, he indicates gaps in literature about ICT integration at schools and provides suggestions for future research. Fu (2013:113), for instance, presents the following as benefits of ICT integration in education, "assist students in accessing digital information efficiently and

effectively. Support student-centred and self-directed learning. Produce a creative learning environment. Offer more opportunities to develop (higher-order) thinking skills …"

Fu (2013) further argues that, if utilised for constructive learning, exposure to an ICT-integrated environment will foster learners' higher-order/critical thinking skills within specific learning contexts; hence, the reason why schools are strongly encouraged to integrate technology across all learning areas. Additionally, ICT improves the quality of the teaching and learning process. Learners develop the skill of taking control of their learning, becoming competent to work by themselves while collaborating with others. Teachers/educators can also design their own teaching materials. Learners would further be able to apply and transfer knowledge by using emerging technologies when they are confident with the application of technology in their learning processes. This can broaden the knowledge they already have effectively. Learners can also discover new technologies such as new multimedia they could use in a creative way to develop materials for learning and sharing with other students, thereby improving the quality of teaching and learning.

This is further emphasised by Ngwane (2017), who stipulates that ICT reduces teachers' workload, improves teacher-to-teacher online communication and interaction, transforms teaching strategies and encourages learner-centred approaches, as well as improve teachers' professional development, even though the main barrier in most countries is lack of training of teachers and the provision of ICT infrastructure. Ngwane (2017) further highlights that teaching is not yet fully transformed; teachers use a combination of learner-centred and teacher-centred teaching strategies. Clearly more still needs to be done to improve teachers' classroom practices of ICT integration. Drawing from the above discussion, it could be stressed that ICT integration plays a valuable role in shaping the education system in accordance with the demands of 21st-century teaching and learning.

Lastly, ICT could facilitate access of course content supporting teaching and learning. Once teachers have facilitated learners' use of ICT in teaching and learning environments, learners can access the course content beyond what is covered in their curriculum, enabling them to understand better what is required of them. ICT therefore changes traditional teaching environments to effective, learner-centred approaches

that encourage creativity amongst both teachers and learners. Scholars emphasise that the barriers still exist. Additionally, recommendations are also made on how to overcome the challenges of ICT integration and factors influencing teachers' use of ICT in teaching and learning and emphasises that professional development changes teachers' determination to use ICT in teaching and learning positively. School culture on ICT use also plays a critical role in effective ICT integration initiatives. One of the gaps in the literature about ICT integration is that not much research has explored the relationship between teachers' beliefs and their actual classroom practices of ICT integration. The implication is that teachers might not be given the relevant support for the integration of emerging technologies.

Moreover, Sasseville (2004) also reveals discourses about ICT in classroom practices; ICT has the potential to transform learning and teaching practices. He further stipulates that some studies do not support the wide-spread use of technology in education, as most studies show an insignificant impact of technology in education. Sasseville (2004) further stipulates that some scholars view ICT integration as an obstacle for diversity in pedagogy. However, it was argued that participants viewed ICT integration as important, because ICT changes the way the world is viewed and how people think, handle and use information. It is also argued that education systems need to move along with evolving technologies, adapting to new school systems and pedagogical practices that align with emerging technologies. It is also highlighted that teachers are still in an ongoing process of establishing proper ways of integrating ICT into teaching and learning. ICT is also viewed as a learning tool for the achievement of educational goals, as well as a contributory factor to the status of teachers' professionalism. However, some teachers still fear that it will replace their profession; hence, they use it only to a certain extent. Additionally, in a UNESCO study, Kalaš *et al.* (2014) stress the educational reasons for using technology in teaching and learning. For instance, it is echoed that teachers have realised the potential of ICT to address curriculum demands and the benefits of ICT to children and parents and it also contributes to development of learners' skills such as communication, collaboration, creativity, interaction among learners globally and critical thinking skills.

ICT discourse in science education

While some studies argue that ICT integration may not have a significant impact on teaching and learning achievements, a number of studies show the positive contribution of ICT integration into teaching and learning. For instance, Pombo, Carlos and Loureiro (2017) present a study on a project in Portugal where teachers were trained professionally on ICT integration and schools were provided with ICT tools for the effective use of the flipboard. After the training, the teachers were monitored on the best practices of ICT integration. This means they had to complete an online classroom grid registration form requiring information about how they used ICTs in their instructional practices. The grid had the following features:

- Selecting the purpose for using the technology; and
- Indicating if the purpose was explicit to learners, etc., even requiring suggestions for improving the teaching strategy for future.

The authors argue that the professional development of teachers is critical for effective ICT integration. Pombo *et al.* (2017) emphasise that the use of technologies in teaching and learning encourages active learning environments, which incorporate active parental involvement and a diversity of presentations of ideas, using a high level of learner creativity. Additionally, they conclude that the presence of technologic tools cannot make a difference in teaching and learning, unless teachers are professionally trained in pedagogy regarding ICT integration. However, Pombo *et al.* (2017) further stress that some teachers still resist using technology in their classroom practices; they are discouraged or constrained when the technology does not work perfectly or when they detect some failure in certain aspects. This implies that more attention should be paid to strategies for improving teachers' pedagogy of ICT integration to improve its practical application. With that in mind, the current study intends to explore teachers' ICT-integrated classroom practices within the Lesotho context in order to encourage teachers to use ICTs effectively in the teaching and learning of science.

Similarly, Light (2010) also confirms the positive impact of ICT in teaching and learning utilising seven factors commonly found in literature to explore classroom practices of teachers in three different countries. The factors used are leadership, pedagogical goals and objectives, experimentation and critical reflection, professional development and ongoing support, infrastructure, time and financing, and sustainability. While some studies suggest that more effort be made to facilitate the effective integration of ICT,

some studies are concerned that ICT integration does not fulfil the required expectations, as most schools equipped with ICT tools and teacher professional development programmes still underutilise the ICT resources in teaching and learning. This calls for more exploration of what the barriers to effective ICT integration in instructional practices could be.

This is also supported by Webb (2005), who highlights the affordances for students in an ICT-rich science learning environment as: learners are able to investigate consequences of making changes to objects in their micro-world, teachers facilitate the learning process with worksheets of specific instruction, simulations and animations that enable visualisation of invisible aspects of matter. Secondly, learners make and check predictions, with the teacher facilitating collaboration and interaction among the learners. Thirdly, learners reconcile data between predictions and observations using software, with the teacher using worksheets with questions that trigger learners to think critically. In addition, it is indicated that ICT-rich learning environments in science reinforce formative assessment and promotes innovation in pedagogy. It is argued that formative assessment can be improved using ICT to inform future teaching plans and to promote students' responsibility for their learning.

This suggests that ICT-rich learning environments align with the demands of 21st-century teaching and learning styles. Even in developed countries there are challenges experienced about ICT integration. Some studies still reveal an inadequate use of ICT by teachers in schools supported with ICT infrastructure. For instance, Erdem's (2019) survey study highlights that even though physics teachers in high schools inefficiently integrate ICT, they have IT knowledge and are willing to use technology to improve learning and teaching. However, the teachers specified that they need professional development training that sensitise them about how to use the emerging technologies in classroom instructions.

Drawing from this view, it is necessary to ensure that schools are equipped with relevant ICT tools and teachers with developed ICT-oriented pedagogy for effective teaching and learning. However, what remains unclear in the studies is why teachers who have been trained in the application of ICT tools, and schools equipped with ICT tools only integrate ICT into teaching and learning on a limited scale. Studies have revealed the underutilisation of ICT resources internationally and locally (Erdem, 2019;

Kalanda, 2013; Lisene & Jita, 2018; Walan, 2020). What lacks in these studies is detailed information about the actual practices of teachers who integrate ICT into their classrooms on a regular basis to inform other teachers about practices that suit teachers and schools' contexts. Only limited literature addresses the exemplary integration of ICT into classroom practices.

It is clear from the above discussions that ICT integration is valuable for 21st-century learners and each country and individual schools should make an effort to integrate ICT effectively into their daily classroom practices. What remains unclear is teachers' discourses about ICT integration from different contexts, as they play a critical role in the implementation of innovations. The current study therefore reveals emerging discourse about ICT integration within the Lesotho context and establishes how such discourse informs teachers on how they can improve the integration of ICT into their classroom practices.

2.7 STUDIES ON ICT-INTEGRATED CLASSROOM PRACTICES

Scholars have focused on ICT integration since the start of initiatives by countries to support schools with ICT pedagogy and ICT resources. The studies show trends from when teachers lacked ICT skills and ICT tools to when teacher training institutions started to empower teachers and governments, and NGOs equipped schools with ICT tools and training, as well as when the majority of teachers gradually started to develop ICT skills and pedagogy. The small pool of studies that focus on actual classroom practices of ICT integration indicates that some exemplary ICT integration strategies that can inform teachers about the effective means of ICT integration do exist. The studies have utilised mostly questionnaires, interviews and document analysis (Baydas *et al*., 2015) to reveal teachers' classroom practices of ICT integration. Some of these studies suggest that classroom observations should be employed to gain deeper insights into teachers' classroom practices of ICT integration.

2.7.1 ICT in international schools

Scholars elaborate how developed countries have advanced with ICT integration using the evolving technologies as developing countries struggle with overcoming the first barriers such as availability of ICT infrastructure. It is therefore noteworthy to highlight some international studies on ICT integration to inform education systems of

developing countries about how some countries are coping with use of ICTs in instruction. These are examples of such studies: Claro *et al.* (2017) investigated classroom practices of teachers' use of ICTs in a mixed-method study and established an alignment between primary teachers and principals' views about the integration of a mobile computer lab (MCL) in teaching and learning in Chile. This was an initiative project for 1 591 public primary schools to promote new classroom practices. Each learner had access to a laptop uploaded with the necessary tools and each teacher was provided with a laptop loaded with software to manage and interconnect with learners. Wireless network technology was used to allow computers in the classroom to communicate in order to facilitate the teaching and learning process. The survey revealed that some schools used ICT tools provided to a minimum; some schools used them adequately, while some schools used them more frequently than others. Three schools from the three categories were engaged in interviews with the teacher and the principal to clarify issues raised in the survey. The analysed data were grouped into three levels of discourse.

The first level focused on the participants' perception of the integration of ICT through the MCL. The second level dealt with the organisation of the material conditions, while the last level represented those responsible for implementing the project. With regard to adopting ICT into teaching and learning, principals and teachers had the same views; they all felt that it was necessary to integrate ICT into learning and teaching. Additionally, teachers' criticisms include that principals do not provide enough support, while principals strongly believe that they do offer such support. The study further reveals that principals are not well informed about what happens in classrooms in this regard. The interview results emphasise the differing views of teachers and principals on issues such as the organisation of materials, the perception and the accountability for formal planning regarding lesson planning for the MCL, preparation for the utilisation of the MCL, and innovative practices.

On the contrary, principals and teachers had similar vague views of the pedagogical contribution of the MCL. It further emphasises the need for the principal or administration to support teachers' initiatives of ICT integration into classrooms actively. This is evidenced by Light (2010), who reveals the positive impact of leadership in classroom reform when realising that such reforms become successful when principals actively take part in classroom reform, being in the classrooms with

the teachers to support any innovations. The implication is that principals should also be computer literate and be trained on ICT pedagogy to improve current practices.

In the qualitative case study about senior teachers' ICT integration strategies in Australia, Tsai (2015) stipulates that even when senior teachers are familiar with ICT, they usually do not use ICT for teaching; yet the requirements of today's education demand that teachers incorporate technology into their daily teaching. It is further stated that research has indicated the value added to teaching and learning when ICT is used in classroom practices. Moreover, some of the reasons for the insignificant use of ICT by teachers are stipulated as lack of knowledge or strategies for integrating ICT into instructional strategies. However, it is further emphasised that teachers are more than willing to learn to improve their pedagogy using ICT. Tsai (2015) further categorises teachers into two groups: teachers who strongly believe that ICT can improve teaching and learning, and teachers who believe that ICT can have a negative impact on teaching and learning, distracting learners. It is further stipulated that teachers who lack the skills for integrating technology with instruction and content knowledge usually integrate ICT inadequately into teaching and learning; hence, such teachers lack an adequate TPACK base. The study also indicates that older and more experienced teachers are more inefficient with ICT integration than young and novice teachers who use ICT more frequently. The barriers are also indicated as factors contributing to teachers' inefficient integration of ICTs into learning and teaching.

In a quantitative study in Turkey, Yucel *et al.* (2010) explored the five different stages during which teachers integrate ICTs. They highlight the stages as Entry, in which students learn how to use technology without the assistance of a teacher. This is followed by Adoption, in which teachers begin to use technology to support traditional instruction and begin to realise the role of ICT in teaching and learning. Adaptation follows, in which teachers appreciate the role of ICT in learning and teaching more and begin to use technology when teaching to promote a learner-centred approach. The Appropriation stage then follows, in which more advanced potentials of technology are realised amongst learners and learners develop higher-order thinking skills than they would do without ICT Integration. Invention is considered as the final stage of ICT integration in which learners are engaged in tasks that require higher order thinking skills and creativity in the utilisation of ICT to establish solutions to the given tasks.

During this stage, learners discover more sophisticated potentials or uses of technology in teaching and learning.

In Margolin, Pan and Yang's (2019) study on evaluation of teachers' use of technologies in instruction at high schools supported with technological facilities including internet and teachers training on ICT pedagogy, it was evident that ICT integration successfully developed learners 21st-century skills necessary for fitting in the global world. However, the study emphasised the need to support schools with ICT facilities and ICT pedagogy for improving the insignificant use of digital tools in instruction in some schools. It should be emphasised that different countries have different challenges about ICT integration. What is important is adaptation to countries and schools' contexts. It is at the heart of this study to understand in depth how teachers in Lesotho are adapting to schools' context to cope with use of ICT in instruction to prepare learners to fit into the global world and world of work.

2.7.2 Integration of ICT in science & technology in sub-Saharan Africa

More studies disclose more insights into ICT integration. For instance, in a study in Nigeria about the impact of computer-assisted instruction in chemistry, physics and biology in high schools, the randomly sampled schools were provided with computers and pre/post-tests of learners (Kareem & Olafare, 2018). The study compared the achievements of learners who were taught with or without tablets at three secondary schools in Nigeria. Each student was provided with a tablet. It was established that the use of technology in teaching and learning has a positive impact on learners' performance. It was also recommended that computer-assisted instruction be used in the teaching and learning of science in Nigeria.

Similarly, in a quantitative study, of which one of the focus areas was the extent to which teachers in Ghana integrate ICT into teaching and learning, Buabeng-Andoh (2012) concludes that there is low ICT integration into secondary schools in Ghana. The author suggests that there is a gap between teachers' perceptions of ICT integration and their actual classroom application of ICT practices, although the gap was established through self-reporting instruments such as interviews and surveys without actual classroom observations. This is in line with what other scholars have established about ICT integration into schools, especially in developing countries. Buabeng-Andoh (2012) further suggests that the gap could be the result of a lack of

infrastructure and ICT skills among the teachers. The implication is that developing countries still experience challenges regarding ICT infrastructure, even though countries have invested heavily in technology in schools. This also suggests the need for continuous support to schools and teachers, as technology evolves rapidly. On a positive note, teachers who integrate ICT into their teaching and learning reported using ICT for instruction and for assessment of learners.

Similarly, in a study in Cameroon, Nsolly and Charlotte (2016) indicate that there is progress in respect of ICT integration at primary and secondary schools in many sub-Saharan countries. Cameroon started initiatives in 2001 and, like other countries, it has also experienced barriers to effective ICT integration in curriculums in various ways. The study intended to establish the current status of ICT integration in the Cameroon. The study also provided guidelines for effective and contextualised ICT integration strategies. The study further revealed that most initiative projects suffer sustainability in Cameroon due to the challenges of buying technology equipment, and by 2010, ICT teaching was mostly theoretical. There is a lack of, or insignificant initiatives of teachers' professional development pertaining to ICT integration at primary and secondary schools. However, teacher training institutions have started to provide schools with teachers empowered with ICT pedagogy, although many schools still have unqualified teachers in this regard. Jita and Akintunde (2021) present successful examples of student teachers' practical application of teaching science in classroom with ICTs during teaching practice. The implication is that it is possible for the professionally trained teachers to collaborate with in-service teachers to improve the classroom practice.

2.7.3 Integration of ICT in schools in South Africa

Like international schools, schools in Africa also experience challenges with the integration of ICT, leading to the underutilisation of ICT tools in teaching and learning. Countries in Africa have also invested heavily in ICT tools and the professional development of teachers. Similarly, it is not clear why teachers who have been trained professionally and have access to ICT tools within their school contexts integrate ICT into their classroom instruction on a limited scale, if at all. However, schools that

actually integrate ICT into its classroom instruction confirm the belief that ICT contributes effectively to teaching and learning in classrooms.

There is growing literature investigating ICT integration classroom practices in schools in South Africa. South Africa has significantly invested in several initiatives supporting schools with ICT facilities and ICT pedagogy to prepare teachers and learners survive globalisation. Qualitative studies disclose the underutilisation of ICTs in connected schools supported with ICT pedagogy. For instance, Chigona and Chigona (2010) and Chigona (2018) investigated teachers' classroom practices of ICT integration in schools that were participating in the KHANYA initiative project. The project provided schools with tablets for teachers and learners and the internet connectivity. Findings highlighted teachers' incompetence in use of ICTs and the need for CPD for in-service teachers. This is also evident in Padayachee's (2017) mixed-method study on the extent of use of ICTs in classroom practices. Additionally, findings point to teachers' use of communities of practice in sharing ICT knowledge and skills. Similarly, Msila (2015) investigated other schools in South Africa about teachers' use of ICTs in instruction. The findings confirm the inadequate use of ICTs in instruction. In the meantime, teacher training institutions are feeding schools with teachers trained on ICT pedagogy.

On the other hand, Chigona (2015) investigated why beginner teachers enriched with ICT pedagogy fail to use ICT in instruction in a qualitative study through the TPACK framework. Findings showed that the main challenge is the quality of instruction the teachers attained during training. This called for Teacher Training institutions to improve their approaches on support of pre-service teachers on relevant ICT pedagogy. Later, Tsakeni and Jita (2019) explored the classroom practices of pre-service and in-service teachers. The study pointed to the more ideal display of TPACK by pre-service teachers who use any available ICT tools at the college than the in-service teachers who are struggling with several constraints of ICT integration at school context. Equally, Jita and Munje (2020) explored enablers and constraints of ICT integration for beginning teachers who graduated enriched with ICT pedagogy, to understand how they cope with use of ICTs in teaching of science in their placement schools.

Even though there were enablers such as experience from teaching practice and availability of digital facilities, findings indicate that the beginner teachers struggled to use ICTs in instruction due to constraints such as lack of support from incompetent colleagues or lack of access to the available ICT tools in the school. This means South Africa is also in an ongoing process of stabilising ICT integration in schools. The implication is that more still needs to be done to confront the emerging barriers as South Africa progresses to reduce commonly known barriers to ICT integration. Countries such as Lesotho should be informed by experiences of neighbouring countries like South Africa to cab unanticipated challenges to ICT integration as they advance with initiatives for effective use of ICTs in schools. The current study aims to contribute knowledge about how teachers cope with ICT integration within the Lesotho context. It is worth noting to realise the experiences of the closest country to Lesotho as Lesotho strategizes to have effective use of ICTs in schools.

Moreover, a case study of four primary schools in South Africa by Gudmundsdóttir (2010) explores in-service teachers' ICT integration strategies in classroom practices. The study stresses the existence of inequalities of teachers' competencies and the use of ICT tools in instructional practices, even though the government has largely invested in ICT infrastructure and the professional development of teachers. This is also emphasised by Dlamini and Mbatha (2018). It also recommends the need to incorporate teachers in decision making about ICT integration in teaching and learning, as teachers are key instruments in successful integration. Gudmundsdóttir (2010) further stipulates that South Africa has invested heavily in ineffective teacher professional development on ICT integration, training teachers out of the context of their environments, which means that teachers are faced with challenges when implementing what they have been trained. It is suggested that teachers' professional development needs be understood first, and programmes then be developed to address them. The quantitative study investigated school managers and head teachers' practices of ICT integration into primary school curricula. It is further suggested that schools should be supported with policies, ICT management skills and infrastructure and software for an effective ICT integration process.

Though scholars advocate more ICT integration into education, in this mixed-method case study (survey and interview) pertaining to Grades 6 - 7 teachers with principals for exit interviews only at three primary schools, Gudmundsdóttir (2010) is concerned

about the influence of language complexity context on the digital divide among learners at schools that have the material and human resources for ICT integration. Moreover, it is indicated that South Africa has introduced ICT policy that encourages digital literacy for all, despite the background of any school. The nine provinces have education departments charged with the responsibility of implementing policy on ICT integration. The policy guides teachers on teaching and the assessment standards required.

On the other hand, Jepkemei *et al*. (2015) specify that Kenya is among one of the leading countries in Africa that facilitate the implementation of ICT policy in practice. Projects provided schools with ICT tools to facilitate the process. Kenya developed an ICT policy that guided the teachers. Jepkemei *et al.* (2015) also stress the general underutilisation of ICTs in classroom practices in developing countries, including Kenya. Additionally, it is argued that there is no evaluation of ICT programmes that focus on learning outcomes; hence, the PRIMR programme development. Of the interventions done in Kenya, the schools at which teachers used tablets provided with teaching information performed better than other interventions. The tablets were loaded with teaching and learning materials, including books, worksheets and other applications to facilitate effective learning. Jepkemei *et al.* (2015) stipulate that the provision of ICT infrastructure without the development of teachers and learners' ICT skills is fruitless and recommend more research to find strategies for the successful integration of ICTs to inform ICT policies.

Jepkemei *et al.* (2015) further present the document analysis of ICT integration into classroom practices. The authors argue that the integration of ICTs require a change in practice and presents three possibilities of such changes and their implications for teaching and learning. They refer to the changes as making already existing practice more efficient, extending the existing practice or transforming the existing practice. The authors conclude that with the introduction of ICT integration into schools, teachers may have to change the way they view and teach their specific subjects. In addition, they have to change what they consider to be school knowledge and what they view as pedagogy. The following is indicated as implications of ICT integration into schools. The authority should be clear about what they want to use the ICT for. The school needs to pay attention to the impact of ICT on pedagogy. Thirdly, the ICT integration initiative should inform curriculum change on teaching and learning,

knowledge and pedagogy. However, the authors are concerned that there is insignificant training of in-service teachers on pedagogy, which they suggest implies the misalignment between teachers' change in pedagogy during ICT integration and policy makers' initiatives of ICT integration.

Drawing from the above discussion, it can be suggested that different countries need to pay attention to the extent to which science teachers are professionally developed with ICT-oriented pedagogy in order to fit in today's education demands. The implication is that more attention should also be paid to the science curriculum regarding the extent to which it provides information that supports teachers' ICT integration in classroom practices. This can be achieved if more attention is given to teachers' actual classroom practices in science instruction and current discourses about ICT integration.

2.7.4 Integration of ICT in schools in Lesotho

To my knowledge, as the researcher in the present study, in the small pool of studies undertaken within the Lesotho context about teachers' ICT integration, most of the studies focused on old science curriculums at Junior Secondary (JC) level (Kalanda & De Villiers, 2013); that is, Grade 10, or sciences at Lesotho General Certificate Education (LGCSE) level (Bohloko *et al.,* 2019); that is, Grade 12 or on teachers generally without focusing on specific subject (Chere-Masopha, 2018). None of the accessed studies focused on ICT integration with regard to the new Science and Technology curriculum that has been in place since 2012. More specifically, none of the accessed studies focused on exemplary classroom practices of teachers who were confirmed to be integrating ICT into their classroom instruction, especially in science in the new curriculum (MoET, 2009) at basic level.

Literature shows that many teachers globally, in both developed and developing countries, have developed a range of useful ICT skills, even though there is still inadequate ICT integration into teaching and learning (Aikins & Arthur-Nyarko, 2019; Chai *et al.*, 2011; George & Ogunniyi, 2016; Jita & Munje, 2020;). Lesotho is no exception regarding the low level of ICT integration into subject teaching (Baller *et al*., 2016; Kalanda & De Villiers, 2013). Lesotho, like other countries, engaged in projects such as the School Net Lesotho, Microsoft School Technology Innovation Centre Project and the NEPAD e-School, providing many schools with ICT skills and ICT

infrastructure (Isaacs, 2007; Kalanda & De Villiers, 2013). Teachers were trained on how to integrate ICT into learning and teaching. However, limited studies have explored ICT integration into the Lesotho Curriculum. On the other hand, Chere-Masopha (2018) focuses on teachers' beliefs and professional identities towards ICT integration in general. The study reveals barriers to ICT integration, such as teachers' lack of ICT skills and infrastructure. Moreover, the study suggests that teachers' professional identities contribute to their decisions whether or not to integrate ICT into learning and teaching.

Similarly, Kalanda and De Villiers' (2013) qualitative study focuses on classroom practices of teachers who have been trained professionally on ICT integration through projects that also provide their schools with technology tools at secondary level. Kalanda and De Villiers (2013) engaged nine high schools from the three ICT integration initiation projects in action research to investigate the efficiency and advancement of ICT integration into curriculum-based teaching and learning in science education in Lesotho after the empowerment of science teachers through the initiatives. In Kalander and De Villiers' (2013) study, data were collected from 40 participants (2 principals, 21 science teachers and 17 students) through multiple instruments such as questionnaires, interviews and classroom observations within the engaged action research. Findings by Kalanda and De Villiers (2013) indicate that Lesotho schools show an improvement in the utilisation of ICT tools in classroom practices. However, there are challenges, especially in the rural parts of the country. The classroom observations in this study also focused on the old syllabus. The improvement on use of ICTs in instruction was also evident in a study by Bohloko *et al.* (2019), examining the integration of YouTube videos into the learning and teaching of LGCSE chemistry curriculum.

Additionally, the improvement is also significant in the survey study by Lisene and Jita (2018), where the study focuses on teachers' TPACK development and extent of ICT integration into the teaching and learning of physical science at LGCSE level in Lesotho. Although the teachers' TPACK level was below average, the teachers frequently seemed to be using ICTs in their classroom practices. The focus was on ICT integration into the LGCSE physical science curriculum. However, the study also confirms the current underutilisation of ICT tools in schools. Though some teachers

have access to ICT tools they use them on a limited scale for learning and teaching; rather, they use technology for other personal tasks.

Similar results were found by Makuru and Jita (2022) in a survey administered to 107 LGCSE Biology teachers in Lesotho secondary schools. The study focused on teachers' perceptions on use of ICT in Biology instruction, the determination of commonly used ICT tools at school and at home and whether the ICT tools were being used for teaching or non-teaching activities. Makuru and Jita's (2022) study further aimed at determining the Biology teachers' practices of ICT integration and the association between the teachers' perceptions and use of ICTs in Biology instructions through the self-reporting questionnaire. Findings through the lens of the TPACK indicate that majority of the Biology teachers value the use of ICTs in learning and teaching. Additionally, the teachers had reasonable access to digital tools and had moderate ICT competency. However, like the other studies, it was evident that they used the ICTs inadequately. What remains unclear are the reasons for the underutilisation of technology at schools that have ICT tools and teachers who have been trained professionally in ICT pedagogy. Drawing from this observation, it can be argued that some teachers may not have enough exposure to ICT-integrated pedagogy, or they lack reasonable competence, or they are challenged by limited availability of ICT tools. The existing studies further argue that a lot still needs to be done to encourage teachers in Lesotho to integrate ICT into classroom practices. This suggests that more studies are necessary to establish the current practices of teachers' ICT integration to inform policies and strategies for their professional development.

Thus, in the current study, I sought to go beyond identifying the challenges of ICT integration and teachers' perceptions of ICT integration into actual classroom practices by contributing to the limited literature on teachers' practices of ICT integration focusing on the new curriculum (MoET, 2009) at basic education level, which accessed studies in Lesotho did not focus on. The present study therefore intended to reveal the classroom practices of teachers who do actually integrate ICTs into their teaching and learning of science within the new curriculum, in order to make teachers aware of ICT-oriented pedagogies at other schools and to contribute to the body of knowledge about exemplary ICT-integrated classroom practices.

2.8 STUDIES ON EXEMPLARY ICT INTEGRATION PRACTICES

Some of the studies on ICT integration focus on expert teachers' practices of ICT integration and explore how they deliver their innovative technology-oriented instruction. In this section I explore how such scholars interpret what they consider good ICT-integrated classroom practices. Equally, the study focuses on practices of ICT integration of teachers in Basic Education in Lesotho. It is ideal to determine how other teachers in other countries are effectively integrating ICTs in classroom instructions.

Zain, Muniandy and Hashim (2016) highlight some of the ways in which ICT is utilised effectively in teaching and learning to encourage the development of 21st-century competencies such as communication, creativity and innovation, problem solving, critical thinking and collaboration. The authors argue that teachers of 21st-century learners are required to develop instructional skills that incorporate pedagogy, technology and content knowledge to meet the demands of today's education. One way is the use of worksheets. It is argued that the Media Integration Analysis Worksheet (MIAW) plays a critical role as a strategy for encouraging best practices of ICT integration. It is further emphasised that the worksheet is based on the TPACK framework and guides teachers on effective ICT integration. In this worksheet the teachers are expected to indicate the types of media, the elements and their modules to be used, skills and learner profiles comprising thinking skills, multiple intelligence profiles, learning styles, moral values and instructional tools, which comprise the methods, techniques and activities and questions.

On the other hand, Liu (2016) explored student teachers' practices of ICT integration. The student teachers used ICTs in 57% of the observed lessons. The technologies mostly used were Smartboard, Document Camera (Elmo), videos, an audio player with microphones, PowerPoint and accessing information on the internet. However, it was observed that the technologies were used differently in procedures, level of participation of students and time management. The implication is that more needs to be done in pedagogy to equip teachers with technology-oriented instruction. The participating student teachers emphasised the value of ICT integration into classroom practices, highlighting that it increases learners' motivation and engagement with the lesson activities. It improves the organisation and time management of the lesson.

Additionally, it is argued that ICT integration caters for inclusive education, meeting all individual learners' needs. However, the student teachers were challenged at schools where the mentors were not competent using ICTs. The implication is that although institutions of teacher training have started supplying schools with technology-oriented teaching professionals, in-service teachers need ongoing professional training on the use of ICT in their instruction.

Earlier on, Hennessy *et al.* (2010) explored how teachers explored computer-based technologies in supporting teaching of science at secondary classroom levels. In this study, the teachers used three different kinds of technologies, the multimedia simulations, data logging and Interactive Whiteboards (IWBs) to support science teaching and learning. The participant teachers were part of the training initiative programme in which they were professionally trained on ICT integration then allowed to prepare technology rich instruction and lessons video recorded entirely followed by post interview after the lessons. The learners were engaged in learner-centred approaches and teachers were just facilitators. Additionally, learners had the opportunity to repeat the experiments as many times as they wish when doing them digitally. This implies an added advantage of digital experiments. The interviews enabled the participant teachers to reflect on successes, problems and challenges of using ICTs in the classroom practices; moreover, to establish change overtime of teachers approaches to use of use of ICTs in classroom instruction. Lastly to gain insights into the teachers' views about their experiences with the project. In this regard I planned to observe teachers' instructional practices using ICT and have follow-up interviews after the lessons so that I could have a deep understanding of how they go about integrating ICTs in Lesotho context and to dig deeper into the successes, problems and challenges the teachers encounter.

2.9 THEORETICAL BACKGROUND

Different models of ICT integration have been developed to explain ICT integration into schools. A key theoretical framework guiding this study is the TPACK framework (Koehler *et al.*, 2013), as discussed by several scholars and as it evolves to incorporate the issues of contexts of ICT integration (Koehler *et al.*, 2013; Koh *et al.*, 2014). Mishra and Koehler (2006) argue that teachers who have developed the TPACK framework constructs have the potential to develop rich, innovative,

technology-oriented instruction. Additionally, Liu (2016) stresses that incorporating the aspect of context encouraged qualitative studies about the TPACK model. However, several studies engaged interviews and focus-group discussions to reveal teachers' classroom practices of ICT integration.

The implication is that limited studies focused on classroom observations to triangulate the findings of the study. In fact, most studies focused on teachers' development of TPACK and barriers to successful ICT integration in education. I therefore used the TPACK framework in this study to understand teachers' innovative practices of ICT integration into learning and teaching. More importantly, I explored in depth how teachers plan and put into action technology-oriented instruction in science. However, the framework has limitations. It does not allow deep insights into classroom practices in different contexts. Therefore, I merged it with the High Possibility Classroom (HPC) model. HPC will enable the exploration and understanding of teachers' classroom practices.

2.9.1 Using the TPACK framework in ICT-integrated instruction

Teachers cannot simply integrate ICT; they need to have special knowledge of technology in order to integrate it into lessons. Mishra and Koehler (2006) have established that teachers manage to utilise technology tools in instruction if they have what is called Technological Pedagogical Content Knowledge (TPACK). This is an extension of Shulman's (1986) model of Pedagogical Content Knowledge (PCK) (Koh & Divaharan, 2013). Shulman (1986) argues that, apart from content knowledge, a teacher needs professional knowledge in order to deliver the lesson effectively. TPACK adds the pedagogy of technology to the PCK model by Shulman, incorporating teachers' knowhow of delivery of instruction using ICT tools.

The TPACK framework has seven knowledge areas, also referred to as constructs the teacher should have in order to integrate ICT effectively into teaching and learning. The seven constructs are Pedagogical Knowledge (PK), Content Knowledge (CK), Technological Knowledge (TK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), Pedagogical Content Knowledge (PCK) and Technological Pedagogical Content Knowledge (TPACK) (Chai *et al*., 2011).

Chai *et al.* (2011:1185) define the seven constructs as,

- TK – knowledge of how to operate computers and relevant software.
- PK – knowledge of how to plan instruction, deliver lessons, manage students and address individual differences.
- CK – subject matter knowledge such as knowledge about … sciences, etc.
- TCK – knowledge of how content can be researched or represented by technology such as using computer simulation …
- PCK – knowledge of the ways of representing and formulating the subject that make it comprehensible to others.
- TPK – knowledge of how technology can facilitate pedagogical approaches … to support social construction of knowledge.
- TPACK – knowledge of facilitating students learning of a specific content through appropriate pedagogy and technology.

Santos and Castro (2021) also describe the 7 TPACK knowledge areas elaborating expectations and actions that could be observed in ICT pedagogical lessons. For instance, the PK of the teacher could be examined from the teaching methodologies and processes, which include classroom management, lesson planning, assessment and student learning. The TK could be examined from teachers' knowledge of digital technologies such as desktop computer, laptop, projector/television, internet connection. The CK could be examined from knowledge of content to be taught and how its nature differs from various content areas. PCK, on the other hand, blends content and pedagogy in order for the teacher to develop better teaching practices. TPK could be examined from the use of various technologies for the purpose of teaching, appreciating that technology changes the way of teaching. TCK could be examined from use of technology for representation of specific content areas to change teaching and learning styles. Lastly, TPACK could be examined from teachers' integration of various technologies into teaching of any content using relevant pedagogical approaches.

Many authors refer to TPACK as the intersection of TCK, TPK and PCK, without reference to the constructs that intersect to yield the three intersecting constructs. However, the authors agree on the fact that at the core of the TPACK model; that is, the seventh construct, teachers are creative and able to develop innovative,

technology-rich instruction that empowers learners with higher-order thinking skills such as critical thinking skills. This is supported by some scholars who emphasise that teachers with a developed TPACK base become innovative enough to be able to design technology-oriented instruction. Rosenberg and Koehler (2015) accentuate that TPACK forms part of the complex components of teachers' actions in instruction. Webb (2005) therefore considers the TPACK to enable teachers to access the affordances of ICT integrating the PK, CK and TK knowledge to develop suitable effective instruction catering for all learners at the same time, covering suitable content area for targeted group. However, most of the ICT-related studies explored teachers' ICT integration strategies and barriers using self-report tools such as surveys and interviews. Only a limited number of studies accessed give details of actual ICT classroom practices through classroom observations.

2.9.2 Trends in the evolution of the TPACK framework

Koehler *et al.* (2013) improved the TPACK model by emphasising the role of contextual factors in science teachers' TPACK and encouraged future research to validate the model. Koh *et al.* (2014) further justify the significance of context in teachers' strategies of ICT integration and refer to the model as TPACK in action. Moreover, Rosenberg and Koehler (2015) stress that contextual factors of the TPACK are under researched, recommending more studies in this regard. However, scholars stipulate that qualitative studies on the impact of context on TPACK do not analyse the factors in depth; hence, the need for further research in this regard. Figure 2.1 shows the contextualised TPACK framework selected for this study to pursue further research on contextual factors that inform teachers' practices of ICT integration.

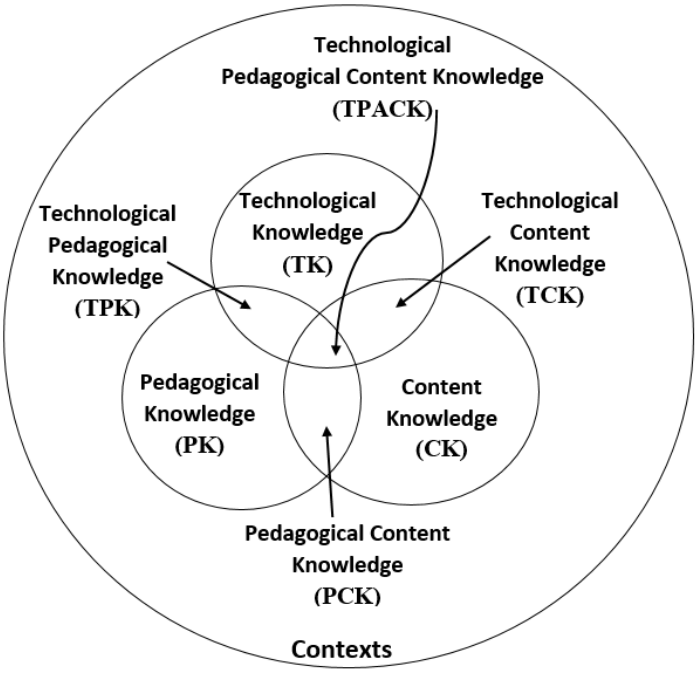


FIGURE 2.1: THE ADOPTED CONTEXTUALISED TPACK FRAMEWORK (ROSENBERG & KOEHLER, 2015:187)

Figure 2.1 shows the seven knowledge areas of TPACK embedded in the context. Liu (2016) also indicates that Jaipal-Jamani and Figg (2015) extended the TPACK framework into TPACK-in-practice from technology skills to the teaching context. The extended framework was engaged by Liu (2016) to explore the ICT integration practices in elementary classrooms in a multiple case study. Student teachers were deployed at different schools with the mandate to integrate ICTs into teaching and learning. They successfully integrated the ICTs with the support of tutors, even though at some schools there were challenges of infrastructure or efficiency of available ICT tools. This led to some student teachers not being able to use all available ICT tools at some schools. The author revealed some of the good classroom practices of the student teachers.

Some authors stipulated the contextual factors that influence teachers' initiatives of ICT integration. For instance, Koh *et al.* (2015) identify the following as the contextual factors: macro-level factors such as the National ICT policies and global educational trends that demands institutions of teacher training to produce 21st-century relevant technology proficient teachers. The school-level factors demand school-level policies that influence and guide teachers on possibilities of practices of ICT integration, encouraging teachers to explore different ICT tools and use ICT oriented pedagogy. The classroom factors encourage daily ICT integration practices, assisting learners

from low to high levels of learning to develop relevant ICT skills, ways of working together, social routines, participation structure and access to technology use in learning and teaching. On the other hand, the teacher-related factors include teachers' beliefs, which incorporates the ability to overcome barriers to ICT integration and the teachers' ability to face the realities of their classroom contexts and make relevant decisions for effective ICT integration.

Swallow and Olofson (2017) further emphasise the existence of TPACK-in-context studies, revealing some of the examples of documented contexts. The authors further argue that there is limited comprehension among researchers about interaction between TPACK-in-context factors and variables such as classroom instruction. The author established that there are macro-levels, meso-levels and micro-levels of context that influence TPACK development and its enactment. Of these levels, the micro-level focuses on the classroom-level context, comprising the availability of resources, inclinations and beliefs of learners and teachers, as well as the joint expectations between learners and the teacher. This implies that micro-level contexts include a teacher's background, personal conceptualisation of modern education and attitudes. They also emphasise that the context affects both the teacher's development of TPACK and its enactment in classroom practices. The need for further research on TPACK in context is also stipulated. The present study explores the complex nature of the different levels (macro, meso and micro) of context influencing the TPACK holistically, to unpack what will emerge in the different schools taking part in this study.

2.9.3 The HPC model

Hunter (2015; 2017) developed the High Possibility Classrooms (HPC) technology integration framework. The HPC enabled me as a researcher to explain and provide detailed data about cases of ICT classroom practices of exemplary teachers in their innovative instructional practices. The HPC framework is characterised by five concepts, which cover 22 themes (pedagogical teaching strategies and student learning practices). It indicates the exemplary good teaching and learning strategies of an innovative teacher who believes that integrating ICT into teaching and learning contributes positively to the education system. Figure 2.2 illustrates the HPC model and the themes underpinning each conception.

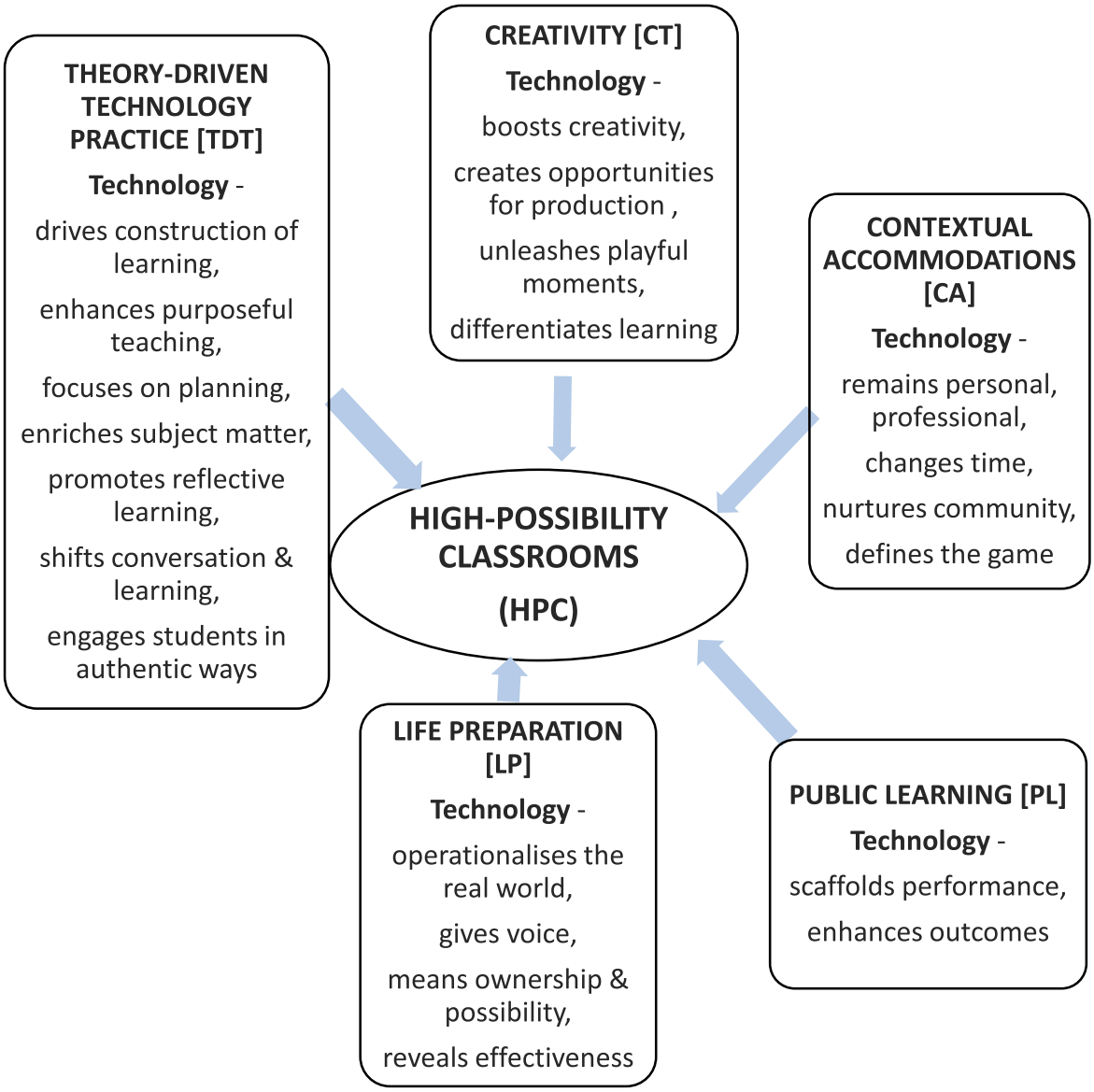


FIGURE 2.2: THE HIGH-POSSIBILITY CLASSROOMS (HPC) FRAMEWORK (ADAPTED FROM HUNTERS, 2017:561)

Figure 2.2 shows the five components of High-Possibility Classrooms which highlights the teaching and learning strategies possibilities for a teacher with well-developed TPACK. It is expected that an innovative teacher who is technology oriented can construct a classroom practice that incorporates the themes under the five concepts of the HPC.

2.9.4 Justification for the TPACK framework and HPC model for the study

The TPACK framework indicates the knowledge bases for the teachers and the HPC model shows the strategies teachers could use in effective ICT integration into teaching and learning. Hunter (2015) emphasises the necessity to merge the TPACK

framework with the HPC model to explore teachers' practices of ICT integration locally and internationally in different contexts to validate the HPC model. It is in this regard, adopting the two frameworks, I intended to explore and understand the practices of science teachers in Lesotho context to document their exemplary practices and to establish how they can contribute to ICT models of good practices to accelerate the ICT integration process at schools. The TPACK-in-context framework will unpack the innovative classroom practices of the teacher with a developed TPACK status. The HPC will enable the researcher to unpack the exemplary classroom practices or strategies of the teachers integrating ICT with developed TPACK.

The current study therefore draws from the contextual TPACK framework (Liu, 2016) merged with the HPC framework (Hunter, 2017) to allow me to gain deep insight into how individual teachers instruct learners by using technology in the classrooms within a variety of school contexts. Both frameworks are extensions of the TPACK framework by Mishra and Koehler (2006). The two frameworks are appropriate for this study, since teachers who have well-developed TPACK are likely to be innovative and can manage technology-oriented strategies, as indicated in the HPC technology integration model. Such teachers usually have the skills to develop authentic assessment tasks (Graham *et al*., 2009) and the TPACK model will thus allow me as a researcher to collect valuable data on teachers' classroom practices in technology-oriented instruction.

More specifically, the TPACK framework will be utilised with the High-Possibility Classrooms (HPC) model of technology to allow the researcher to explore innovative classroom practices of teachers who are passionate about technology integration into teaching and learning with developed TPACK.

The two frameworks can be merged as follows,

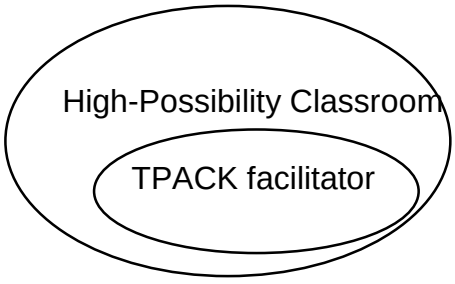


FIGURE 2.3: MERGED TPACK & HPC

Thus, Figure 2.3 shows that if we have a classroom adhering to High-Possibility Classroom practices, the facilitator is the teacher, with developed TPACK displaying the components and strategies of the HPC. However, constraints of some of the school contexts may not allow all the opportunities of HPC to be explored.

Alternatively, apart from the TPACK model, there are other models of ICT integration in education I did not find fitting the focus of this current study. Asabere *et al*. (2017) stipulate the following as other kinds of ICT integration models in education: the Activity theory of Nyvang (2006), the Generic ICT model of Wang (2008), the ICT-Enhanced Teacher Development Model (ICTeTD) of Engida (2011), and Wang and Woo's (2007) systematic model for designing ICT integration plans and the newly proposed Awareness Incentives Demand and Support (AIDS). Asabere *et al.* (2017) further emphasise that the Activity theory has three elements: Selection of ICT, Adaptation of ICT, and Change of Practice, and is usually used for the implementation of ICTs in higher education. The theory is therefore silent about the role of pedagogy in the integration process, whereas the TPACK framework focuses on the knowledge bases the teachers apply when developing innovative classroom practices and integrate ICT in their pedagogy.

The Wang (2008) model, on the other hand, has three elements: Technology, Social Interaction, and Pedagogy. This model focuses on the effective incorporation of ICT into curricula and designing of a learning environment that involves online discussions and a comparison of available ICT tools. The model requires established ICT infrastructure in a school environment. With the limitations of infrastructure in the Lesotho context, the model would not be suitable for the varying school contexts. The ICT-enhanced Teacher Development model, although, it is relevant for the use of technology in teaching, is suitable for tertiary institutions, with the potential for advanced technology infrastructure. The model focuses on presentation of teachers' knowledge when engaged in the following activities: curriculum review and development, lesson planning, classroom instruction and assessment.

Engida (2014) contextualised the ICT-enhanced Teacher Development model in the context of a chemistry teacher and referred to the model as ICT-enhanced Chemistry Teachers Development. It is clearly highlighted that the model is an advanced TPACK model. It categorises the teachers into different levels of complexity of use of

technology in teaching and learning; with the lowest level being Emerging Technological Pedagogical Content Knowledge (TPCK) teachers, then Applying, Infusing and Transforming TPCK teachers. It is elaborated that Emerging TPCK is the first stage of teachers' TPCK development and can be referred to as first stage of TPACK development. At this stage, schools or institutions do not have much of the infrastructure and the teacher uses the ICT for basic technical functions and uses of ICT and usually have instruction that are teacher centred. At this stage also the teacher can prepare a PowerPoint shared by the whole class or download information for learners to take notes.

The next stage is applying TPCK, though the teacher still dominates the learning process; however, there is development about how ICT contributes to learning. The instruction includes a digital presentation of concepts. There is flexibility within the school about allocation of time for computer lab and subject periods and allowance of learners to access computers. However, at this stage, computer proficiency is still taught as a stand-alone subject. The teacher can use a PowerPoint and download and project multi-media for learners to demonstrate concepts, stopping the multi-media and asking questions and predictions at intervals. The third stage of Infusing TPCK demands that teachers have a more developed TPACK and allow learners to become active and creative, managing their learning process. At this stage, the teachers master ICT tools, animation tools, multi-media tools and relevant instructional software for their subject areas. At this stage, the institution or school has a wide range of ICT tools in laboratories, the administrative area and in classrooms. The learners work independently on projects using ICT and teachers are also able to design their own lessons using relevant software.

The most advanced stage of Transforming TPCK requires that both teachers and learners are at advanced stage of use of ICT in teaching and learning and the curriculum has been developed accordingly to guide the process. There is mastery of subject specific software, learning management system, modelling and simulation tools, and various web and networking tools for effective transformation of the education system. Both teachers and learners are creative and innovative enough to create a website for school for sharing. The implication is that though the model focuses on what the TPACK framework focuses on, referred to as TPCK in this model,

it requires institutions with a well-established ICT infrastructure so that the teachers are not restricted by barriers to ICT integration.

For developing countries such as Lesotho, the participant in this study, it is still a long way to go before institutions such as primary schools could have a variety of ICT tools and other related infrastructure for the facilitation of effective ICT integration. Knowing the already existing challenges in Lesotho, the model cannot be user friendly. Despite the current situation, there are teachers who use available ICT tools to integrate ICT effectively into their instructional practices. Those are the teachers that are at the heart of this study to inform practice. We need a simple TPACK model that can allow the teacher to be flexible within their limited context resources to make efforts to integrate ICT in their instruction. Hence the use of TPACK in context in general for this study.

On the other hand, the systematic model for designing ICT integration plans focuses more on the planning for ICT integration, not the actual classroom practice. The model focuses on problem statement, learning objectives, the technology required, rationale, strategies, assessment and reflection displayed in a plan of instruction rather than the actual implementation of the instructional plan. This means the model is catered for within the TPACK model. Lastly, the Awareness Incentives Demand and Support (AIDS) model incorporates both teachers and learners' views about their satisfaction and conversance about the available ICT infrastructure at their institutions, which is definitely not the focus of the current study. The elements of this model are Awareness, Incentives, Demand, Support Services and Increase in the use of ICT. The AIDS model requires that institutions have adequate available ICT infrastructure. The current study is otherwise interested in how the teachers adapt their TPACK knowledge bases to their present contextual environment to have effective ICT integration, regardless of challenges they have in their respective environments. The current Lesotho primary schools' situation about infrastructure is already a disadvantage for this model, as there are generally persisting limitations of ICT infrastructure availability.

Additionally, there is also the Technology Acceptance Model (TAM), although it focuses on teachers' beliefs and attitudes about technology integration, which is not the focus of the current study. TAM emphasises the critical role of perceived usefulness and perceived ease of use of technology by the teachers for effective

integration of technology in education. The model provides the basis for establishing the impact of external variables on teachers' determination to incorporate ICT into teaching and learning. Kihoza, *et al.* (2016) stipulate that the TPACK model and the SAMR model can be used to evaluate ICT integration. Both the TPACK and SAMR constructs have similarities that could be used to interpret teachers' ICT integration practices. In this study I therefore choose the TPACK model, because the focus is now on the actual classroom practices of teachers who actually use ICT in teaching and learning, to reveal their teaching strategies to inform education system about good practices within different school contexts.

The teachers have undergone professional development training on the use of technology in teaching and learning through the initiatives that took place in the country and are now passionate about the use of ICT in their instructional practices. As a researcher I believe the science teachers in Lesotho trained on ICT-oriented pedagogy have developed TPACK constructs that could enable them to design innovative ICT-integrated science instruction. The current study therefore aimed to explore and reveal the classroom practices to inform other teachers about how they can go about integrating ICT into science instruction, as several studies emphasises that it is still a challenge to date.

2.10 GAP IN LITERATURE ABOUT ICT INTEGRATION

Generally, research indicates that even though the majority of teachers have developed ICT skills and have undergone professional development on ICT integration strategies, few of the in-service teachers actually integrate ICT into their daily instruction (Aikins & Arthur-Nyarko, 2019; George & Ogunniyi, 2016; Liu, 2016; Walan, 2020). However, in limited cases where teachers are successfully integrating emerging technologies, Continuous professional development is emphasised to support teachers with strategies for effective use of ICTs in science instruction and to develop learners specialised skills such as collaborative scientific argumentation (Hsu, Mukhopadhyay & Al-Ararah, 2020). It is not surprising, therefore, that some researchers have called for more exploration of actual cases of ICT integration into classroom practices to develop models of good practice (Prestridge, 2012), as most studies have not explored ICT-oriented instruction in depth. Some studies focus on teachers' TPACK development and how contextual factors shape the TPACK. Such

studies call for more research on TPACK in context to validate the model. In what is already revealed about the context, not much is indicated about how classroom practices contribute to the improvement of teachers' TPACK.

Generally, there is a gap between the extent to which different countries have invested in ICT infrastructure and the rate at which teachers integrate ICT into teaching and learning. What is not clear is why teachers who have been trained professionally for ICT integration and are employed at schools with sufficient ICT infrastructure are hesitant to utilise the ICT tools in their daily instruction. Limited studies are pointing to constraints such as lack of competence of teachers and lack of access to available digital facilities in the schools. Moreover, little is known about actual classroom practices of ICT integration, as scholars mostly used interviews to establish the actual classroom practices. In the Lesotho context, none of the limited literature about ICT in education has focused on the new, integrated curriculum after its implementation. Thus, in this study, I sought to understand in depth how teachers use ICTs in classroom practices in the teaching and learning of science in the new curriculum at basic education level. I intended to explore the classroom practices and the interpretations science teachers attach to their situations and actions within different school and classroom contexts.

2.11 THE CONCEPTUAL FRAMEWORK GUIDING THE STUDY

In this section a theoretical model within which the current study is positioned is provided. In this study I intended to investigate teachers' classroom practices of ICT integration in science at basic education level in Lesotho. In this study there are four operational concepts that help to address the research questions: ICT integration in science classroom practices, TPACK framework merged with the HPC model, ICT integration discourses, and Teaching and Learning of science. Figure 2.5 demonstrates how I propose the concepts interact:

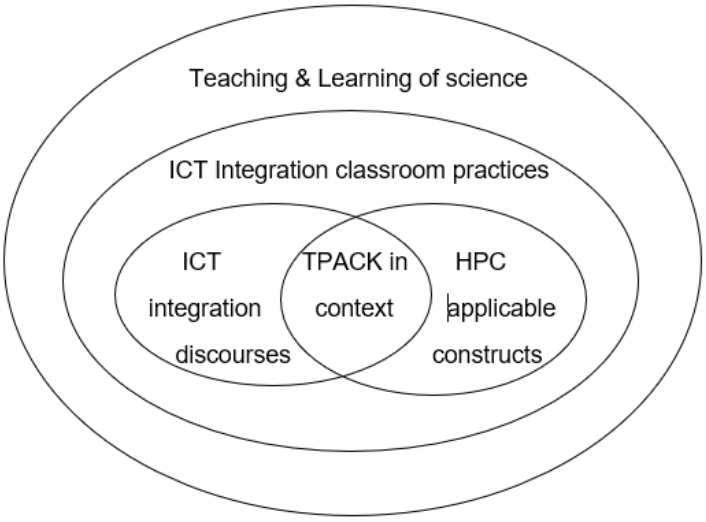


FIGURE 2.4: INTEGRATION OF TEACHERS' TPACK KNOWLEDGE AND OTHER CONCEPTS IN THE STUDY

Figure 2.4 demonstrates that the key construct which is ICT integration is informed by TPACK in context, the ICT integration discourses and the HPC constructs applicable in schools' contexts. The context could be macro, meso, micro or a complex combination of these levels. What is important is to establish the link between these concepts and how they interact to make the framework comprehensible for the study. This means the teachers' developed TPACK knowledge contributes positively to designing ICT innovative classroom practices, drawing from the HPC constructs depending on available ICT resources. ICTs are then used incorporated within the science instruction. The participant teachers have already been trained on ICT pedagogy and have developed TPACK. The study therefore investigates teachers' integration of ICTs in teaching and learning of science in primary schools within the Lesotho context. Discourses about ICT integration in education also play a critical role influencing teachers and schools' decisions about effective ICT integration in their contexts. The discourses are established from literature, participant teachers and principals to determine the current views about ICT integration. The study will then establish how the teachers developed TPACK and the current discourses about ICT integration shape how teachers integrate ICTs in their daily classroom practices. It will then establish the participants' views about the impact of ICT integration on learning and teaching of science.

2.12 SUMMARY

In this chapter, the literature accessed indicated teachers' practices of ICT integration into their classrooms globally, as well within an African and Lesotho context. Emerging classroom discourses were discussed, as well as indications of how they influence teachers' instruction practices. The challenges and successes of classroom practices involving ICT tools were also discussed with outstanding teachers' best practices of ICT integration. The education system, the Curriculum and Assessment Policy and the newly developed integrated curriculum that incorporates Science and Technology at Basic Education level within the Lesotho context were briefly highlighted as a foundation for highlighting the context of the targeted research site. Moreover, the philosophy for ICT integration through the lens of some scholars was also highlighted and the TPACK theoretical framework was merged with the HPC model for the current study. A briefing was also given about teaching and learning science in the 21st century and what informs ICT integration in education systems to emphasise the critical role of ICT in instructional practices. The gap in literature about ICT integration was also highlighted, with the motive to establish the basis for the current study. Moreover, the framework for the current study was also established in this section to situate the current study which focuses on teachers' classroom practices, aiming to contribute to the existing literature about good practices of ICT integration.

CHAPTER 3: RESEARCH METHODOLOGY AND DESIGN

3.1 INTRODUCTION

In Chapter 2, literature was reviewed on how Information and Communication Technologies (ICTs) were integrated into teaching and learning at schools. Several discourses emerged about use of ICT in instructional practices and gap in literature review was identified. TPACK framework and HPC models were discussed as lenses for establishing the successes and challenges of ICT integration in education systems of different countries. The frameworks were also discussed directed to guiding this study.

Chapter 3 discusses in detail the where, when and how data were collected in response to the research questions for the study. This is usually referred to as research methodology (Creswell & Creswell, 2018). In this chapter, I firstly describe the philosophical assumption, i.e. interpretivism, followed by the qualitative multi-case research design, purposive sampling procedures and data collection tools used to collect data and proposed data analysis strategy. A brief detail of both the issues of trustworthiness and the ethics are also provided.

Overall, the primary goal of this study was to investigate how Basic Education teachers in Lesotho integrate ICT into the teaching of science and technology across a variety of selected school contexts, exploring how the discourses inform teachers' ICT integration practices in Lesotho. The intention was to document the actual classroom practices of science and technology teachers across different schools in Lesotho and to construct a theoretically sound account and explanation of why the integration of ICT into the teaching of science and technology is the way it is in Lesotho. This was achieved by answering the following research question:

> How do teachers integrate ICT into the teaching of science and technology in basic education in Lesotho classrooms?

The following sub-questions were used to collect qualitative data:

What are the discourses that inform ICT integration practices of teachers of science and technology in Lesotho?

How do teachers across different school contexts in Lesotho practise the integration of ICTs into the teaching of science and technology in Grades 6 to 7?

How can a (theoretically and empirically) sound account be constructed of the teachers' integration of ICTs into teaching of science and technology in Lesotho?

3.2 RESEARCH PARADIGM AND PHILOSOPHICAL ASSUMPTIONS

The current study adopts the philosophy of interpretivism. Bryman (2016) argues that Interpretivism respects humans and objects they interact with, and it accommodates participants' sense making of the world. There are specific sets of ontological and epistemological principles that guides a specific paradigm. The current study is therefore informed by the qualitative paradigm. The study acknowledges that reality about the world exists independent of people's principles and understandings and there is the difference between people's opinions and elucidations about the world and the way the world is (Lewis *et al.*, 2003). Moreover, in this study I also acknowledge that reality can be known through construction of meanings on a social basis by humans and there is always a series of social constructions. The study therefore involved the use of data collection tools such as interview, observation and document analysis that enabled gathering of information from participants' views about the ICT integration and its best practices in learning and teaching of science.

The study also adopted the philosophy of ICT integration into teaching and learning. Moursund (2006) argues that every teacher, regardless of the discipline, needs to know some content and pedagogy on ICT and ICT is an influential aid to teaching, learning and problem solving in every discipline in schools. Additionally, Webster (2017:27) stipulates that technology is inevitable and instrumental for achieving educational goals. Consequently, the focus in this study is on exploring and understanding the participants' social world using the data interpretations as well as the participants' understanding and interpretations of ICT integration into instructional practices. The present study acknowledges that knowledge can be acquired through experience, in most cases using sense organs, which can also be acquired through reasoning as supported by Johnson and Christensen (2014). The authors emphasise that through experience, most information is gathered through interaction with the environment and culture. As Johnson and Christensen (2014) stipulate that reasoning is the source of knowledge, it was anticipated that participants in this study would

reason and construct knowledge about their practices of ICT integration in instruction of science as they interact with the ICT tools and people around them.

As a researcher concerned about ICT integration in education, I am of the view that our education systems can no longer cope without ICT integration if we really want to overcome the challenges of poor performance and lack of interest in subjects such as science and mathematics. Teachers and learners need a paradigm shift and support from the Ministries of Education and Training to shift from their usual, everyday classroom practices to technologically enriched classroom practices. One way of support could be the professional development of teachers' pedagogy, involving exposure to the effective utilisation of ICT tools. Teachers could also be supported by revealing classroom practices of exemplary teachers on ICT integration. I believe the idea that technology is unavoidable, and schools need to keep up with emerging technologies in order to assist learners develop 21st-century skills. This study therefore endeavoured to reveal the classroom practices of teachers who actually integrate ICT into their teaching and learning of science in basic education in Lesotho, thus promoting and advocating the use of ICT in teaching and learning. The implication is that, as a researcher I needed to interpret the meanings from carefully observed activities of teachers' ICT integration practices and there was a need for member checking to ensure that the interpretations align with the intentions of the participants. It is in this regard that I had to be in contact with participants in their natural social settings while exploring their classroom practices of ICT integration.

As a researcher I also assume that human beings construct meanings as they engage with the world or objects and interpret them. The study therefore used open-ended questions in data collection instruments to gather the meanings constructed by the teachers within their respective school contexts. Furthermore, the teachers' construct knowledge is based on their individual interpretations and subjectivity about ICT integration, creating their own meaning of events; therefore, events cannot be generalised (Mack, 2010) to all teachers. I further gained knowledge about how teachers integrate ICT into their classroom practices through strategies that respect that people are different as are the objects they interact with in the world and in the different contexts within which they live and interact. Knowledge is gained through personal experiences, which can be different for teachers in different contexts; therefore, this approach enabled me as a researcher to generalise the findings to

individual teachers and not to all the teachers in Lesotho. I therefore generated meaning from data collected personally from individual schools. I am also aware that my background shaped how I interpreted the collected data; therefore, there is a need for member checking to ensure that the participants' views are reported satisfactorily.

3.3 RESEARCH DESIGN AND APPROACH

In light of my intention to gain deep insights of how and why teachers integrate ICT into teaching and learning the way they do in classroom practices in science, qualitative approach was appropriate for this study. This is supported by Creswell and Creswell (2018), who argue that a qualitative research enables the researcher to collect data in the participants' natural settings and the investigator is the key instrument for collection of data. I personally collected data from research sites employing document analysis, classroom observations and interviews. The qualitative approach enabled me to explain how teachers and principals at the three participating schools make sense of ICT integration in learning and teaching of science. I also established current emerging discourses about ICT in schools.

As supported by Creswell and Creswell (2018), I collected data through multiple sources, such as documents, interviews, and observations to ensure the collection of reliable data. I also intended to establish patterns, themes, and categories through inductive and deductive forms of data analysis. I also ensured to retain teachers and principals' opinions of ideas as I interpreted data and flowed with the flexible nature of qualitative studies as I collected data in different contexts, reflecting regularly on my role as a researcher to avoid bias. I eventually provided a holistic account of all the processes engaged in this study.

The present study employed an exploratory multiple-case study from an interpretive perspective to develop an in-depth analysis of science teachers' ICT integration into classroom practices. Bell and Waters (2014) argue that the case-study approach is the most appropriate approach for individual researchers as it enables the researcher to study phenomena in depth within a limited period of time, even though some case studies can last for years. Thus, in this study, the case study enabled me to explore in depth and within a short period of time, teachers' classroom practices of ICT integration. The case is a teacher of Science and technology at Grades 6 - 7 and a

school is a research site in Lesotho. Bell and Waters (2014) further indicate that even though case studies can be carried out either as follow-up or as a prerequisite to a survey, they are usually carried out as independent exercises. In this study, a qualitative case study was undertaken as an independent exercise.

Moreover, in the multi-case study I was able to understand, interpret and explain the observed actions and meanings of teachers' use of ICT tools in teaching and learning. Johnson and Christensen (2014) affirm that a multiple-case study enables the researcher to explore different cases of the same phenomena within limited resources in their natural settings. In this study, specific schools where ICT integration happened were selected and I investigated how teachers integrate ICT into the teaching of science in Lesotho; thereafter, generalising the findings to the specific school contexts, while abiding by the characteristics of qualitative research.

3.4 RESEARCH SAMPLE AND SAMPLING TECHNIQUE

The target population in this study is Basic Education science teachers in Lesotho. I opted for teachers in Grades 6 to 7. At Basic Education level, Science is replaced by Science and Technology curriculum from Grade 5 up to Grade 8 according to the new, integrated curriculum (MoET, 2009). The assumption was that the new curriculum for primary schools had been in place for some years since 2012 and teachers should be more established with its implementation than secondary schools that just began to implement it in 2019. Purposeful sampling of participants who provided rich data was possible (Cohen *et al.*, 2018; Creswell & Creswell, 2018) by selecting three science teachers and their principals for exit interview from schools of different contexts. The teachers' expertise in utilising ICT and their experience with the new science and technology curriculum were the criteria for selection. The teachers were identified through a process of nomination, including self-nomination, as well as by multiple recommendation of the principal and the inspector. Table 3.1 shows the demographic information of the three participant teachers, which includes the number of years of experience with ICT integration in classroom practices. Pseudonyms are used to protect the participants and their schools.

TABLE 3.1: SUMMARY OF DEMOGRAPHIC INFORMATION OF PARTICIPANTS

Name	School in Maseru	Teaching Subjects	Gender & Age	Teaching Experience	Qualification	ICT Integration Experience	Grade
Pseudonyms							
Thupa	Sentleng Primary School	Science & Technology and Arts & Entrepreneurship	Male 36 years	15 years	Diploma in Primary Ed.	9 years	6 & 7
Lethu	Leratong Primary School	Science 7 Technology, Mathematics and Arts & Entrepreneurship	Male 35 years	6 years	Diploma in Primary Education	4 years	7
Nasi	Lebisang Primary School	Science & Technology and Arts & Entrepreneurship	Male About 27 years	4 years	Degree in General Management	3 years	7

The purposive selection of three male participants as shown in Table 3.1, depended amongst other factors on the teacher's use of ICTs in science and technology instruction in Grades 6 and/or 7. These were the teachers in the target grade level during the period of data collection. The selection of participants was not gender bias; the teachers tend out to be all males in the target grades during the implementation of the study. One of the participants, Nasi was not willing to declare his age, but is estimated to be around the late 20s. However, there was an estimated age gap of about 10 years between him and the other two participants who declared their ages. Nasi was also unqualified teacher of Science and technology in his school. This is typical of some schools in basic education in the country.

Initially, the study had four participant teachers. However, due to the teachers' strike in Lesotho in 2019 and the Covid-19 protocols and lockdowns in 2020, further data could not be collected to complete the case of the fourth teacher and he was dropped from the study. Primary schools in Lesotho were closed from March 2020 to about February 2021 due to the Covid-19 pandemic restrictions. As a result of these constraints, the study presents data on only three case teachers. Another participant was dropped and replaced in 2022 when further observations and follow-up interviews could not be undertaken in his case. The case had an initial interview, two follow-up interviews, two lesson observations and the principal's exit interview, of which I strongly believe there are lessons to be learnt in the collected data of this case. The teacher had resigned and transferred to another school in another district with no ICT facilities due to Covid-19 pandemic complications which the former school

experienced. The school could not afford to pay teachers when the parents did not pay school fees when the schools were closed due to Covid-19 lockdowns experienced in Lesotho. The teacher was therefore replaced with a new case within reach. The action was informed by the qualitative data principles, which allow for the researcher's flexibility (Saldana, 2011) when conducting the study and responding to circumstances prevailing during fieldwork.

3.5 DATA COLLECTION

The case study design and the purposive sampling employed in the present study as indicated in the previous section, enabled me to access the required information from science and technology teachers who are actually using ICT tools in instructional practices in teaching at basic education in Lesotho. Data for this study were collected from an outsider perspective (McMillan & Schumacher, 2010). I collected data from the initial data collection period in 2019/2020 within 6 weeks to add to the 2022 data collection for each participant. McMillan *et al.* (2010) argue that valid data are achieved when events are unfolding naturally when participants ignore the presence of the researcher. Moreover, I was open to changes to the initial plans of data collection as it usually changes after selection of the research sites and incorporation of terms of reference of participants suggesting new directions of interviews and observations especially due to the timetable schedules. To support this idea, Saldana (2011) stipulates that in qualitative studies, data collection is observed as an evolutionary process where pre-planned data collection methods can be changed to secure the required data if the existing plan does not work.

Additionally, Johnson and Christen (2014) argue that there are strategies for the collection of data and handling of fieldwork. Firstly, the data to be collected should be qualitative, in the form of observations, reviewed documents and interviews. Secondly, the personal experience and engagement of the researcher are priorities, as the researcher plays a critical role in collecting data personally to inquire and understand the phenomenon under study in depth while remaining neutral, without any form of judgement to participants' provided data. Lastly, the researcher should display dynamic characteristics to incorporate the ongoing change throughout data collection stages and should be open-minded. To ensure rich data collection in this study, I used multiple instruments, employing document analysis, audio recorded observations and

interviews. The three instruments supplemented one another. Document analysis informed the study about how teachers are guided to integrate ICT into the classroom instruction. Frequent observations of lessons provided rich data about teachers' actions and sense making of ICT integration into teaching and learning. Interviews on the other hand provided rich data, clarifying some of the actions observed in the classroom and emerging discourses about ICT integration into schools, especially when the interviews are after the lessons which was the case with this study.

3.5.1 ICT integration assessment tools

Different assessment tools are used to establish the classroom practices of expert teacher's ICT integration instruction. The current study adopts Zain *et al.*'s (2018) Media Integration Worksheet assessment tool to evaluate the participant teachers' lesson plans and to observe the actual classroom practices. The assessment tool has the following variables: Types of media, media elements, components, learning skills/students' profiles, teaching tools (methods, techniques and activities) and instructional questions. It is highlighted that the types of instructional media integrating ICT include students watching of videos, observing or analysing still pictures, interaction sessions and browsing internet/searching materials.

On the other hand, the International Society for Technology Education (ISTE) has developed standards for teachers for ICT integration in teaching and learning (Trust, 2018). They can also be used to determine teachers' classroom practices of ICT integration. The Technology Integration Assessment Instrument measuring ICT integration in lesson plans in this regard consists of the following dimensions: Planning, Standards (both content and NETS-S) and Attention to student needs. For each of the indicated dimensions the following variables are recorded: Supportive technology component; Essential technology component; Non-essential technology component and Technology not present. Trust, 2018 emphasises that the instrument enables systematic examination of level and style of ICT integration into standard classroom activities.

Moreover, Trust (2018) postulates that ISTE developed the ISTE Classroom Observation Tool (ICOT) to be utilized when observing classroom teaching and learning. The ICOT has the following variables: Number of students; Students' groupings; Teacher roles such as lecturing, modelling, interactive direction or

facilitator; Learners' activities such as presentations creation, running of simulations, analysis of information, researching and other hands on skills development activities, Engagement % in ICT use, Technology Use Time, Technology use by the teacher and by the students such as use of spreadsheets, word processing, and other software applications, video use or use of laptop/tablet/Interactive board, need for Technology such as the extent to which the technology was useful and NETS for Teachers which incorporates about 28 standards for teachers when teaching 21st-century learners. Examples of the NETS are appropriately selected technologies, development of technology-rich instructional practices, technology applied to support learner-centred strategies, assessment of student learning using technology and the teacher teaching learners models of legal and ethical technology and many others.

The mentioned assessment tools will be adopted to build an assessment tool for analysing both the lesson plan and the classroom observation practices of teachers' ICT integration practices in the present study.

3.5.2 Document analysis

To triangulate data in the present study, I also employed document analysis to gather information from all relevant documents that guide teachers about integration of ICT into learning and teaching. Bowen (2009) defines document analysis as an organized technique of revising and assessing documents. Thus, in this study, I systematically collected data about ICT integration into classrooms in education from the accessed National policy documents such as the Vision 2020. National ICT policy, The Education Strategic plans, the new Curriculum and Assessment Policy (MoET, 2009), the integrated science and technology curriculum and lesson plans, that contributed to ICT integration into Lesotho schools.

Bowen (2009) further argues that document analysis enables the researcher to generate subsequent interview questions and promotes effective participant observation. In the present study, I was therefore able to gather rich supplementary data from the available documents within each school context. I was also able to track the development of ICT integration into Lesotho schools. The three methods engaged in data collection in this study thus interactively complemented one another.

However, document analysis also has limitations. In most cases the documents were originally not produced for research and hence have limitations with information concerning the research questions for the present study. There is also a challenge with accessibility of some relevant documents such as the government speeches and newspapers that contain relevant information about ICT integration into primary schools in Lesotho.

3.5.3 Classroom observations

In the present study, the three teachers from different primary schools were observed teaching 45 minutes to one-hour lessons each week for four weeks in 2019/2020 and an additional two weeks in 2022, with five weeks of lesson observations for the participant teacher recruited in 2022 as replacement of one of the cases. I used a semi-structured template to collect data during the observation. However, due to the flexible nature of a qualitative study, I was able to collect additional data that I recognised to be valuable for the study. McMillan and Schumacher (2010) argue that intensive observations reveal verbal, tacit knowledge, non-verbal words and other social interactions difficult to express but people usually demonstrate by actions or use of objects. Additionally, Creswell and Creswell (2018) emphasise that in a qualitative observation, the researcher uses a semi-structured or unstructured approach to gather field notes on the activities about phenomena under study. This should be done in an environment that allows participants to provide information freely, in their independent opinion. In this study, the lessons were video recorded with the permission of the participants to support the field notes from the researchers' journal.

In classroom observations, I indicated specific actions of use of ICTs that took place during the classroom. I also took note of meanings from participants' views, especially how they explain the causes of or meanings of actions about ICT integration in science instruction. I also narrated on participants' actions and the relationships of events and actions of ICT integration observed in different settings and contexts. I further provided rich data about the settings for the different contexts especially on actions and behaviours observed in each case. Cohen indicates the following as checklist for content of field notes after observation (2007:425-426),

> *Space* – the physical setting, *actors* – the people in the situation,

Activities – the sets of related acts that are taking place,

O*bjects* – the artefacts and physical things that are there,

Acts – the specific actions that participants are doing,

Events – the sets of activities that are taking place,

Time – the sequence of acts, activities and events,

Goals – what people are trying to achieve, and

Feelings – what people feel and how they express this.

The checklist enabled me to cover the contextual and physical settings and all relevant data, including the critical events observed with regard to classroom practices of ICT integration in teaching and learning of science. Cohen *et al*. (2018) further emphasise the necessity for the four sets of observational data to ensure systematic observations. Across all participating three schools, I took notes and expanded them immediately after each observation in the journal for recording ideas, issues and challenges experienced during classroom observation and a tentative, developing ongoing analysis and interpretation written record.

In line with Cohen *et al*. (2018), who highlight the critical role of reflecting on the field notes after observations, I reflected on the descriptions and analyses done, the methods used in the data collection and ongoing data analysis, as well as on the challenges, tensions and any other ethical issue that needed immediate attention. I considered my reactions as a researcher to observations critically and ensured that my attitudes, emotions and analysis approach remained neutral without any bias throughout the data collection stages and throughout the study. I also reflected critically at each stage on the raised points or ideas that needed further clarification in the next stages of data collection. This aided in the formulation of relevant questions for subsequent interviews that were undertaken after classroom observations.

Creswell and Creswell (2018) further indicate that classroom observations have both advantages and disadvantages. As a researcher, I had first-hand information about what happened in the classrooms when ICT was integrated into the teaching and learning of science in basic education, with the advantage of recording information as it happened. I could experience finer details of ICT integration classroom practices in science instruction, which could not be observed with other instruments. The

disadvantage could be that my presence as a foreigner in the particular classroom could cause some discomfort among the learners. However, access to the classroom was carefully negotiated to encourage learners behave as normal as possible even in my presence.

3.5.4 In-depth interviews

After observing teachers' instructional practices of ICT integration, I employed in-depth interviews with the teachers for one hour. The purpose of the interviews was to get deep insights and an understanding of the teachers' actions of ICT integration. I was able to seek more clarification of why and how some actions took place in the classroom instruction using ICT tools. Creswell and Creswell (2018) indicate the following as features of an interview protocol: the presence of a heading indicating date, interviewee, interviewer, and place where the interview is held; a clear and standard instruction for the interview that will be applied on all interviewees; icebreaker questions to enable the participants to relax; probes for the questions to seek more clarifications or justifications of ideas raised; enough space left between questions to enable writing of responses in the interview session; and lastly, the researcher keeps a log for recording all the events of the study, including data from triangulation of instruments. The present study therefore developed interview protocols with expected features.

Moreover, McMillan and Schumacher (2010) postulate that there are different types of interviews such as informal conversation, interview guide, standardised open-ended interview, key informant and others. In this study I engaged a combination of some of these interviews. I engaged informal conversation where I asked questions that emerge from the immediate context after classroom observations. This type of interview is usually triggered by what is experienced in participant observation, which was also the case in this study. In the current study, I had such questions exploring what I experienced in classroom observations to understand in depth what happened in the ICT integration classroom practices. For instance, in the case of Thupa, I had to inquire in the follow-up interview about a teacher who came in and sit among the learners, why that was the case. Section 4.4.2 elaborates on the collaborative effort of this scenario.

In the present study, I also employed the interview guide approach where I had already prepared some questions from some topics of interest to interview the participants about, guided by literature review (Refer to Appendix B). For instance, there were questions inquiring about how the teachers were incorporating ICT into the planning of instruction, how they were using ICT in instruction, challenges experienced and how they could be mitigated. This was to ensure systematic coverage of ideas from all teachers and principals within different school contexts. Additionally, I gained more rich data by probing the teachers depending on observations in the classrooms and other context related factors revealed in actions of ICT integration. However, due to the flexible nature of qualitative studies, the sequencing of the questions was determined by the researcher during the interview sessions at the different schools.

On the contrary, there is also the standardised, open-ended interview, which entails asking participants the same questions and in the same order, seeking their opinions about their ICT integration classroom practices. However, the disadvantage of standardised open-ended interviews is that it limits the researcher's flexibility and openness of responses and their relevance, though probing may be utilised to seek more clarification. In the current study, since the three participant teachers from different schools were studied, I utilised this type of interview to collect information about teachers' classroom practices of ICT integration consistently, even though from different contexts, to ensure that all areas of interest are covered, but incorporating new emerging issues per context as well. Semi-structured interviews served the purpose.

Thus, the current study utilised a combination of interview guide, key informant and informal conversation interviews to collect rich data about teachers' ICT integration classroom practices. The principals were also interviewed afterwards to get a sense of the context, support and expectations from the leadership of the school. The audio-recorded interviews enabled intensive collection of data from a small sample (Creswell & Creswell, 2018). Ritchie *et al.* (2013) emphasise the critical role of the researcher for a successful interview.

3.5.5 Gaining access to primary schools

Before starting data collection, permission was sought from the UFS, the MoET, principals of the participating primary schools and the participating teachers. The

nature of the purposive sampling strategy enabled me to identify the teachers who actually integrate ICT in the teaching and learning of science and technology in classroom practices. I negotiated access through nomination by officers from MoET and the principals. I then had verbal conversations with the nominated teachers to negotiate their self-nomination on voluntary basis. I also arranged to visit their classrooms before data collection started. This enabled me to verify that indeed they existed and would provide rich data about ICT integration into learning and teaching. After confirming the teachers' interest in participating in the study on voluntary basis, I then prepared formal authorised invitations to the study.

3.6 DATA ANALYSIS

The qualitative data collected in the present study were analysed inductively by coding, categorising and interpreting (McMillan & Schumacher, 2010). In this study, narrative and content analysis was used to analyse data (Creswell & Creswell, 2018; Guzey & Roehrig, 2009), more specifically, to analyse the ICT integration practices of science teachers. The first stage was to reduce the bulky data from interviews, classroom observations and data from document analysis. Individual teachers' cases were coded, and categories established from their ICT integration classroom practices. The codes were compared with previous cases coded in the same categories. Additional information that emerged from the collected data about teachers' actions of ICT integration was also acknowledged. Patterns were developed and they offered in-depth descriptions of ways teachers use ICT tools in science teaching. Saldana (2011) specifies that similar codes are grouped together and named category. Teachers' use of TPACK and HPC constructs to integrate ICTs in classroom practices was also interpreted qualitatively. Table 3.2 shows the guidelines used to code-specific examples of the teachers' actions in classroom practices (Hunters, 2017:561), which enabled extracting qualitatively the teachers' specific examples of classroom practices showing application of constructs of the theoretical framework in the ICT integrated observed lessons and from the lesson plans. Erduran and Ince (2018) used the adopted guidelines to qualitatively identify difficulties that five mathematics teachers had in ICT integrated lessons from lesson plans, observations and one-on-one interviews. Similarly, the present study used the adopted guidelines

which includes the HPC constructs to establish classroom teachers practices of ICT integration in the context of primary schools in Lesotho.

TABLE 3.2: GUIDELINES FOR CODING TPACK AND HPC ACTIONS IN ICT INTEGRATED LESSONS

THE KNOWLEDGE AREA	DESCRIPTION	THE PARTICIPANT TEACHERS SPECIFIC EXAMPLES
TPACK Constructs (adopted from Erduran and Ince (2018: page 557)		
Pedagogical Knowledge (PK)	Teacher uses teaching methodologies and processes reflecting classroom management, evaluation, student learning and develop teaching plans.	
Content Knowledge (CK)	Teacher shows knowledge of specific field for teaching learners	
Technological Knowledge (TK)	Teacher shows knowledge of using emerging technologies which includes use of soft wares.	
Pedagogical Content Knowledge (PCK)	Teacher uses subject specific presentations and activities in teaching practices to enable learners' comprehension.	
Technological Pedagogical Knowledge (TPK)	Teacher uses teaching practices which motivate learners comprehend the taught concepts through use of technology.	
Technological Content Knowledge (TCK)	Teacher knows how to suitably present specific subjects within the given field using available technologies.	
Technological Pedagogical Content Knowledge (TPCK)	Teacher uses emerging technologies to coordinate subject content knowledge with specific teaching practices/activities to facilitate learning.	
HPC Constructs (adopted from Hunters (2017: page 561)		
Theory-Driven Technology Practice [TDT]	Teacher drives construction of learning, enhances purposeful teaching, focuses on planning, enriches subject matter, promotes reflective learning, shifts conversation & learning, engages students in authentic ways	
Creativity [CT]	Teacher boosts creativity, creates opportunities for production, unleashes playful moments,	
Contextual Accommodations [CA]	Teacher remains personal, professional, changes time, nurtures community, defines the game	
Public Learning [PL]	Teacher scaffolds performance, enhances outcomes	
Life Preparation [LP]	Teacher uses teaching practice that operationalises the real world, gives voice, means ownership & possibility, reveals effectiveness	

:

Moreover, NVivo qualitative software was used in this study to analyse the collected qualitative data, especially from interviews. According to Hunter (2017), the software includes text storage for interviews, observations and other data sources. Additionally, the software organises data into units and assigns codes to words and phrases. It also reorganises the data, establishing queries, categorising the codes accordingly and

developing network views of phenomena under study, in this case of classroom practices of ICT integration. However, though faster, NVivo also has challenges; it has limitations on the interrogation of data in detail, especially on similar meaning in context from different phrases. Data analysis were maintained both manually and digitally for this study.

On the issue of coding data, Welsh (2002) also emphasises the need to combine both manual and digital data analysis using software to ensure thorough interrogation of the collected data. Welsh (2002) agrees that even though the use of software tools speed up the process of data analysis, the software has shortcomings. For instance, the NVivo encodes faster, ensuring the quality and trustworthiness of the study. However, it can miss some themes expressed in different words. One other disadvantage of NVivo is that it interrogates data at a particular level and not throughout the data analysis stages. Therefore, it is not very useful for issues of validity and reliability. Thus, the study utilised both manual and digital analysis of data.

In the present study, data were generally analysed using Laws *et al*.'s (2003) model consisting of seven steps:

Step 1: Data in this study were read and reread in-depth to understand what informs teachers' ICT integration practices and how teachers use ICT tools in the instruction.

Step 2: The preliminary list of themes and categories emerging from the data was identified and arranged in alignment with the research questions for the study.

Step 3: Data were frequently reread reaffirming alignment of the raw data from the participant teachers' interviews and observations, and the principal's exit interview with the research questions merging themes and categories with common issues.

Step 4: At this stage, the emerging themes were then linked to the literature accessed.

Step 5: At this stage, as the themes were interpreted, and reference to the research questions was frequently made to ensure alignment.

Step 6: At this stage I tried to establish patterns in the data across all the cases.

Step 7: Interpreting data and deriving meaning. Through the steps mentioned, I was able to identify themes which were used in case narratives in Chapter 4 for presenting data analysis and interpretations. The emerging themes, therefore, informed the

interpretations made in the cross-case analysis section to answer the third research question, which interprets and constructs a meaning to why teachers in Lesotho Basic Education level integrate ICTs the way they do within their schools' contexts.

3.7 TRUSTWORTHINESS OF THE RESULTS

To ensure reliability of the results, consistency was maintained when collecting data in this study so that valid conclusions (Johnson & Christensen, 2014) could be reached. The interpretation of results was further supported by adequate evidence from observations of video records. To ensure the validity of the results, there was evidence that the selected teachers actually utilised ICT in the learning and teaching classroom practices. Issues of trustworthiness such as triangulation of instruments, member checking, thick description, prolonged time spent in the field, an external auditor and clarity on bias were considered in this study (Cohen *et al.*, 2018). According to Shenton (2004), the following are the criteria for ensuring trustworthiness of qualitative studies: Confirmability, Transferability, Credibility and Dependability. When defining the four criteria, Shenton (2004) elaborates that credibility ensures confidence that the researcher has recorded data about phenomena under study accurately.

Shenton (2004) further accentuates that this is achieved by: adopting well-established research methods; developing dialogue with participants before first data collection day; triangulation of data collection instruments; strategizing to ensure that participants give honest opinions about phenomena under study; frequent debriefing sessions; scrutiny of the study by peers; and lastly the researcher's scrutiny of the report and data analysis procedures, member checking, thick description of teachers ICT integration practices and examination of research findings from previous studies to inform the current study.

Transferability is concerned with the extent to which the findings of the qualitative study can be applicable to other situations. Since this is a qualitative study, the findings were generalised to specific contexts; however, the findings were used to inform other situations about how to improve the practice of ICT integration in learning and teaching of science. Alternatively, dependability is concerned with the thick description of the research design to enable other researchers to access the information if they want to repeat the same study in another context.

Confirmability is concerned with assurance that findings from this study are the result of the experiences and the information gathered from the participants, not shaped by the researchers' preferences and beliefs; hence reducing the researcher's bias (Shenton, 2004). The following subsections discuss the strategies that were used in the current qualitative multi-case study to address the four criteria in order to ensure the quality of the study.

3.7.1 Triangulation of Instruments

Cohen *et al.* (2018) define triangulation as using more than one data collection instrument in a study or using multiple methods of data collection. Cohen *et al.* (2018) further argue that the more the instruments align, the more confident the researcher is about the findings. For the present study, I collected data by using several instruments, namely an interview protocol for teachers and principals, a classroom observation schedule and a document analysis protocol to ensure consistency and verification of information provided by individual participants within different school contexts. Both the principals and the teachers were interviewed to ensure validity and reliability of information provided. I also ensured that I used the same amount of time and frequency for classroom observations and interviews when triangulating data. I observed the classroom practices of ICT integration at three different schools, twice a week, for about three weeks and once a week with a double period in one of the schools due to school's special arrangements of using devices from learners' homes. By the second week, the participants normalised, getting used to the researcher in their contexts. Each interview per participant lasted about an hour.

3.7.2 Member checking

Once data had been divided into themes and categories, member checking was used, allowing participants to validate the transcribed data with initial emerging themes. This is supported by Cohen *et al.* (2018), who stipulate that it is critical for qualitative research to involve member checking to develop theory from participants' point of view. Moreover, when the final report had been done, participants verified that they had been interpreted correctly. Member checking is critical in qualitative studies, as the researcher develops a theory from the participants' views. Cohen *et al.* (2018) stress that member checking addresses thick description explained in the next sub section.

3.7.3 Thick description

Creswell and Creswell (2018) argue that detailed descriptions about the setting make results richer and more realistic, thus increasing the validity of the findings. In this study, I provide detailed information about the contexts of each participant teacher. Details of infrastructure and available ICT devices at individual schools and the extent of accessibility of such tools will be elaborated on in this chapter. Some background on how each teacher developed ICT skills professionally or otherwise are indicated, as well as details of ICT integration practices in the different contexts, while data collection is supported by audio and video recordings.

3.7.4 Prolonged time in the field

Usually, teachers and learners do not behave normally when there is a stranger in the classroom for the first time. Once the stranger visits the classroom for a number of times, they get used to being with the person in the classroom and behave normally. I visited the classrooms several times to normalise the situation and observed whether there was a trend of change of behaviour of teachers and learners in my presence. I also negotiated a presence of a relaxed atmosphere in the classrooms with both the teacher and the learners.

3.8 EXTERNAL AUDITOR

After the data had been coded and throughout the data analysis stages and report writing stages, the supervisor, and the co-supervisor, as well as the team members of the cohort were engaged in interrogation of the collected data. Creswell and Creswell (2018) emphasise the role of an outward auditor who reviews the entire project in research studies. The auditor provides an objective evaluation of the entire project, checking the accuracy of transcriptions, alignment of the research questions, collected data and data analysis procedures as well as interpretations and conclusions drawn.

3.8.1 Clarity on bias

As a researcher, I played a critical role in interpreting the data collected from the participants, coding it in accordance with what the participants wanted to say. Because of threads of biasness from my side, I needed to interrogate the collected data more than once to ensure the participants' messages were interpreted correctly. It was also

likely that the participants might treat me as a person in authority when I invited them to participate in this study. They could think they were obliged to take part; however, I negotiated access, assuring them that the data collected would be used for my study and would not have any impact on their teaching as a career. I issued informed consent forms and signed contracts of confidentiality. Additionally, I emphasised that the participants would take part in the study on a voluntary basis, from which they could withdraw at any time during the course of the study without any penalisation.

3.8.2 Crystallisation

From the commencement of data collection for this study, I immersed myself into in-depth interrogation of collected data on a daily basis to gain deep insights and an understanding of emerging issues from the data. I interrogated the data frequently to make careful interpretations that align with participants' intended views and meanings. Stewart, Gapp and Harwood (2017) argue that crystallization requires of the researcher to engage fully in a variety of ideas, assumptions and perceptions of participants in order to interpret and represent the data appropriately.

3.9 DELIMITATIONS AND LIMITATIONS

Like other studies, this qualitative study had limitations and delimitations (Beglar & Murray, 2009). The purposive sampling employed did not enable generalisation of the findings to the entire Basic Education teachers' population in Lesotho. The present study focused on three teachers in one district of the country which is urban. Some schools in other districts are in regions that are very difficult to reach and was expensive for the researcher to engage, due to limitations of time and funds. These schools from one district in Lesotho within my reach are not generally representative of the varying contexts across the districts. The targeted schools are in the vicinity of the town in which I work. They could easily be accessed within the stipulated period of data collection. However, to mitigate the limitations, the three schools were found in varying contexts of the target district. One school was in the city centre, the second school was about ten km from the city centre while the other school was about 50 km and in the remote part of the district. This enabled to get deep insights of varying contexts.

3.10 ETHICAL CONSIDERATIONS

In this study, ethical considerations applied throughout the research stages. I adhered to informed consent (Flick, 2014). The teachers and the principals participated in the study on a voluntary basis and could withdraw from the study at any time (Morrell & Carroll, 2010). The participants were further provided with a feedback report. Before I commenced with data collection for the study, I sought ethical clearance from the University of Free State (UFS, reference number: **UFS – HSD2019/0512/0106**). MoET also granted permission (Appendix F) to carry out research at primary schools in Lesotho. Application for the extension of data collection was also approved by the UFS and MoET for additional data collected in 2022. Moreover, participants signed consent forms and were provided with the necessary background information, introducing them to the study and offering them assurance on the protection of their identities while taking part in the study. They were assured that the information they provided would be used for the purpose of this study. Pseudonyms were therefore used for names of the teachers and the schools in the study.

3.11 SUMMARY

In this chapter, the qualitative methodology, the paradigm, research design, sampling techniques and instruments used in this study were discussed, as well as details of how data about teachers' ICT integration into their classroom practices were collected and would be analysed. The multi-case study enabled me as the researcher to gain an in-depth understanding and interpretations of how teachers integrate ICT into teaching and learning of science in the Lesotho basic education sector. Since this is a qualitative study on three cases of teachers, findings could not be generalised to all teachers in Lesotho. However, the findings from this study would contribute to the existing knowledge about ICT integration and current discourses about ICT integration in education. The study would also encourage other teachers to integrate ICT into their teaching and learning instructional practices. The next chapter presents the case by case analysis of data, and the content analysis of the policy framework guiding ICT integration into this study.

CHAPTER 4: DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.1 INTRODUCTION

Chapter 4 presents the primary evidence gathered from the primary schools of the three participant teachers in this study and its subsequent analysis and interpretation. Chapter 3 previously justified from literature, the qualitative approach to the study, the purposive sampling technique used, the data collection tools, the narrative and the content analysis employed in the study. The evidence is also discussed supported by relevant literature and quotes from interviews and lesson observations in order to provide thick description of the context of schools. Interviews of teachers and exit interview of principals, document analysis of relevant policy documents and classroom observations were used to generate data about Grade 6 - 7 teachers' classroom practices of ICT integration in science in Lesotho. Data about discourses informing Information and Communication Technology (ICT) integration were also gathered from policy documents and from the participants' expressions of how they cope with ICT integration in their respective schools.

Data are presented in two phases. Firstly, data are presented as case-by-case narratives demonstrating classroom practices of ICT integration of individual teachers in their schools' contexts. Discourses guiding ICT integration emerging from the policy framework are then presented. Data presentation commences with case-by-case narratives followed by policy framework, since the key focus of the study is on the teachers' classroom practices of ICT integration. The narratives present the practices. Data from the relevant policy documents are then used to present discourses that contribute to the teachers' ICT integration practices pointed out in the narratives. The emerging themes are then discussed in cross case data analysis in the next chapter, to establish similarities and differences between the three cases. To ensure anonymity of the three teachers and their schools, pseudonyms are used in all the narratives (and in the whole thesis).

4.2 DATA PRESENTATION

This section presents the data needed to answer the research questions upon which the study is grounded. The main question for the study is, "How do teachers integrate

ICT into the teaching of science and technology in basic education in Lesotho classrooms?" The section begins with the case by case data presentation of the three teachers' narratives with data relating to their classroom practices of ICT integration. Data from the narratives respond to the sub-question, "How do teachers across different school contexts in Lesotho practice the integration of ICTs into the teaching of science and technology in Grades 6 to 7? Data showing teachers' expressions relating to discourses that drive ICT integration at primary schools in Lesotho are presented in interview quotes provided as evidence in the narratives. The discourses documented in relevant policy documents are also presented in this section. Evidence from the teachers' views and the policy documents respond to the sub question; "What are the discourses that inform teachers ICT integration practices in Lesotho? The three participant teachers are coded Thupa, Lethu and Nasi, using pseudonyms in the narratives that follow. Their schools are coded Sentleng Primary School (PS), Leratong Primary School (PS) and Lebisang Primary School (PS), using pseudonyms.

4.2.1 The case of Thupa, the ICT-savvy teacher

> *I want to share my stories with other teachers so that they can be inspired as well.*

4.2.1.1 Introducing Thupa and the Sentleng Primary School classroom profile

Thupa, the participant teacher in this study, was the Science & Technology, and Arts & Entrepreneurship teacher for Grade 7 in 2019. In 2020 he taught Grade 6. The teacher has a Diploma in Primary Education, as indicated earlier in Table 3.1 from the Lesotho College of Education (LCE), the oldest teacher training institute in Lesotho. He has been a teacher at this school for about 15 years. Thupa started teaching as an unqualified teacher in 2005, where after he enrolled at the teacher training college where he was exposed to a variety of emerging pedagogies. During his teacher education, he acquired ICT pedagogy training at the School Technology Innovation Centre (STIC) within the teacher training institute. He has been using ICT integration in his classroom practices since 2011.

STIC was one of the projects the Government of Lesotho established to empower teachers with ICT pedagogy (Kalanda & De Villiers, 2013; Isaacs, 2007). Thupa is a beneficiary of this project. It was at the STIC where he was trained on the use of Microsoft tools and other digital tools that he uses. In addition, he mentioned during

the interview that he was exposed to the use of other such media as videography, voiceovers and storytelling using digital tools. Here is how he explained the exposure to these ICT tools:

> *I was introduced to different tools that I can employ in teaching. That ranged from Microsoft tools in general to other digital tools … We were trained on use of different media in the classroom to drive innovation. You can talk of videography, you can talk of voice overs, storytelling using digital tools. So that is basically what we were trained on.*

The examples of ICT tools Thupa are listed in this quote: Microsoft tools, videography, voice overs and possibility of using digital tools for story telling in instruction show that he had exposure to ICT pedagogy. The quote suggests that the teacher was exposed to a variety of tools and approaches for ICTs integration in instruction. However, he did not necessarily use these media in the observed lessons, due to some of the contextual limitations such as lack of ICT resources, electricity and Wi-Fi connectivity at the school, which he stated in the interview when asked how he copes with ICT integration. He had to shift and mobilise the use of available ICT tools such as mobile phones in his teaching practices. As the narrative from Thupa will show, he did not only rely on the ICT skills developed at the college during pre-service teacher education; he further advanced his teaching strategies by exploring collaborative opportunities with other schools locally and globally to keep up to date with the latest innovative ICT strategies. Furthermore, he committed himself to becoming a constant reader by signing up for online portals that support ICT integration. This is how he told the story,

> *There are online supporters that I signed in. That's where I went on learning about innovative means of using ICTs in teaching.*

The indication of learning through on-line, innovative means of using ICTs in instruction in this quote shows that Thupa continuously improved his ICT pedagogy. This was also evident when I observed him training teachers from other schools on how to sign up for the Microsoft Innovative Educator programme during a collaboration workshop. In one of the interviews, he emphasised that he wanted to share experiences of ICT integration with other teachers in order to motivate them to implement ICT integration effectively. That statement seemed to anchor and reflect on classroom practices and thoughts about ICT integration.

The Sentleng Primary School and classroom context

Sentleng Primary School (pseudonym) is a public primary school belonging to the Lesotho Evangelical Church in Southern Africa (LECSA), one of the main proprietors of primary and secondary schools in the country. The school is 50 km from the capital city of Maseru and is located in the rural region of Lesotho. The school adheres to the rules and regulations as determined by the MoET in the country. Learners from this school are taught using the same regulated ministry curriculum as the government-owned schools. There is no computer laboratory at the school. Moreover, as is typical of most rural schools in the country, the school has neither electricity nor any internet connectivity. The conditions at the school resonate with the findings in the literature which suggest that to date, many schools across developing countries are still challenged by the lack of ICT infrastructure (Gunes & Bahcivan, 2016). There are about 58 learners in the Grade 7 class at this school, which represents an average intake for each level from Grade 1 to Grade 7, with a total enrolment of about 350 learners.

The school relies on devices brought by learners from their homes for ICT integration. It was therefore not possible to observe the lessons twice a week, as was originally planned, as there would not be continuity with one group regarding the use of gadgets. Therefore, I only went to the school for classroom observations once a week over a period of four scattered weeks in 2019/2020, with additional data of two weeks in 2022. Another challenge was the inability to collect data in consecutive weeks due to several factors, such as events on the school calendar, teachers' strikes and the Covid-19 pandemic lockdown. Follow-up interviews were also held, with the last set of interviews done telephonically with the teacher and the principal due to the Covid-19 pandemic restrictions. Additional data were obtained during two follow-up classroom observations and interviews in two weeks of February/March 2022. This last data set gave valuable insights of how Thupa copes with ICT integration when the Wi-Fi router has a technical problem.

The next section narrates how Thupa initiated the use of mobile phones in the school through affordable means. The section further shows how he planned and introduced lessons to accommodate use of ICTs.

4.2.1.2 The teacher's ICT integration initial preparations

> *I would so wish to have them (learners) sit comfortably looking at the smart board. It would be so comfortable for them.*

Teacher Thupa, the 'Bring-your-Own-Device' initiator

Thupa, a teacher who is passionate about ICT integration in the teaching and learning of science in Basic Education in Lesotho, works at a primary school with significantly limited resources of ICT infrastructure. In one of the follow-up interviews after a lesson observation, he emphasised that he wished the school had a Smartboard, as that would enable the learners to work comfortably. Despite the circumstances prevailing at this school, supported by colleagues, the administration and the parents, the teacher facilitated the development of the school's ICT policy and the 'Bring-your-own-device' initiative. Parents support the school by buying smartphones for learners to use at school, when required. This is what the principal had to say in the interview, when emphasising how Thupa was the pillar of the initiative,

> *Through the guidance of Thupa, the school was able to start using mobile phones in classroom instruction. He assists the teachers and supports them in their lessons; not only teachers at this school; he also visits other schools and helps when he has a free period here.*

The indication in the quote that the schools started using mobile phones through the guidance of Thupa and that he also assists other teachers shows that Thupa is committed to initiating ICT integration in the context of different schools. The commitment was evident even in Thupa's interview where he said:

> *In the first place it was difficult, I was the only one who was passionate. So, I had to instil the love of digital technology in other teachers. It was difficult at first.*

The extract affirms that after learning how to use ICTs in instruction, Thupa was the only one using it at the school. The indication in the quote that he was the only one passionate about use of ICT tools and had to instil the love of digital technology amongst other teachers shows that when he realised that he needed the support of others to succeed in using ICTs at his school, he strategized and trained colleagues. He indicated from there on that many started using ICTs in their classroom practices. This is how he expressed his satisfaction with how the implementation had taken off at his school:

> *But I think I am glad that lately, almost everybody is into it, so we kind of like help each other, in as much as we use 'your own device approach in employing*

> *ICT in education, I see most teachers helping with their devices. So, in that case they do support the whole initiative.*

The use of the phrase, "*I am glad that lately, almost everybody is into it, so we kind of like help each other*", in the extract shows that teachers in this school are collaborating and supporting one another on use of ICTs in classroom practices. The teachers' collaboration effort was realised in a lesson when one of the teachers joined in and worked with learners to access the required information as demonstrated in Figure 4.1.

FIGURE 4.1: TEACHER JOINING THUPA'S LESSON FOR SUPPORT

Figure 4.1 shows the visiting colleague working collaboratively with some learners using her own mobile phone to support Thupa as he presented the lesson. In another instance another teacher also lent him the mini projector to present his lesson. Thupa stated:

> *I do bring my Wi-Fi router too, for the connectivity, and one teacher has a projector, and we use the projector to display whatever we displayed from the searches or browsing. So basically, that's how we go about it.*

The use of the phrase, "*one teacher has a projector and we use the projector to display whatever we displayed from the searches*" in this extract reflects Thupa's ability to collaborate with other colleagues in facilitating ICT-oriented instruction. This is advocated by Fu (2013), who emphasises collaboration and sharing of ideas as some of the benefits of using ICTs in learning and teaching. As such, ICT integration does seem to motivate the development of 21st-century skills, such as collaboration.

Available digital tools

As discussed earlier, the school does not have ICT equipment of its own, but through the 'Bring-your-own-device' initiative, learners bring mobile phones, tablets, cameras and/or laptops from home. Teachers' mobile phones, Wi-Fi routers and mini-projectors

are also used to support the initiative. Teachers lent learners their own personal mobile phones for the ICT-integrated lessons on a voluntary basis, as not all learners would manage to bring their own devices along. Over and above, parents were involved in the implementation of the initiative. The majority of the parents do support the initiative, thus making work light for the teachers. Most parents allow learners to take their mobile phones, tablets and sometimes laptops to school. On the days when learners are asked to bring electronic devices to school, in the morning, when they arrive at school, their devices are placed on the teachers' desk as shown in Figure 4.2.

FIGURE 4.2: MOBILE PHONES BROUGHT TO SCHOOL BY LEARNERS

The ICT devices in Figure 4.2 show that learners bring the mobile phones and adapters for ICT integrated lessons. I was particularly interested in understanding how the school managed to win the parents' support for the initiative. The principal explained the parental support as follows:

> *Re sebelisa Mobile phones tsa bana le batsoali. Re ba joetsa feela bana hore batle le tsona. Bana ba sebelisa liphone tseo tsa bona tse bohlale ka thuso ea batsoali. Lekala le ne le ile la re eletsa hore re hle re bue le batsoali ho re supporter curriculumong ena e ncha. hore re kope batsoali ba batlele bana liphone li tla hlokahala, tse bohlale. Kannete batsoali ba re supporter haholo. Bana ba sebelisa liphone tseo tsa bona tse bohlale ka thuso ea batsoali.*
>
> *(We use mobile phones of learners and parents. We just tell learners to bring them along when they are required. They use smart phones. The MoET had advised us to sensitise parents that learners are going to use mobile phones in*

the new curriculum. Parents are largely supporting us. Learners are indeed using smart phones with the support of parents.)

The phrase, "*Parents are largely supporting us. Learners are indeed using smartphones with the support of parents*" in the extract shows that parents are supportive of ICT integration in classroom practices at this school. Sometimes the administration supports Thupa with data, although most of the time he uses his own data. The administration also wired the office so that they could have electricity. Unfortunately, it is an expensive exercise for them as the learners do not pay school fees. Consequently, the school does not yet have electricity. The parental support was also evident in additional classroom observations in 2022 when parents volunteered to buy data for learners when the teacher's router had a technical problem. This further provides evidence that the community was most likely involved in the development of the school-based ICT policy, which required their buy-in. This is stressed by Pombo *et al.* (2017), who postulate that effective use of ICTs in instruction somewhat encourages parental involvement. Involving parents in plans of ICT integration could benefit basic education schools especially those that are still struggling to get started in using ICTs.

Incorporating ICT into lesson planning

Figure 4.3 is an extract of the first part of the lesson plans of three of the observed four lessons in 2019/2020 showing the objectives of the lessons and the resources including mobile phones for these lessons.

Thupa's Lesson Plans		
Date: 31/10/2019 **(Grade 7)** **Class Size: 48**	**Date: 14/11/2019** **(Grade 7)** **Class Size: 48**	**Date: 13/02/2020** **(Grade 6) Class Size: 61**
LO		
LO 2: Factors affecting agriculture	**LO 17**: Classify organisms into viruses, bacteria, and fungi	**LO 30:** Describe Cholera and its treatment
Objectives: By the end of the lesson, learners should have begun to:		
i) List the factors that affect agriculture ii) Investigate the effects of the aforementioned factors on plant growth.	i) Classify organisms into viruses, bacteria, and fungi. ii) List characteristics of aforementioned organisms. iii) Compare structure of bacteria, fungi and viruses.	i) Name causes of cholera ii) Its signs and symptoms iii) Its treatment and preventions
Materials		
Pictures, videos, mobile phones, internet, exercise books.	Pictures, videos, mobile phones, internet, exercise book.	Mobile phones, projector
Methods		
Discussion, Socratic, Grouping, Brainstorming.	Grouping, Discussion, Socratic.	Discussion, investigation, question and answer, and grouping.

FIGURE 4.3: THUPA'S LESSON PLANS COMPARISON

Figure 4.3 stated the materials for these lessons as "pictures, videos, mobile phones and internet" shows that learners would be using ICTs in instruction. The methods in Figure 4.3 stated as, "*discussion and grouping*" across the three lessons further indicate that Thupa preferred using groupwork and discussions. The two methods were apparent in the observed lessons as indicated in the lesson plans. Figure 4.4 further shows an extract of the lesson plans highlighting teacher and learners' activities.

PLANNED ICT INTEGRATION ACTIVITIES		
Lesson 1	**Lesson 2**	**Lesson 3**
LO 2: Factors affecting agriculture	**LO 17**: Classify organisms into viruses, bacteria, and fungi	**LO 30:** Describe Cholera and its treatment
Teacher (T): Allows learners to google images and information about factors they mentioned. **Learner (L)s**: Google images and information and safe images for future use. **T**: Allow learners to share their findings and share saved pictures in the laptop. As learners present the findings, develop picture slide for each factor. Play the pictures slides from all groups and summarise the factors **L:** In groups, they present the findings according to each factor assigned to the group.	**T:** In groups, allows learners to google definitions of virus, bacteria and fungi. **L:** They google definitions of virus, bacteria and fungi. **T:** In groups, allow them to search for characteristics of virus, fungi and bacteria and also compare their structures. **L:** They search for the characteristics of organisms and compare their structures. **T:** Let each group to present their findings and share saved videos in his phone. **L:** In groups they present their findings according to topic given. **T:** Play the picture slides and videos and do survey. **L:** They watch and comment.	**T**: Helps students to google causes of cholera. **L**: They google the causes of cholera. **T**: Help students to search images of bacteria, signs and symptoms of cholera. **L**: They search for images, saving them. They also search for signs and symptoms taking notes. **T**: Instruct learners to search for treatment of cholera. **L**: They search for cholera treatment and take notes.
KEY: ICT using activities T: Teacher L(s): Learner(s) LO: Learning Outcome		

FIGURE 4.4: SNAPSHOT OF THUPA'S LESSON PLAN ACTIVITIES

The activities in Figure 4.4 stated as, "*google images and information, play picture slides and videos from all groups, share saved videos*" required of learners to use available mobile phones to gather educational information and share it. Even though the lesson plans were only written briefly, Figure 4.4 shows that Thupa incorporates the aspect of ICT in the planning of the instruction. The teacher and learners' activities indicate how the teacher would introduce the learners to ICT during the classroom instruction.

Initial Introduction phase

Before observing the lessons, I undertook the pre-observation interview with Thupa in order to have a picture of discourses he has about ICT integration and how he viewed his own practices of use of ICTs in a science and technology instruction and how he

thought the Policy Framework documents supported him on the use of ICTs in classroom practices.

At the beginning of the lessons, teacher Thupa specifies the learning intentions. He writes the topic for the day and as learners raise issues during the introductory part of the lesson, he writes them on the board for later reference. He starts the lessons by ensuring that learners have formed groups in such a way that all will have access to mobile phones, constructing a culture of a sharing spirit among the learners. He introduces the observed lessons with inquiry questions that probe learners to reveal what they know and think about the topic of the day.

Starting with samples of introductions of lessons in Thupa's classroom practices of ICT integration, two lessons were presented in a double period on a Thursday morning of last week of October 2019 and mid-November 2019 to a class of 48 Grade 7 learners consisting of 28 girls and 20 boys. The third lesson was presented to 61 Grade 6 learners in Mid-February of 2020 to a class of 61 learners consisting of 22 boys and 39 girls. This was due to the fact that the teacher had been allocated a different Grade in 2020. The observed lessons in the 2022 follow-up classroom observations in Grade 6 revealed a turnover of events on number of boys and girls in the classes. Grade 6 class of 57 learners had 26 girls and 31 boys. After introducing each lesson through the question-and-answer session, Thupa directed learners to their assigned group task for browsing and presenting the collected information. Lesson Segment 1 shows the teacher directed introduction that took place in the three of the four observed lessons in 2019 and 2020 on factors affecting agriculture, Classifying organisms into viruses, bacteria, and fungi and the Cholera disease.

LESSONS' INTRODUCTION		
Date: 31/10/2019	**Date: 14/11/2019**	**Date: 13/02/2020**
Lesson 1: LO 2	Lesson 2: LO 17	Lesson 3: LO 30
INTRODUCTION		
Teacher (T): Place the phones upside down on your tables, not under the desk, on your tables. (*He Checks the spread of the cell phones and rearrange the learners to allow for even distribution.)* T: So, we need to sort out those who have the mobile phones and those who do not so that when the time arrives for using them, we can share. So, can I see the hands of those who brought theirs? Ok, for now I want us to have a very short discussion about the factors that affect agriculture. Factors that affect agriculture (he repeats) And, this is what we are going to do. We will for a short time, ehhh discuss about it. And we are then going to break into groups and in those groups we will be investigating or searching for information on all those factors. This means one group will look at one factor and google about it. And during that google search, pictures will be saved.	T: Place your mobile phone on the table. Everybody put your phone on the desk, and then we look at the classifications of the organisms (*He writes it on the board and continues*). So, under the classification of organisms, we have to know (*disrupted by observing learners with many phones in one group*). T: You can't be four there. We just have to make sure that we work with phones at least three people on one phone that will be ok. So we are looking at the classes of organisms or the types as we are given and then we will have to look at specifically one classification and under that classification there are three items that you will focus on.	Teacher (T): Good morning. Let's have the very same groups that we were using while we were drawing our art things, right? Learners (Ls): Yes sir. T: In each group there is going to be a chart which we are going to put every information we find. So now if you have a phone come and get it. *(Learners are rushing to a teacher's desk, and they are taking their cell phones.)* T: one person from each group should come and get the chart. *(Learners are taking charts)* So as a group, you are going to choose at least two or three people just to share the information, so very quickly let us look at the causes of cholera.
KEY: Group work emphasis Assigning different tasks Indication of Mobile phones T: Teacher Ls: Learners		

LESSON SEGMENT (THUPA) 1: THUPA INTRODUCING LESSONS

Phrases such as, "*in those groups we will be investigating or searching for information, we work with phones at least three people on one phone, one person from each group should come and get a chart*" in Lesson Segment 1 show that the teacher preferred use of groupwork in ICT integrated lessons. Phrases such as, "*place the phone upside down on your table, put your phone on the desk, now if you have a phone come and get it*" across the three lessons show that the ICT device used is the mobile phone, as highlighted in grey in the introduction of lessons in the three lessons. Additionally, phrases such as, "*one group will look at one factor and google it, we are looking at the classes of organisms or the types as we are given*" show that assigning different tasks to groups was a similar pattern for the observed lessons as highlighted also in Lesson Segment 1.

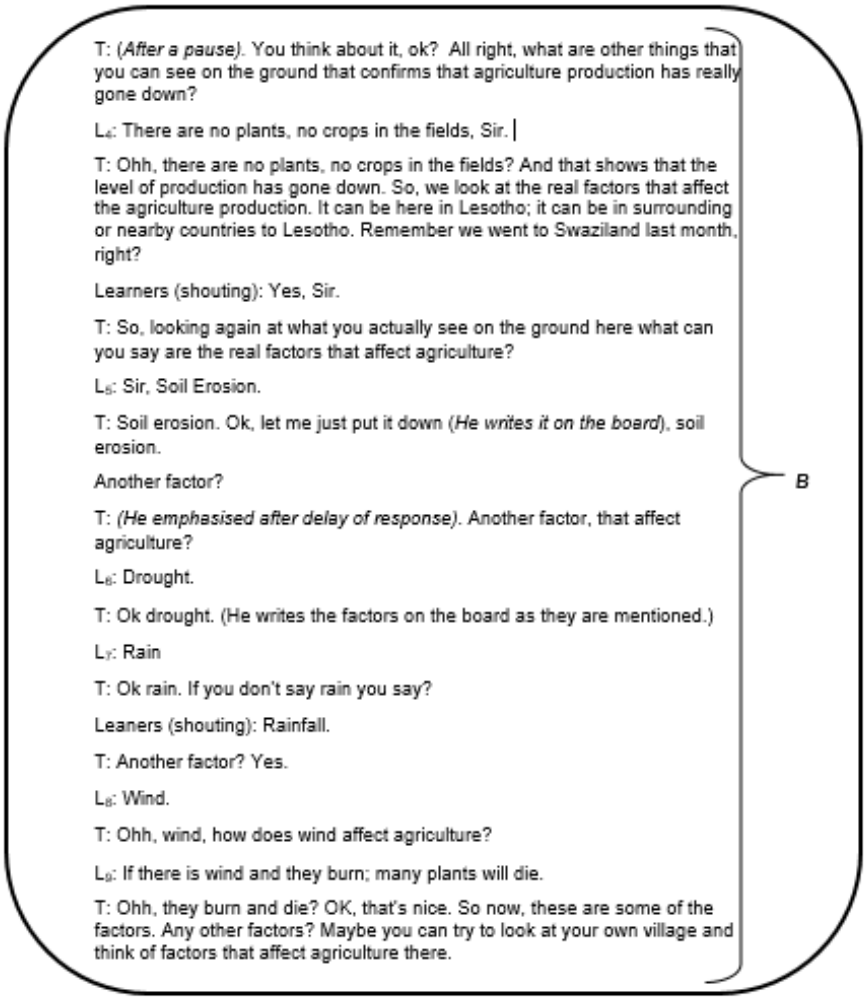
The lessons continued as highlighted in Lesson Segment 2 to reflect the Teacher-learner interaction.

LESSONS' CONTINUATION		
Lesson 1 continuation	Lesson 2 continuation	*Lesson 3 continuation*
That means you will go to that option of images and then you save the pictures and after saving the pictures, one of you in the group will be writing a summary of what you have found, what you have investigated about that factor. And those pictures will be shared with me. Right? So the main issue is one of you in the groups will come and present about all your findings when you google. And those pictures will later be displayed for all on the main board. So we have got a mini projector here and we will be sharing all those pictures on the board and so we will be summarizing, we will get to see what other people found, ok? So now, looking at the conditions outside here do you think agriculture is in a way that it should be? Learners (Ls): No (*shouting*) T: Why do you think so?	So, can you briefly remind me the classes of organisms, how are things classified? How are things classified (*He repeats)?* Can someone have an idea of classification of things, classification of things (*he repeats*)? In fact, there are two classes only, two classes under classification of things. (*There is silence for a moment and eventually one or two raises hands to try*) T: just give it a try. *(He just called one student to give it a try.)* L1: sir, (*indicating with expression that she is not sure)* Classification of things? L2: (*pointed having raised up the hand*): classes of beverages. T: beverages? Ok anybody else? ok now, we have two classes, living things and non-living things, as simple as that, living things and non-living things, so let's focus on living things, how many classes do living things have, can you just give me the one that comes in mind, classes of living things, how are they classified, there are two classes of living things they are?	We look at the causes of cholera, right? But before that, let me ask, what makes a person to get diarrhoea, you know what is diarrhoea right? *(Learners are raising hands shouting "yes, sir" and he points at a learner).* L1: Dirty water T: Dirty water? Tell me what dirty water does. How does dirty water get into somebody's body and how does dirty water cause diarrhoea? (*He repeats*). Ok think about it. L2: Sir, I think the disease gets into the water. T: What do other people think? Which are the causes of diarrhoea? How does one get diarrhoea, some said dirty water, the other cause? The other way in which a person can get a diarrhoea, only dirty water? L3: Sir, I think if we drink dirty water we can get it. T: If you drink dirty water, so the main idea is drinking dirty water, am I right? When you drink dirty water you are sure to get diarrhoea, so another person, what is in dirty water that causes diarrhoea? L4: It is a virus T: Ok he says it is virus, what do you say? *(Teacher picks another hand).* L5: Sir, it is germs. T: Germs? Ok. So now we are going to get on our phones to help us more to find what exactly is in the water because now our understanding is that dirty water is the main cause of diarrhoea and as we will see as we go on, diarrhoea is one sign that you are having cholera.
KEY: ICT Resources using activities Probing Introductory questions Challenging probing questions		T: Teacher L(s): Learner(s)

LESSON SEGMENT (THUPA) 2: TEACHER-LEARNERS' INTERACTIONS

It is worth noting from the extracts in Lesson Segment 2 that phrases such as, "*looking at the conditions outside, do you think agriculture is in a way that it should be? how many classes do living things have? and what makes a person to get diarrhoea?*" show that Thupa started lessons with questions requiring simple general knowledge to

trigger learners to think about ideas raised in the discussions. Phrases such as, "*Why do you think so? How does dirty water cause diarrhoea?*" and all highlighted similarly in Lesson Segment 2 show that Thupa also asked questions which demanded learners to think deeply about the topic under discussion. The discussion went on with Thupa making an effort to narrow down the ideas to learners' specific environment such as village and country, to make information more meaningful. For instance, Lesson Segment 3 shows how the teacher-learners' interaction continued before browsing after learners attempted to identify physical features that show that agricultural production has gone down.



T: (*After a pause)*. You think about it, ok? All right, what are other things that you can see on the ground that confirms that agriculture production has really gone down?

L_4: There are no plants, no crops in the fields, Sir.

T: Ohh, there are no plants, no crops in the fields? And that shows that the level of production has gone down. So, we look at the real factors that affect the agriculture production. It can be here in Lesotho; it can be in surrounding or nearby countries to Lesotho. Remember we went to Swaziland last month, right?

Learners (shouting): Yes, Sir.

T: So, looking again at what you actually see on the ground here what can you say are the real factors that affect agriculture?

L_5: Sir, Soil Erosion.

T: Soil erosion. Ok, let me just put it down (*He writes it on the board*), soil erosion.

Another factor?

T: *(He emphasised after delay of response)*. Another factor, that affect agriculture?

L_6: Drought.

T: Ok drought. (He writes the factors on the board as they are mentioned.)

L_7: Rain

T: Ok rain. If you don't say rain you say?

Leaners (shouting): Rainfall.

T: Another factor? Yes.

L_8: Wind.

T: Ohh, wind, how does wind affect agriculture?

L_9: If there is wind and they burn; many plants will die.

T: Ohh, they burn and die? OK, that's nice. So now, these are some of the factors. Any other factors? Maybe you can try to look at your own village and think of factors that affect agriculture there.

B

Key:

***B*: Thupa directing learner's thoughts to their specific environment, including own villages.**

LESSON SEGMENT (THUPA) 3:TEACHER-LEARNERS' CONVERSATION ON THEIR CONTEXT

Phrases in Lesson Segment 3 such as, "*factors that affect the agriculture production, it can be here in Lesotho, it can be in surrounding or nearby countries, may be you*

can try to look at your own village and think of factors that affect agriculture there" highlight Thupa's attempt to bring learner's ideas closer to their context, encouraging them to think of the factors that affect them directly in their villages. This shows that the teacher helped learners understand concepts using what is readily available in their environment. He then let the learners browse to get relevant information from the internet and encouraged them use cheaper means of sharing information, for instance, the use of Bluetooth instead of SHAREit that requires internet connectivity.

However, the analysis of the three lessons introductions shows that Thupa did much talking and learners only gave short phrases with responses. This is probably because of the types of questions asked in most cases, which were demanding short answers. This is what the majority of teachers struggle with as they attempt to shift to learner-centred teaching approach. Even though Thupa had good intentions of probing the learners, he could have done more to enable them express themselves to reveal the depth of prerequisite knowledge on the concepts taught. The next section shows how the ICTs were used in the development of the lesson after introduction.

4.2.1.3 Using ICT in instructional practices

Data on how Thupa uses ICT in classroom practices were collected over four scattered weeks of fieldwork from 2019 to 2020. The data were obtained from document analysis of related policy framework documents and lesson plans, four lessons I observed him teaching, the collaboration workshop with the local teachers, the skype lesson with an International school in the USA that I also observed, the initial pre-observation interview and the follow-up interviews after every lesson observed. Additional data were collected from two follow-up classroom observations and follow-up interviews after each lesson in 2022. The school relies on the 'Bring-your-own-device' strategy for engaging in ICT integration. Learners bring predominantly mobile phones which are used for browsing text, pictures and video format information for learning and teaching while the teacher brought the Wi-Fi router for internet connectivity. I observed that the students were excited when browsing and they frequently confirmed with Thupa whether they had found relevant information.

Learners predominantly worked in groups of about three to five learners in all observed lessons in order to share the available mobile phones as not all learners were managing to bring them to school. Each group presented the text and pictures

collected during browsing over the class discussion guided by probing questions from Thupa. However, I observed that some learners were shy to make presentations standing in front of other learners. Moreover, even though the teacher gave the chance to other groups to ask the presenting group, not many questions were raised in the lessons I observed. However, the teacher encouraged the learners to build confidence. Lesson Segment 4 shows how learners started using the mobile phones as the three lessons continue.

USING THE MOBILE PHONES IN CLASSROOM PRACTICES		
Date: 31/10/2019	**Date: 14/11/2019**	**Date: 13/02/2020**
Lesson 1: LO 2	**Lesson 2: LO 17**	**Grade 6: LO 30**
ICT INTEGRATION ACTIVITIES		
T: This is how we are going to work. We will need our Phones, right, … other people will be searching on the internet, and you will be summarizing, …, just summarise one of the factors that I am going to assign to you. And after that, we go to the pictures, the images and you save them. Those images are going to be shared using the mini projector and they will be displayed on the board. Remember to choose only one person who will present for the group. … T: Let me connect the Wi-Fi router first. *(The learners start connecting the phones to internet as the teacher checks that the Wi-Fi router is connected. He assigns the factors to different groups).* T: So now, this group over here, I don't know how you can come together. You will be looking at soil erosion. You search how soil erosion affects agriculture, right? L: Sir what did you say we search? T: Google scholar. Let me connect first and then I will tell you when it is ready, And this group over here will look into draught. Are you okay? And this group, you here, you look at wind. And you, right here you investigate how rainfall affects agriculture. And over here humidity.	T: Nice, so the internet is on. I hope you will just catch it up if you are using the same phone as in the last session *(Students are connecting phones Teacher writes the password on the board).* T: These two groups I want you to download four videos that show how a fungus looks like, how bacteria looks like and how a virus looks like. Explain all definitions typing, the characteristics, how they look like and where they are found. *(Teacher points at a group):* *T:* This group, you are looking for a virus, … what is virus, everything about virus. Where is it found? How does it look like? *T:(Teacher points at another group): And* here you will be talking about bacteria Another group will be talking about fungus. *(He Points at another group) And then* here I want you to look at the videos. Are you connected? So for the videos we are working on videos right for this two groups. We download them using google not YouTube. You go straight to google and then you search and pick up a video.	T: And then Wi-Fi, yah? And then make sure the Wi-Fi is on. *(Learners are connecting phones to the internet, they are helping each other).* L(s): The Wi-Fi is on (*some shouting*) T: (*the teacher guidance continues to assist all learners get connected to Wi-Fi)* Then tap on it and then you type in the password So it has to say connected. T: Phones face down and then you look at me. So today we look at the first infectious disease that we are going to look at. The phones are going to help us get a lot of information from the internet. So we are going to look at cholera, so the phones are going to help us to find more information on cholera, and the information that we are going to have … jot down the information and then also, … as we see the pictures we try to draw those diagrams or the pictures on the charts right? L(s): Yes sir T: So I want to see your artistic juices running, so you need to draw, and then write some short notes. And after that, one or two people have to come to the front and present your information that you got and present it to the rest of the class. So as a group, you are going to choose … people just to share the information, so very quickly let us look at the causes of cholera. … what makes a person to get diarrhoea, you know what is diarrhoea right?
KEY: Mentioned ICT Using Activities — T: Teacher Allocating different group activities — L(s): Learner(s)		

LESSON SEGMENT (THUPA) 4: DEMONSTRATION OF ICT INTEGRATION PRACTICES

Phrases such as, "*we will need our phones, go to the pictures, images and safe them, Wi-Fi rooter is connected, download four videos, go to the pictures and then as we see the pictures we try to draw*" in Lesson Segment 4 shows that learners used the internet to browse educational information using the mobile phones. Phrases such as, "*this group over here you will be looking at soil erosion, these two groups I want you to download four videos, and here you will be looking at Bacteria, as a group you are going to choose at least two or three people to share information*" show that each group of learners was allocated different concepts or ideas to search for. However, in the case of the Grade 6 lesson in 2020, the learners were guided more on the use of mobile phones for browsing, as they brought the mobile phones for the first time to school and groups were given a similar task. The lessons continued with Thupa moving from one group to another to monitor progress and ensure that learners are browsing the required educational information. For instance, Lesson Segment 5 shows how Thupa guided the learners in the lesson about factors affecting agriculture. The guidance was more or less the same, even in the other observed lessons.

Some have succeeded some are still trying. Some learners type in text as they search. Some use voice recognition search. E.g. in one of the groups a learner shouts to the phone, "How does soil erosion affect agriculture?"
In another group, "How does humidity affect agriculture production?"

General observation: Learners so enthusiastic about the exercise. Conversation in each group agreeing on what to do or what is being found could generally be heard, however they were not loud enough for the researcher to capture the words. This was the first observation. However, some were freely shouting.

As they found the information, they were all excited and shouting to teacher to come and witness that they have found the information. Patiently the teacher tried to reach each and every group. Some asking for help while others just wanting sir to verify that they have found the relevant information.

T: So, these are your results? You are searching about how draught affects agriculture. So, you can just click on this one and then, open this picture. It is coming.

T: *(then shouts to the whole class):* Make sure that you save your pictures. So, this is how you go about it. You tap on the picture, it will show in the big screen, right. Then you long press the picture, it will give you an option of save.

They start calling sir from different angles. He then attended them together by saying:

T: Ok, let me say this, this will help everybody, *(He sits on a student desk nearby where he was).* After searching, you will see those blue or purple texts. Those are search results. So, you just click on them. And then the whole page will open up and you will get the information. Haele putsoa joalo feela, ha u so qete (*when it's just blue you are not there yet*). So, make sure that you open that blue thing, tap it. Make sure that you save those pictures because we are going to need them.

The teacher further moves around to attend the learners as they call him for help.
A group exploring searching using voice recognition, a learner shouts: "How does humidity affect agriculture". They take turns shouting. More and more excitement across the classroom as they find the results. They call sir from different angles. Patiently sir attends them one group after the other.

LESSON SEGMENT (THUPA) 5: THUPA GUIDING LEARNERS BROWSING

The phases in Lesson Segment 5 such as, "How does soil erosion affect agriculture? How does humidity affect agriculture production?" indicate when learners also used the voice recognition search mode for browsing their respective tasks. Learners also called him from different groups when they required assistance. Phrases such as, "*they were all excited and shouting to teacher to come and witness that they have found the information, they start calling sir from different angles*" in this lesson segment show that some groups frequently consulted Thupa to affirm that they had found the relevant information. I could realise that Thupa was overwhelmed attending to all groups in these large-size classrooms. This suggests that he needs assistance to

handle the large class in the ICT integration lesson. It can also be realised that phrases such as, "*These are your results, click on this one, open this picture, make sure that you safe your pictures, tap on the picture*" repeatedly, show that Thupa guides the learners and monitor progress to ensure effective use of the mobile phones. One learner asked if he could share pictures by SHAREit. He said,

> *No, no, no, Bluetooth. I don't use SHAREit. I am Mobicel Berry.*

The phrase, "*no, Bluetooth*" and the joke which learners enjoyed and laughed, "*I am Mobicel Berry*", show that Thupa encouraged the use of cheaper means of sharing pictures such as Bluetooth in the science and technology instruction. The pictures were then sent to one of the learners through Bluetooth to get them ready for projection. The lessons quoted continued and groups made presentations as highlighted below.

Groups' presentations

During group presentation, two representatives for each group moved to the front of the class to deliver the presentation. Some learners were confident, while some were a bit shy and not raising voices enough. When presentations were not completed, they were continued in the next lesson. The teacher encouraged them to speak louder and in some cases read the information from the charts to the class to clarify some points. The teacher also intervened where words could not be pronounced appropriately, assisting learners to pronounce them accordingly. Lesson Segment 6 demonstrate how the groups started presentations in each lesson.

GROUP PRESENTATIONS		
Lesson 1	**Lesson 2**	**Lesson 3**
T: Hey, let's sit down and pay attention. Bring those pictures. (*He sits next to the student who is uploading the pictures*). **Group 1** presentation: How does rainfall affect agriculture? Precipitation especially rainfall has a dramatic effect on agriculture. While a regular rain pattern is usually better to many plants. Too much or too little rainfall can be harmful, even devastating to crops. Draught can kill crops and can increase erosion. While overheat wet weather can cause harmful fungus fall. (*The presenters steps down. The teacher asks*) T: Your topic was draught or rainfall? L: Rainfall T: Rainfall, Aright. We have seen the connection of soil erosion and rainfall as to how they affect agriculture, in the previous presentations. So, Can I get more pictures as the group over there presents.	T: Don't share too many picture just share at least five, as we are saving pictures giving them to him (*called by name*). Can we have this group to present? (*Teacher preparing the stand for the projector getting ready for projecting pictures*). T: let's pay attention to this, ok, let's focus on a group presenting. **Group 1:** (presenting)**:** *Organisms*: virus are found on or all around us. They are found in matter and environment … (NB: *The presenters were not loud enough to be captured fully).* T: Ok let's have another group. *Let's* give them a round of applause. Make sure that you speak aloud. *(Learners are clapping hands)* **Group 2:** (presenting): Bacteria are a type of biological cells. They constitute the large group of prokaryotic Microorganisms. They are micro phobic single celled organisms that occupy the environment. *(However the groups were not loud enough. The teacher kept on encouraging them to speak louder as they present)* *Learners are clapping hands*	T: Listen, let's hear what they have for us (*Referring to the group ready for presentation in front of the class*). Ok read what you have found for us. Ok let's listen, (*they keep quite)*. Read aloud. **Group 1** (*presenting*): What is cholera? Cholera is an infectious disease that causes death and severe watery diarrhoea, which can lead to dehydration (*the teacher intervenes helping with proper pronunciation of words*). Dehydration and even death can happen. It is caused by eating food or drinking water contaminated with a bacteria called **Vibrio cholera.** Treatment of cholera: the most important of therapy consists of correction water and electrolyte imbalance to correct severe dehydration and salt sanitation, and antibiotics. T: (*pointing at the group's information on the chart*): The group has the information that cholera is an infectious disease, this is important to note, I want everybody to pay attention and look at the board. It is an infectious disease and that simply means it can be passed from one person to another, alright? L(s): Yes sir. T: (reading *and highlighting the point from learners' chart on the board*) Severe watery diarrhoea which can lead to dehydration and even death is secondary from cholera if untreated. It is caused by eating food or drinking water contaminated with bacteria. So what causes cholera? (*Asking the class*). What causes cholera? Talk to me. Give it a try. L: Dirty water T: Dirty water? And what else?
KEY: ICT Resources using activities — T: Teacher Showing Teacher talk — L: Learner Showing Learners presenting browsed information		

LESSON SEGMENT (THUPA) 6: GROUP PRESENTATIONS IN ICT-ORIENTED INSTRUCTIONS

Phrases such as, "*Can I get more pictures as the group over there presents, let's have another group, let's focus on a group presenting, let's hear what they have for us*" in Lesson Segment 6 show that the learners in Thupa's lessons do groupwork when using mobile phones, which leads to sharing of information monitored effectively to encourage collaboration among the learners, as collaboration is one of the key pillars of 21st-century skills development. The global collaboration was observed in the Skype lesson between Thupa's class and an international school in the United States of

America. Group work is a teaching strategy that works for Thupa with the limited number of mobile phones that need to be accessed by every learner, as not all learners can afford to bring mobile phones to school. Some parents could not afford them at this school.

I also observed that during group presentations, Mr Thupa carefully spotted the areas that required his intervention and after each presentation he would fill the gaps where learners were not clear about what they presented. However, he did that strategically and patiently, encouraging the learners.

Moreover, as learners worked in groups, even when presenting the information to the whole class, the teacher carefully assessed learners' achieved skills and strategized how to use the learners' acquired skills to benefit the whole group in subsequent lessons. I wanted to know in the follow-up interview how he assessed the learners' acquired skills in the previous lesson. Thupa elaborated,

> *I will be assessing the presentation skills, I will be assessing the, you know, how they put up their presentation comprehensively. I will be assessing how their communication skills and teamwork goes. I will be assessing how they are able to interact amongst each other. I will also be assessing the … you know, how other learners understand what they are presenting about.*

Thus, the phases such as, "*assessing the presentation skills, communication skills and teamwork, how they are able to interact*" in the extract show that Thupa assesses the learners' 21st-century skills, as recommended by global education. From the interviews, it was clear that Thupa could probably do much more with ICT integration if he were placed at a school that is better equipped with ICTs. His efforts to remain up to date with emerging technologies could largely influence ICT integration in the country. However, Thupa is limited by the contextual challenges such as lack of the school's ICT resources, Wi-Fi and electricity to use acquired ICT pedagogy skills to maximum.

From the teacher training institution and from the online forums where he voluntarily underwent professional development on ICT integration, Thupa was exposed to the use of different ICT tools, including the Smartboard. However, barriers to ICT integration in his school largely affect his choice of instruction strategies. Thus, Thupa was not discouraged; he realised that in his context, mobile phones were the option to use, and he planned an action strategy to get learners to use mobile phones in the science instruction. His passion for using ICT has contributed to learners' positive

attitude towards the learning of science. This was evident in their excitement when using mobile phones to access text, pictures and YouTube videos about concepts under study.

It was interesting to realise how Thupa would professionally clarify points without discouraging learners (**Lesson Segment 6, lessons 2 & 3**) when they struggled to express themselves clearly. He would ask probing questions and eventually agree on the required explanation of facts after letting them explore the internet first before drawing conclusions. He narrowed their search by providing keywords or questions. Thupa also advised the learners to use Google Scholar to get accredited information and use the Make-me-Genius site for accessing educational videos relevant to their level of learning. Learners were also advised on how to use the internet in a safe space and how to access relevant information in the observed lessons. He warned them about threats and distractions while browsing the internet. This is what he said in one of the lessons,

> *We are seeing something here. Sometimes when you search for information or picture, there is this thing called pop ups. Something just comes up on the screen about for instance something you can buy or whatever. Something not relevant to what you are looking for. Just cancel that, OK?*

Phrases in the extract, "*there is this thing called pop ups, just comes up on the screen, something not relevant, just cancel tha*t", show that Thupa cautioned learners to be careful when in the internet space. This suggests that it is necessary for teachers to be familiar with these technical distractions to guide learners effectively in ICT-oriented instructions.

Teaching approaches Thupa is comfortable with

It was revealed in the interview that Thupa believes in employing inquiry-based teaching and project-based teaching approaches. This is advocated by the body of literature that emphasises the need for learners to be exposed to inquiry-based teaching to achieve 21st-century skills (Guzey & Roehrig, 2009; Ghavifekr & Rosdy, 2015). Thupa emphasised that the two approaches comfortably catered for learners' different ways of acquiring information. However, in the observed lessons only inquiry was evident. A brief impression of how Thupa used the method of inquiry in the introduction of lessons is indicated in the subsequent paragraphs.

In the lesson about the classification of organisms, this is what he said as he continued with the introduction probing learners to think about where they could find microorganisms,

> *Have you ever seen that thing that grows on food, which is rotten, what do we call it in Sesotho?*

The phrase, “seen that thing that grows on food, which is rotten” in this quote shows that Thupa used practical examples in this lesson. Learners quickly responded that it was called *hlobo* (fungus). Next, he continued and tested their level of knowledge about *hlobo* by asking them,

> *We call it hlobo (fungus) right! And we are going to learn how that organism forms, have you ever asked yourself where it comes from because when food is fresh, we don’t see it but then after some time, maybe when the food is left on high temperature for a long time and then we are going to see it growing, where does it come from, does it mean even on fresh food we still have fungus.*

The phrase in the extract, “*have you ever asked yourself where it comes from, does it mean even on fresh food we still have fungus*” shows that Thupa attempted to use what learners experience in everyday life to appreciate presence of micro-organisms: Talking about *hlobo* (fungus) brought micro-organisms closer to what they experience in everyday practices and that helped them to appreciate other micro-organisms as well. He then indicated that they were going to search information on the internet to get to know more about fungi and other micro-organisms.

What was remarkable in his introductory remarks was how Thupa was patient with all the responses the learners provided. Learners were free to give their points of view, some of which were rejected after they had searched for the information on the internet to support their thoughts. From the lesson segment extracts, it is evident that there is interaction between the teacher and learners as he encouraged them to think critically about their responses. It was also evident that the teacher determined what learners knew before allowing them browse and accept what the internet informed them. This suggests that teachers need to be patient with learners and support them develop high order thinking skills.

As the lessons continued, there came the time for class discussions with projected pictures. For instance, Figure 4.5 shows Thupa projecting pictures learners have collected from the internet.

FIGURE 4.5: PROJECTING PICTURES ON IMPROVISED WHITEBOARD

Figure 4.5 highlights how teachers recycle posters to have whiteboard for displaying pictures using the mini projector. Observing Thupa in the classroom, I realised the confidence and competency he has in the use of ICT in his classroom instruction.

Hassles with time management and ICT integration improvisations

In an interview, Thupa when highlighting challenges in management of time in the lessons, he said,

> *I so wish we have a Smartboard; all learners would be comfortably seated in the classroom, and we will have no wasted time …*

The phrases in the quote, "*I so wish we have smartboard, we will have no wasted time*" show that Thupa is disadvantaged by lack of ICT devices such as the smartboard which he was exposed to during training on ICT pedagogy, as he mentioned in the interview. In his classroom practices, teacher Thupa trains learners how to access relevant educational information on the internet using the mobile phones, guiding learners in accessing suitable sites such as Google Scholar and Make me Genius. He further trains them how to avoid risks on the web. However, it is time consuming to access all groups in a crowded classroom of about 58 learners, as is the case in this target group.

Almost all groups wanted the assurance of the teacher that they were on the right track; hence, they frequently verified the accessed information with him. Exhausting as it looked while I observed him being called from all corners of the classroom, he patiently attended to all of them. They all wanted to share the joy with their teacher that they were indeed accessing the relevant scientific information on their mobile phones. Some of the teaching time was also spent struggling to connect, especially during days

when the internet signal was weak. Time was also spent on improvisation for the whiteboard. It is in observation of classroom practices of teachers such as Thupa that I realised the disadvantage of lack of access to suitable ICT resources when a teacher is well trained in ICT integration. One could witness the underutilisation of acquired ICT skills as emphasised by Chai *et al.* (2011), though in this case, it was not the choice of the teacher but the lack of availability of relevant resources.

While the learners were searching for information, teacher Thupa moved around to check the progress of each group, clarifying some of the issues as they asked questions when he moved around. Where he identified a common problem for many, he would call the class for attention and explain the problem to everybody. For instance, when he noticed that some learners struggled to access the details from the documents, he clarified how they could open the files of search results. He reminded learners to follow the right procedure saving pictures. Some learners enjoyed searching by means of the voice recognition method. They enjoyed shouting the question and were overwhelmed by the resulting search results. Figure 4.6 shows learners attentively listening to their search results.

FIGURE 4.6: LEARNERS BROWSING USING MOBILE PHONES

Figure 4.6 shows how excited the learners were when they found results. Some learners were observed moving across to other groups where the teacher was or to any other group to share information. There was movement in the classroom throughout the lesson, but that did not bother the teacher. It was inspiring to see how free the learners were in the instruction and how willing they were to share experiences, even helping one another where some experienced challenges. However, whenever

the teacher wanted them to be quiet and pay attention to some issues, it happened reasonably.

Going beyond the usual teaching practices

Thupa has his own way of instilling love for digital technology among learners and colleagues. His passion for access for all learners made him think of how to provide access to learners who are sometimes absent from school due to various family challenges. He explained,

> *What I did when I begin ICT integration. Back then was that I would record my lesson, and during that time I had a serious problem of absenteeism. So, a learner who was absent if now present I would give the learner a phone any time especially lunch time and the learner would listen to my lesson. I found that not only the learner who was absent is benefitting from this lesson, even those who were present they are now reminiscing on the lesson and begin to have more questions and do play backs to get clearer about the information.*

Phrases, "*I would record my lesson, I had serious problem of absenteeism, would give the learner a phone, learner would listen to my lesson*" in the quote show that learners who are usually absent from school benefited from ICT integration, the details of previously done lessons. The phrases in the extract, "*not only the learner who was absent is benefitting from the lesson, even those who were present*" show that use of mobile schools motivated collaboration and sharing of ideas, since even those who were present in the lessons would volunteer to join the group which was absent. Thupa further indicated that this greatly inspired him.

The clips benefited many learners beyond the targeted group. Thupa then started recording many clips. He wanted to do this to address the national problem of the high rate of dropout against the Lesotho policy of retaining learners for 10 years in Basic Education. Thupa indicated that he decided to voice record some of his lessons using a mobile phone. When those who were absent came to school again, he would then ask them to sit together and provide them with his phone during break or lunch time to listen to the clip. What is also interesting is that during the classroom presentations and discussions, I saw the learners' freely audio or video recording the discussions. This suggests that Thupa's classroom instruction practices engage learners actively. This was highlighted by Erdem (2019) who stresses that science teachers are willing to use ICTs to improve learning and teaching.

4..2.1.4 The teacher's ICT integration collaboration practices

Thupa regularly collaborates with other teachers to improve his ICT integration strategies continuously. The teacher's commitment to ICT integration has benefited him in the form of international exposure where he represented Lesotho on international forums, giving him the opportunity to establish professional development networks with other teachers who are also passionate about the use of ICT tools in teaching and learning. The next subsection highlights his collaboration practices.

Community school-based collaboration

Teachers at this school enjoy the support of the community in the 'Bring-your-own-device' initiative. In addition to the digital devices such as mobile phones, extension cords and camera equipment are also brought along by the learners, when required. The learners from other classes also bring extension cords, since many are required to access electricity from the neighbouring family to support ICT integration into the school. Although the learners mostly use mobile phones in the instructional practices, electricity is required to connect the Wi-Fi router. This is the teacher's personal Wi-Fi router, and the teacher sometimes uses his data to connect learners. This is what the teacher indicates,

> *On my side I bring my own Wi-Fi router, I bring my iPad or my laptop if it is not busy at home. So, we get to connect with learners.*

The phrase, "*I bring my own Wi-Fi router, iPad or laptop*" in the extract shows Thupa's commitment to ICT integration at this school.

A family in the neighbourhood has volunteered to support the school with electricity in most cases without being paid. This was evident when Thupa stipulated,

> *the electricity comes from a neighbour to our school. And the extension cords that ehhh, connect the electricity from our neighbour to our school comes from the students.*

The phrases, "*electricity comes from a neighbour to our school, extension cords… comes from the students*" show that the community supports the ICT integration initiative at Sentleng primary school. The community support was also echoed by the principal in the interview when she said,

Motlakase re sebelisa oa moahisane, kannete ka ha o rata sekolo sa rona haholo. Boholo ba nako re haka mahala empa re e re iteke neng neng hore re mo akhelle letho ka linako tse ling re se re soabile kannete.

(We use the neighbour's electricity since she loves our school. Most of the time we use it for free, sometimes we pay when we are ashamed to ask to use it frequently.)

The phrases in the extract, "*we use the neighbour's electricity, sometimes we pay when we are ashamed to use it frequently*" further shows that the community consider use of ICT in classroom practices as their responsibility. I also witnessed the connection of extension cords to the family during a classroom observation.

Learners' collaboration practices

Members in each group were allocated tasks, as some searched for the information on internet, some were responsible for jotting down the points in a brief way, some were responsible for saving the pictures and some were responsible for reporting to ensure that learners work collaboratively in a group. As the learners were working together and presenting, the teacher assessed them on competences learners are expected to develop in the 21st-century learning approach. He clarified,

There are specific tools that when I use them I know I would be looking for what my students could critically achieve. If learners could be able to complete certain activities, then I know their competency in their critical thinking ability. And some other tools like Souls smith, where students come up with a song that is build out of the learning content. So they sing about what they have learnt in class. So through that, I can assess how students can arrange information so that it can be sensible to anybody who listens. I think that is basically what I do.

The phrases, "*If learners could be able to complete certain activities, I know their competency in their critical thinking ability, other tools like Souls smith, where students come up with a song … out of learning content, I can assess how students can arrange information*" in the extract show that Thupa has the potential to use ICTs to assess learners. However, in the observed lesson the assessment part could not be explored beyond the groups' presentations probably because of time constraints. The groupwork revealed that sharing information is deeply rooted amongst the teachers and the learners at this school. For instance, during presentation sessions, as some learners were presenting, when information was displayed, other learners recorded the presentations on their phones. Sometimes they even took screenshots of information displayed, especially during the projection of images on the board.

Moreover, the culture of sharing with learners who did not manage to bring mobile phones was overwhelming. Everybody in the different groups freely handled the phones within groups. Learners were reminded to send pictures through Bluetooth, while the other group members were presenting. This suggests that Thupa guided the learners on the efficient use of technology to access relevant information and cheaper means of sharing digital information.

Eventually the learners shared the captured information through WhatsApp and other social media platforms. This is recommended in the Integrated Primary Curriculum Grade 7 Syllabus of 2017 in Table 4.1, which encourages learners sharing of educational experiences through social media such as social networking sites. During the observed lessons, as the teacher moved around to check progress, he also had a camera and randomly took pictures of the learners when searching and writing information from the internet. One could see that learners were so used to it that it did not cause any distraction as he took the photos. In the observed lessons, some learners also freely captured the projected information for sharing with others later.

Collaborating at school level

Teachers at this school collaborate on the use of ICT in instruction. The colleagues inspired by Thupa's determination of ICT integration came on board to support and join him in implementing ICT integration. Since not all learners can bring mobile phones as they come from different backgrounds, Thupa clarified the support he gets,

> *I think the most important thing is that all of the classes help us, because some of the extension cords don't come from the families of students in my class. They come from students in other classes and one other important thing is as for the mobile phones, some of the teachers lend their mobile phones to the class so that they can be used and everybody takes part by bringing their devices. And I do bring my Wi-Fi router too, for the connectivity, and one teacher has a projector, and we use the projector to display whatever we have from the searches or browsing.*

The phrases, "*all of the classes help us, some extension cords don't come from the families of students in my class, for the mobile phones, some of the teachers lend their mobile phones to the class, everybody takes part by bringing their devices*" in the quote show that learners and teachers at Sentleng Primary school support one another with their personal gadgets. In the observed lessons, lack of ICT infrastructure was evident when the collected information was supposed to be projected in the absence of the

whiteboard. The teacher and learners improvised; nothing is considered a waste at this school. Rather, used materials are stored safely for future use. Used charts are used as a whiteboard. Learners actively help to prepare the board for projection, as shown in Figure 4.7.

FIGURE 4.7: IMPROVISING FOR WHITEBOARD FOR PROJECTING PICTURES

Figure 4.7 shows the improvised whiteboard from a recycled poster. Both boys and girls help to prepare the board and cover windows to reduce the light intensity for a clear focus. In Figure 4.7, there is a learner in front of the projected picture, taking a video of the projected presentation and will share the information later with classmates.

Collaborating locally with other ICT passionate teachers

Additionally, all teachers who are passionate and active about the use of digital tools in teaching and learning held a local collaborative professional development training workshop at one of the primary schools in central Maseru for free, where teachers could share their experiences and learn from one another about how to integrate ICT in simple ways within a highly challenged school context. Figure 4.8 shows Mr Thupa as a presenter at this collaborative workshop.

FIGURE 4.8: TEACHERS' COLLABORATION WORKSHOP ON ICT INTEGRATION

Figure 4.8 shows such workshops where Thupa and other teachers share experiences on how to handle some topics using available ICT tools within their schools' contexts. The teachers help one another to create e-mails for sharing information between the schools. It is at such workshops that Thupa and colleagues assist colleagues from other schools to achieve the educational goals as one of the presenters. He usually introduces the workshop by motivating participant teachers through team-building exercises that emphasise the need to work together regarding ICT integration.

During one of the interviews, Thupa stated that he had been nominated as a worldwide ICT educator by one of the international ICT Integration Foundation NGOs. This suggests that he has a wealth of experience about ICT integration which he freely shares with colleagues. He is just restricted by the lack of ICT infrastructure within his school context.

Global teacher-learners shared skype Lesson

Figure 4.9 shows the Skype lesson shared with a school in the USA in 2020, which I observed.

FIGURE 4.9: (THUPA) THE SKYPE LESSON WITH AN INTERNATIONAL PRIMARY SCHOOL

In Figure 4.9 the learners are sharing ideas about viral diseases. Learners in the United States discussed the Corona virus and advised Lesotho learners about how they should protect themselves from infection. The learners and Mr Thupa presented about viral infections that are frequent in Lesotho, such as influenza and the common cold. There was a struggle to connect, as it was raining. The lesson was delayed when learners had to improvise by covering the connections of extension cords to prevent rain interfering with electricity. This is what Thupa had to say further stressing challenges experienced that day,

> *We are using one device. Ehh, it's not easy for me because if everybody would want to be where they can be seen, you know, at the point where the camera can see them, and the crowding and pushing and that control is really a problem.*

The expressions, "*using one device, everybody would want to be where they can be seen, the crowding, pushing, control is really a problem*" in this quote continue to elaborate some of the contextual challenges of ICT integration in this school. On the contrary, as shown in Figure 4.9, the reception from the USA partner school was clearer and more visible. I witnessed the difficulties on the Lesotho side, where the teacher was unable to project the session and learners were compelled to cluster around a single laptop screen. They tried to project on the chalkboard, but there was a technical problem that could not be resolved immediately. It was striking to see how relaxed the teacher and the learners were as they encountered challenges and worked together to find a resolution. Learners volunteered to attend to any challenge to support the teacher.

In the follow-up interview, I wanted his opinion about what he considered to be the successes of Skype instruction. Thupa elaborated,

> *I would consider the successes to be, the fact that we were able to connect because sometimes we experience connection problems. So, I think that was the first success; Secondly, the fact that, Ehhh, our learners were able to communicate with each other and also asked the teachers. We were able to guide them on how to, to approach some steps. Particularly when they had to do short statements that, other learners had to understand, or rather don't know. So, another success I think is that one of, you know, our learners getting to know each other better and gaining confidence from both sides. This time around we see that the confidence level, has increased somehow. So that, I would consider to be the successes of the lesson.*

It can be noted from expression, "*we were able to connect*", in this extract shows that Thupa's ICT integration competency enabled him to handle the situation. He was not scared to be observed with the group when using ICT for the first time in his instruction with this group. It can also be realised that he was ready to deal with any challenge that could emerge. This suggests that Thupa is competent in using the ICTs in instruction. The phrases, "*learners were able to communicate with each other and also asked the teachers, learners getting to know each other better*" show that the Skype lesson promoted global communication between learners in Lesotho and USA.

4.2.1.5 Experienced challenges and mitigations in the classroom context

Even though learners have developed a culture of sharing, it cannot be ignored that learners who do not have mobile phones sometimes feel out of place. The principal emphasized that in rare cases they had unanticipated incidences where they had to deal with disciplinary cases of learners who stole other learners' mobile phones. However, she emphasized that parents are very supportive in this regard; they usually report when a learner arrives home with a stolen mobile phone.

The digital divide

Although the initiative works, there are learners who are very disadvantaged because they do not have their own devices. This was highlighted by Thupa during an interview when he stipulated,

> *The other challenge could be students who cannot afford to have the digital devices, I can see as their teacher that they are in some form of depression. In the sense that they kind like feel like they are not contributing to their learning.*

The phrases, "*students who cannot afford to have the digital devices, they are in some form of depression, feel like they are not contributing to their learning*" in the quote show that learners familiar with digital tools were more confident than the ones who did not have them. The quote suggests that Thupa realises the presence of the digital divide among the learners. This is echoed by Bladergroen *et al.* (2012), who highlight that ICT integration sometimes creates a digital divide, learners who do not have ICT devices at home are disadvantaged to fine tune acquired ICT skills. The implication is that ICT integration goes beyond classroom instruction if planned properly.

However, the teacher was always careful to rotate tasks within the group and monitoring that all be given a chance in the group to use the mobile phones. Additionally, as the learners searched for information, the teacher moved around the groups and posed questions to check if they understood the information they collected. However, some challenges were observed when some learners presented the information. In some cases, they just wrote down what they had found from the internet without internalising the information. The teacher could have missed that as the class was overcrowded.

It was remarkable to observe as early as the beginning of the year how Thupa started using ICT tools with a new class, Grade 6 learners of 2020 and 2022, when they brought their devices to school for the first time. He patiently controlled the discipline and instilled a culture of collaboration among the learners. That was clearly observed when the teams presented their findings, even when some displayed a lack of confidence standing in front of the whole class. The teacher treated those who had little confidence cautiously and patiently encouraged them to improve, to speak out louder, etc. Everybody had the courage to try it. The teacher never made a negative comment about any of the presentations; rather, he would intervene strategically, emphasising points raised in the presentation by explaining more, or reading the key points on the learners' presentations if some information was not clear. Additional notes were also provided in the next lessons to ensure that all have content covered.

Struggles without IT expertise within the school context

Enthusiastic as he is, sometimes it was evident that Thupa required an expert IT person to assist with technical challenges. Unfortunately, the school does not have such an employee. There were days when learners downloaded pictures and shared

with a learner assigned to collect the pictures and the pictures would not appear on the board. In that case, some of the teaching time was spent trying to establish what the problem was and trying alternative means of sharing the pictures. However, some days the lesson would have to end without any success. In Figure 4.10, Mr Thupa and a learner are trying to establish why the pictures do not show up.

FIGURE 4.10: TEACHER & LEARNER ATTEMPTING TO RESOLVE TECHNICAL PROBLEM

Figure 4.10 shows when a learner was assisting Thupa during another lesson when the projector did not work, and the teacher could not immediately determine what the problem was. The interesting part is that the learners were not worried; they just continued searching for more information on their mobile phones while the teacher tried to find a solution to the problem. In another lesson fortunately, Thupa realised the challenge with the mini projector before the lesson I observed started and he was flexible enough to design activities that could replace the projection of pictures. He instructed them,

> *We are going to look at cholera, so the phones are going to help us to find more information on cholera … as we see the pictures we try to draw those diagrams that will be there, the pictures on the charts … So I want to see your artistic juices running, so you need to draw.*

The phrases, "*as we see the pictures we try to draw those diagrams, I want to see your artistic juices running*" in the extract show that instead of projecting the pictures, he challenged the learners' artistic skills. He asked the learners to draw the pictures and as they presented the information, the diagrams were also displayed on the recycled posters. They had already been used on one side and safely kept for future use, when needed. The quote shows that the teacher was flexible in instruction

depending on the contextual challenges experienced, such as lack of IT technician at the school to assist when there are technical challenges. I observed the learners enjoying drawing what they saw on their mobile phones. In Figure 4.11, the group is writing text and drawing a picture of cholera while browsing the internet.

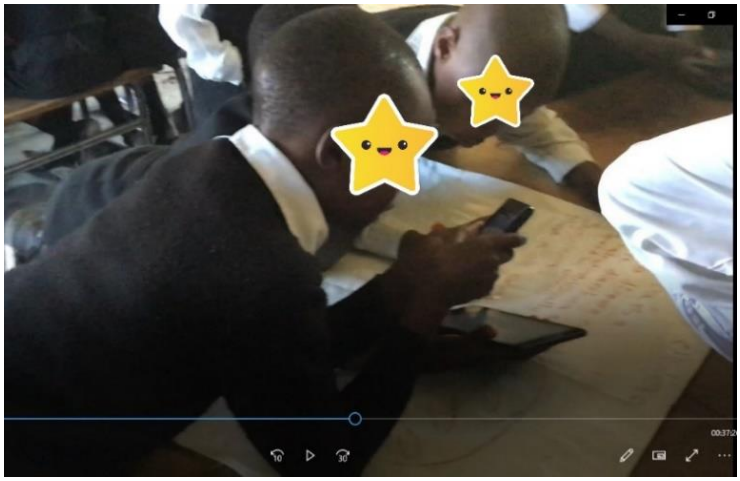


FIGURE 4.11: DRAWING PICTURES ACCESSED ON MOBILE PHONES

Figure 4.11 shows how focused the learners were as they harness information from internet and draw the pictures. This shows that the mobile phones managed to engage the learners for educational purpose as supported by Liu (2016), who stresses that using ICTs in instruction motivates learners and increases their engagement with lesson activities.

4.2.1.6 Synthesis of Thupa's practices of ICT integration at Sentleng PS

The synthesis is based on evidence adduced mainly from data gathered from the initial and follow-up interviews, classroom observations and document analysis of selected policy framework documents informing ICT integration in Basic Education in Lesotho. This framework includes the prescribed Science and Technology learners' textbooks in Grades 6 and 7. Even though Thupa did not have access to the policy documents especially the Curriculum and Assessment policy (MoET, 2009) that led to the development of the current curriculum for primary schools, especially Grades 5 to 7 syllabuses, the target level for the study, he is conversant with the demands of vision 2020 policy of Lesotho with regard to ICT integration into schools. He stressed,

> *Schools do not have digital tools … It is up to teachers to make teaching practice enjoyable; it is up to you (teacher) to take a step further.*

The phrases, "*it is up to teachers to make teaching practice enjoyable, to take a step further*" in this quote shows that as a professional teacher on the ground, Thupa feels that it is his responsibility to ensure that ICT integration happens. This quote shows that Thupa developed a passion for ICT integration and strongly believe that teachers are responsible for implementing use of ICTs. It seems he is able to use ICT in any topic, even in the absence of supporting prescribed textbooks to facilitate teaching and learning. Thupa does not just rely on technology content knowledge and skills he acquired during his training some years back; rather, he frequently engages in Continuous Professional Development programmes on a voluntary basis. It is in these programmes that he shares ICT skills and teaching strategies with other teachers who are also passionate about ICT integration. This empowers him to be up to date with the evolving technologies in education.

The interactions with other teachers enable Thupa to cope with the contextual challenges at his school. He also manages to improvise for ICT integration. Even though he works at a school without electricity, ICT infrastructure and internet access, his belief that ICT integration has the potential to make a positive difference in teaching and learning motivated him to mobilise the community to develop the 'Bring-your-own-device' initiative to sustain ICT integration within his school context. This initiative was successful and led to effective ICT integration at Sentleng Primary School. It was also observed that the learners at Sentleng primary school are passionate about using ICT tools in their lessons, making life easy for teacher Thupa when he asks them to bring their mobile phones to school.

4.2.1.7 Case conclusion

It was apparent from the observed lessons that Thupa is determined to sustain ICT integration at the school. He displayed creativity and flexibility as he improvised with available materials within his school context. The teachers' efforts to use ICTs in instruction were also alluded to by Bohloko et al. (2019) and Makuru and Jita (2022) who argue that even though there are challenges in school contexts, teachers are using ICTs in classroom practices in Lesotho. Hennessy *et al.* (2010) motivate that classroom practices of experienced teachers could be studied to inform literature about ideal ICT integration practices. This could overcome the persistently insignificant use of ICT in teaching and learning (Chai *et al.*, 2011; George & Ogunniyi, 2016).

ICT-passionate and experienced teachers such as Thupa could have effective teaching strategies and contribute by shaping the future of ICT integration into education in this country positively. He could contribute largely to the professional development of teachers on ICT-oriented pedagogy, if supported with relevant ICT infrastructure at his school. Of the limited studies in the Lesotho context, none of the studies reveals the practices of teachers who are passionate about ICT integration, regardless of the hard conditions under which they work, if their schools have not been equipped with ICT infrastructure from the projects that were undertaken in the country to promote ICT integration into education. Moreover, none of the existing studies I accessed reveals the extent to which ICT-oriented teachers collaborate globally to meet the requirements of 21st-century teaching and learning, especially at primary schools in Lesotho, with the challenges of the availability of ICT infrastructure, electricity and internet accessibility.

This case reveals the power of collaboration within the school system to achieve set goals, which may be a challenge at some schools. The study further reveals the power of determination by individual teachers to help move their learners with the times, regardless of hardships within their school contexts. The study emphasises Webster's (2017) notion that technology integration is inevitable and cannot be avoided. No study accessed in Lesotho context, has revealed the extent to which teachers collaborate nationally and globally on a voluntary basis without support from the MoET, supported by the community within their school contexts.

4.2.2 The case of Lethu, the lucky-bird teacher in an ICT-enriched primary school

> We had a chance to have a Smart Board, then one of the 5 schools in the project took it. We were very disappointed for not getting the smart board because we were already having a plan of how we were going to use it. I used the smartboard in South Africa

4.2.2.1 Introducing Lethu and the Leratong Primary School (PS)

Teacher Lethu, one of the participant teachers in this study, was the Science and Technology (ST), Mathematics and Arts & Entrepreneurship teacher for Grade 7 in 2022. This is the participant recruited to replace Phuthi who transferred to a school in another district and his case of three interviews, two classroom observations and the principal's exit interview was dropped because it was impossible to have additional

classroom observations at Linoking Primary School in 2022. Like Thupa, Lethu has a Diploma in Primary Education from LCE, the same Teacher Training Institute in Lesotho. Before enrolling at the Teacher Training institute, Lethu worked in South Africa after completing secondary education, Form E (Grade 12) in Lesotho. He then engaged in a short course called A+ exposing him to computer literacy. Lethu graduated at the teacher training college in 2015, thereafter he volunteered to teach in one primary school in South Africa for two and half years. He acquired ICT pedagogy at this primary school. This is how he explained his exposure to ICT integration,

> *I used the smartboard in South Africa. South Africa is investing in ICT classroom practices, so the school I volunteered to work on had the smartboard.*

The phrases in this extract, "*I used the smartboard in South Africa, the school I volunteered to work on had the smartboard*" show that Lethu had an opportunity to teach using the smart board. He started using ICTs in his classroom practices during this voluntary period. The quote suggests that Lethu is confident about using ICTs in classroom practices. His volunteer services contributed to his professional development on ICT pedagogy. Lethu then joined the current primary school in Lesotho as a permanent teacher in 2019. Even though Lethu joined LCE after Thupa had graduated, he did not have exposure to STIC within LCE. This suggests that it may have been ineffective during his teacher training period, LCE might have not been able to sustain it. This is typical of most projects in our education system. The primary school is part of the current Ireland Action project supporting five schools with amongst others computer laboratories. A local entity CAMARA also provides support by installing software in the computers to enable searching offline from Wikipedia during classroom instruction.

Introduction to the curriculum

Lethu started teaching at Leratong Primary School two years after the new curriculum reached Grade 7 in 2017. He graduated in 2015. Even though Lethu was teaching integrating ICTs according to the requirements of the syllabus, he seemed unfamiliar with the background information stipulated in the syllabus, but he was aware that the syllabus requires ICT integration. He further stated that for him, planning to use ICTs just happens naturally because he is passionate about it and he has ICT skills. For Lethu, using ICTs is more of a teaching aid to address the problem of limitations of available teaching resources. He believes that some of the concepts demonstrated in

the textbooks are more clearly unpacked on the computers and YouTube videos. There was no specific training at the Teacher Training institute Lethu obtained about the current syllabus. He highlighted that during his teacher training at LCE, they were interrogating the old syllabus and he met the new syllabus at teaching practice. Lethu further stressed that when he started teaching, he was not given orientation about the new curriculum, he was just allocated the Sciences and Technology (ST) subject without guidance on how to incorporate use of ICT in instruction. Lethu highlighted,

> *There was no specific training on how we are going to use ICTs in the science lessons at the college. So integrating ICT into the new syllabus. Is an individual effort. A teacher has to think of how to go about it. Ke uena ea inahanelang u le tichere (You as a teacher has to think for yourself) on what you should do.*

The expression, "*there was no specific training on how we are going to use ICTs in the science lessons at the college*" in the extract shows that Lethu did not have exposure to STIC at pre-service teacher training. The phrases in the extract, "*integrating ICT into the new syllabus is an individual effort, a teacher has to think of how to go about it*" show that Lethu had to think for himself about how he could go about teaching ST at the current school. This may mean that the school may have assumed that being from college in the recent years, he has probably been oriented about how to cope with the new curriculum. It also suggests that the first few years of introduction of new curriculum may require intensive induction of pre-service teachers when they transit to schools as there is a possibility of gap between dissemination and implementation of new changes to both schools and teacher training institutions. These are teachers who are probably trained with the old syllabus when the new syllabus is enrolled to schools.

What is surprising is that Lethu went to the teacher training college after Thupa who graduated from the same institution trained on ICT pedagogy at STIC within the institution. This may suggest that the institution may have not sustained the project after the implementation process. Furthermore, Lethu stressed in the interview that some of the ST teacher colleagues do not cope with using ICTs in their instruction, except when treating the technology domain as is in the syllabus. He stated,

> *I could say I am able to use ICTs because I already have computer skills and I do love using ICT in my lessons. Most teachers here do not manage to use the available ICTs. They use textbooks yet there is no science lab here at school.*

The use of the phrase, "*I am able to use ICTs because I already have computer skills and I do love using ICT in my lessons*" show that teachers who are not exposed to ICT pedagogy could have challenges with using ICT in instruction. The phrase, "*most teachers do not manage to use available ICTs, they use textbooks*" in the extract shows that the ST teachers rely on the pictures in the prescribed textbooks due to inadequate ICT skills, even though the school has a variety of ICT resources. The inadequate use of ICTs by other teachers was further corroborated by the principal in the exit interview who stressed,

> *We are in a transition of teaching. Transiting from teacher-centred pedagogy to learner-centred pedagogy or ICT pedagogy. Because we have these computers, I encouraged teachers to actually have lessons in that computer lab… We are driving to the point where the teacher will teach Sesotho using the computers and teach mathematics lesson in the computer lab and all other subjects. But we are trying, it is only a few of the teachers, especially in the upper grades who are trying that.*

The use of the phrases, "*because we have these computers, I encouraged teachers to actually have lessons in that computer lab, we are trying, it is only a few of the teachers especially in the upper grades who are trying*" in the extract show that the principal encourages the teachers to use ICTs in their instruction, even though there is no significant impact as yet. Jita and Munje (2020) share the same sentiments by revealing that some of the schools in South Africa are adequately equipped with ICTs, but teachers use them inadequately in instruction for various reasons.

The Leratong Primary School and Classroom context

The Leratong Primary School (pseudonym) is a public school, also belonging to LECSA. The school is located in the urban area, 10 km from the capital city of Maseru. Leratong PS also adheres to the rules and regulations as determined by the MoET in the country. Learners from this school are taught using the same regulated ministry curriculum as the government-owned schools like Sentleng PS. There is a computer laboratory in this school donated through the five schools' Hub project sponsored by the Action Ireland Trust capacitating five schools inclusive of Leratong PS, in the vicinity of the school. The school has electricity even though not all classrooms are wired but it generally has no internet. However, a local entity has installed Wikipedia in the computers and the UBUNTU software, which enables offline search. Even though a computer laboratory has been donated, the school is still challenged by lack

of internet to access adequate educational information. The offline search has limitations.

To some extent, the conditions at Leratong PS share the same sentiments with findings in the literature, which highlight that many schools in developing countries are still challenged by the limited teachers' ICT pedagogy and competencies. Unlike many primary schools in the country, the school has a significantly adequate variety of ICT devices. Leratong PS is one of the old primary schools in the country with a population of about 1 400 learners. The school is celebrating its centennial in 2022. There are three classes per stream from Grade 1 to Grade 7. There are 68 learners in Grade 7, of which half of the group goes to the computer laboratory for Science and Technology for 45 minutes, followed by the remaining group in the next 45 minutes on a Monday or any other arranged day. When one group is in the computer lab, the other group is simultaneously in the library monitored by the librarian. The principal stated,

> *The project that we are currently having is called the 5 Hub Schools Project, which is sponsored by the Action Ireland Trust. The project supplied us with the computers. We currently have 39 Desktops in the Computer lab. We did not have the computer lab before but since 2019 when we started the partnership. They gave us those computers. What happens is we also are lucky that we also got the Library that was donated by School Aid, so the library has the timetable on how the learners use it. So we incorporated that timetable into the computer lab timetable, to ensure that learners use the library simultaneously with the computer laboratory.*

The phrases, "*the project supplied us with computers, 39 Desktops, we did not have the computer lab before … 2019*" in the extract show that Leratong PS was lucky to be part of the 5 Hub schools project and benefitted ICT resources. The phrases, "*the library has the timetable, we incorporated that timetable into the computer timetable, learners use the library simultaneously with the computer laboratory*" in this extract show that the school strategised for learners to use efficiently the time for Library/computer slot even though Grade 7 is a large class. The rest of the ST lessons are held in the Grade 7 classroom. It was possible to observe lessons in this school two times a week, except in the weeks when there were interrupting school activities. I managed to undertake classroom observations at the school over a period of about six weeks. Follow-up interviews were audio recorded, held telephonically as the teacher was not available immediately after the observations; he had other lessons.

The next section narrates how Lethu planned to use the available ICT tools in classroom practices. The section also shows how he introduced lessons in ICT oriented instructions.

4.2.2.2 Lethu's ICT integration initial preparations

The lesson planning

Even though Lethu marks how much to cover for each lesson, and seems to be managing the lesson period in the observed lessons effectively, what was surprising was that he writes one lesson plan for all lessons of the LO for teaching the whole week. He states all the objectives and the activities for the teacher and the learners. Figure 4.12 is part of three lesson plans out of six for the observed lessons:

Lethu's Lesson Plans		
Lesson 1 Date: 22/02/2022 Grade: 7 Class Size:	**Lesson 2** Date: 28/02/2022 Grade: 7 Class Size:	**Lesson 3** Date: 07/03/2022 Grade: 7 Class Size:
LO31: Demonstrate an understanding of magnetism. The Earth & Magnetic field	**LO 15**: Describe the structure of a typical cell and functions of each part. Cells	**LO 35:** Describe rock formation. **& 37**: Describe weathering processes & their effects. Rocks (2nd Lesson)
Objectives: *At the end of the lesson learners should be able to*		
• recognise that the earth has a magnetic field • distinguish between North pole and South pole of the magnet. • Understand that magnetic field act through nonmagnetic materials.	• Identify parts of the cell • State functions of parts of a plant cell. • State functions of parts of an animal cell. • State similarities between plant and animal cell.	• State the three types of rocks. • Define weathering. • List examples of each type of a rock. • State the use of each type of a rock. • Describe the formation of each type of rock. • Identify the differences between types and processes of weathering. • Identify the process that lead to physical weathering
Teaching Materials		
Slide show, textbook, YouTube, Magnets, papers.	Computers, textbook, charts, poster.	Projector, Laptop, videos.
Methods		
Demonstration, Discussion	Discovery & Discussion	Discussion
Assessment Criteria & Method		
Verify poles of a magnet using a magnetic compass (Oral)	Define a cell (Oral) Identify parts of the cell Draw & label plant and animal cell (Drawing) State functions of plant cell State functions of animal cell (Oral & Drawing)	What colour are the rocks, small or big that you have seen? (Oral) How do you think weathering affects rocks? (Oral)
Success Criteria		
Identify and verify poles of a magnet	What a cell means State functions of the plants and animals cell Draw and label plant and animal cell	Identify types of rocks and their examples Know what is weathering & the agendas of weathering

Figure 4.12: Lethu's Lesson plans extract

The teaching materials in Figure 4.12 stated as, "*slide show, YouTube, Computers, Projector, Laptop, video*" show that Lethu indicates in his planning the ICTs he would use in instruction. Indication of the ICTs in the lesson plan may mean that Lethu plans the ICT integration lessons effectively, considering the available ICT resources in the school. The subtopics stated as, "*assessment criteria & method and Success Criteria*" in the extract highlights how Lethu planned assessment to be used in the lesson. What was surprising about Lethu's lesson plans was that he drew one lesson plan for all lessons of the week, covering all the objectives of the LO targeted. For instance, the

lesson plan on rocks covered four lessons of which I observed two. The lesson plan on magnetism covered four lessons of which I observed one. However, he plans how much to cover for a day period and how long he teachers a specific LO. He further prepares PowerPoint slides for all the lessons planned to be projected within the week. This seemed advantageous to the learners in the observed lessons, since as they struggled to remember what was taught in the previous lessons, Lethu shifted back and forth the slides to assist them in recapping the information.

The Initial Introduction phase

Prior to observing lessons, a pre-observation interview was undertaken to establish how Lethu views his own practices of ICT integration and how he plans for ICT integration instruction. The support he has for effective ICT integration in his instruction was also determined. During the beginning of the observed lessons, Lethu highlighted the topic of the day. He wrote it on the blackboard or just displayed it on the slide. He asked the whole class to read information from the ICT devices together. It was observed that, throughout the lesson, Lethu preferred to ask learners to respond together as one of the approaches he used many times throughout the lesson.

The lessons started with the teacher-directed discussion, Lethu asking questions guiding learners to recall what they did in the previous lessons or what they know about the topic being introduced. In the samples of introductions of his lessons, Lesson 1 was the continuation of the previous lesson where they were introduced to magnetism, defined magnetism and discussed the magnetic field. Lethu used the projected slides with embedded videos in this lesson. In Lesson 2, beginning of the following week, they started a new topic cell. Lethu probed them to find the background information they had about cells. It was apparent in their responses in the introduction that majority of learners had no idea about the scientific terminology of cells. He used the offline Wikipedia in the computer room to facilitate this lesson. Lesson 4 was the second lesson observed about rocks. Lethu used both computers and the downloaded video projected on the mobile TV in the computer lab in this lesson to build on examples of rocks learners had searched about as homework. They were requested in the previous lesson to use the parents' mobile phones to search for examples of types of rocks. Lesson Segment 1 shows how three of the six observed lessons were introduced.

SAMPLE OF INTRODUCTIONS OF LESSONS		
Date: 22/02/2022	**Date:28/02/2022**	**Date:07/03/2022**
Lesson 1: LO 31:Magnetism	**Lesson 2:** LO 15: Cell	**Lesson 3:** LO 35: Rocks
INTRODUCTION		
T: What did we do in the last lesson? L(s): Magnets. T: What did we say a magnet is? What is a magnet, can somebody remind us? L1: A magnet is a material that can pull a certain type of metal towards itself. T: Another definition of magnet? Is she correct? L(s): Yes sir. T: Another definition of magnet if you still remember it. I remember we learnt it this week. If you can't it means you have not been reading. (*A learner raised a hand up*) No you are copying from the book. L2: No sir. T: I'm not giving you that opportunity. Where do we find the magnets? L(s): In the speaker. T: Why do you think we find them in the speaker? Even myself I don't know why we find them in the speaker but we will have to find out. I remember I gave you homework. L(s): Yes sir T: I gave homework on the? L(s): Earth and magnetic compass.	T: Today we are going to talk about something called (*Teacher writes cell on the board*). What is it? L(s): (*Shouting*) Cell T: Do you know any cell? L(s): Yes sir T: What type of cell do you know? L: Cell membrane T: Wow where did you learn that from? L2: Prison cell T: He says prison cell L3: Cell phones T: Cell phone? (*Whistles & ask the class*) what kind of a cell do you know? (*no response, he continues*) Now that you are seating in front of the computers please go to Wikipedia and search any type of a cell and tell us what you have found there. Then we will decide which cells we will talk about. You have your pens; you have your books and pencils. Work alone (*confronting one student*), you know I hate people who sit in front of computers and do nothing. (*He continues*) If you find something please raise up your hand and tell us what kind of a cell you are finding.	T: You are not going to use your computers, there is no electricity (*joking*). Turn your chairs. (*Learners turn their chairs and face on the board*) L(s): No sir there is electricity (*pointing at the TV flashing connected to the plug*) T: Oh there is electricity (*pretending he was not aware*)? But we are still not using the computers. (*learners murmuring showing dissatisfaction. He writes on the board*) Remember our topic is still on? L(s): Rocks T: And remember last time I gave you homework on? L(s): Rocks T: Rocks, how many types of rocks do we have? L(s): Three types of rocks T: I can't hear you (*demanding more shouting of all learners*). L(s): Three types of rocks T: The first one will be? L(s): Igneous rock T: What? L(s): Igneous rock.
Key: Purple: Learners responding to teacher shouting together Guiding learners recall previously acquired knowledge Examples of unscientific ideas of the cell concept		T: Teacher L(s): Learner(s) LO: Learning Outcome

LESSON SEGMENT (LETHU) 1: INTRODUCING LESSONS

Phrases in the Lesson Segment 1 such as, "*what is a magnet, can somebody remind us? Another definition of magnet if you still remember, Do you know any cell, what type of cell do you know? How many types of rocks do we have*" show that at the beginning of the lesson, Lethu guided the learners to recap what they had learnt in the previous lessons. The teacher-guided discussions were mostly requiring of learners to shout altogether the responses. Phrases in the extract, "*show examples of when learners were responding together"*. When few learners answered, Lethu demanded

to hear all of them shouting. However, responses such as, "*prison cell and cell phone*" in the extract show that some learners did not know the cell concept from science terminology. This may suggest that use of ICTs in the instruction would benefit learners gather scientific information about the cell.

Lesson Segment 2 shows how the three lessons introductions continued:

CONTINUATION OF INTRODUCTIONS OF LESSONS		
Date: 22/02/2022	**Date:28/02/2022**	**Date:07/03/2022**
Lesson 1: LO 31 Magnetism	**Lesson 2**: LO 15: Cell	**Lesson 3**: LO 35: Rocks
LESSON CONTINUATION		
T: Magnets have poles which are? L(s): North Pole and South Pole. T: What happens if I bring a North pole together with another North pole? L: They do not attract. T: What is the term used for not attracting? What does that mean? (*He continues After a pause with no response from learners*) If the north and north don't attract, it means the North Pole and South Pole will? L(s): They attract. T: What is the term used for those not attracting? Can you read here (*He referred to previous lesson's slides*)? L(s): (*reading the projected slide)* We can say that like poles repel and unlike poles attract T: Can you read this word? L(s): Repel T: So we say that when we bring the North Pole and North Pole together they repel. So this is the example but it looks so small. Can you all see here (Pointing at the slide)? … T: What about the like poles? L(s): Like poles repel. T: So these are the examples of North Pole with North Pole they will repel because they are the same. The North and North Pole repel and the South Pole and South Pole will also repel. Right? L(s): Yes sir. T: We are to continue with the earth and magnetic compass. So the earth has the magnet. Do you know the earth? L(s): Yes sir	T: Thank you, somebody else? Somebody who got something different from cell culture. L2: Cell cycle T: Cell cycle, yes what is it? L2: Cell cycle, each turn of cell cycle (*pause*). T: Is it something difficult you don't know? Somebody else who got something different. L3: Cell chrome T: Remove your mask and speak aloud L3: Cell chrome is used in the context of biological cell development T: Look at me, do you understand all the explanation you gave me. L(s): No sir T: Okay, if you don't understand we need to find a specific cell that we are talking about. It is you who is going to tell me what it is. now that we couldn't find the meaning of this, now let's search "what is a cell". Did you find what a cell is? it should write cell biology in the brackets. Or if you can't find this, just type cell and if its written biology in the brackets, click on it. Did you find it? L(s): Yes sir T: Did you open it? L(s): Yes sir	T: How do you spell igneous? (*he writes as they spell on the board, repeating each letter after the learners*) L(s): i; g; n; e; o; u; s T: Okay, igneous rock. And we said another type is? L(s): Sedimentary rock T: Are you all answering L(s): Sedimentary rock (*all shouting*) T: Who can spell sedimentary? L(s): s T: I want one person L1: S; e; d; i; m; e; n; t; a; ry T: r y. sedimentary rock. The next one will be? L(s):(*all shouting*) Metamorphic rock T: Metamorphic rock, can we all spell metamorphic? L(s): M; e; t; T: How many are you in here, I shouldn't hear only two people. L(s) (all shouting): a; m; o; r; p; h; l; c; rock T: So now I remember I gave you homework to go find out the examples of igneous, sedimentary and meta what is this word? L(s): metamorphic rock T: I want the examples that you search on the internet when you were at home with your mothers' phones. Can I see those who were able to search on the internet, so it is only three people? Raise up your hand if you were able to go to the internet to do my work. (*Only a few hands are up*) … (*learners continue listing and spelling out several examples of different types of rocks until a learner mentioned chalk*). T: The chalk we write with? L(s): Yes sir. T: Oh? yeah that one I know, haeso koana e ne e le teng (*At my birthplace, it was there*)
KEY: Reusing Previous lessons slides Phones as sources of information Encouraging Learners to shout together Cell Information from offline searching T: Teacher L(s): Learner(s)		

LESSON SEGMENT (LETHU) 2: THREE LESSONS INTRODUCTION CONTINUATION

The phrase, "*What is the term used for those not attracting? Can you read here (He referred to previous lesson's slides)"* in Lesson 1 of Lesson Segment 2 highlights Lethu's use of slides from previous lessons assisting learners recall what they learnt in the previous lesson. Learners had forgotten the term "repulsion". He shifted to the slide that stresses repulsion and asked learners to read the information on the slide and instructed them to repeat the word repel that he pointed at, in that slide. This suggests that Lethu encourages learners use of relevant terminology in Science and Technology. However, what was surprising was that when revisiting the slides for the previous lessons, Lethu did more talking than learners. This suggests that he missed the opportunity to explore the extent of depth of understanding of learners in the previous lesson. For instance, learners had covered the attraction and repulsion in the previous lesson and had forgotten the term, repulsion. He shifted to the slide about repulsion and point where they should read instead of letting them make sense of that projected slide.

On the other hand, the extract from Lesson 2 of this lesson segment shows how learners struggled to search for relevant information about cells on off-line Wikipedia. Lethu had asked them to search about cells. Phrases in Lesson 2, "*cell culture, cell cycle, cell chrome*" show that learners could not get information specifically about the biological cells. He asked learners to read the information found and asked them if they understood what they were reading. Learners indicated that they did not understand. He then narrowed their search by asking them to search using phrases in the extract such as, "*What is a cell, it should write cell biology in brackets, just type cell, if its written biology in the brackets click.*" Learners then succeeded in finding the relevant information. This suggests that Lethu was vigilant to realise when the search was too broad and narrowed it to enable learners get relevant information.

On the contrary, Lesson 3 shows how Lethu continued with the lesson on rocks; that was the second lesson on rocks observed emphasising proper pronunciation of words. The phrases in the extract, "*can you read this word, another type is, how many are you here, I should not hear only two people, can we all spell metamorphic*" further highlights his common practice of questioning which encourage learners to shout together when responding. This was typical of observed lessons. Highlighted in yellow in Lesson Segments 1 it can be noted that Lethu guided the learners to read together information on the slides or their search results. As they were reading, Lethu also

guided learners on the appropriate pronunciation of words as highlighted in Lesson 4. The shouting of responses together and the spelling out of words were predominantly used in observed lessons. He also pointed one learner to read on his own, however, it was on few occasions in which after the learners read together, he would call few individuals to read the words alone. This is how Lethu justified this practice:

> *I have learners who are like really very slow. How can I explain it? I want them to feel as part of the class. I don't want them feel like they don't know anything. And at the end of the day, they do end up learning from others, nakong eo ba ntseng ba bua mmoho joalo (as they are talking together), they end up realising that ntho ena e tjena, e buuoa tjena (this is like this and this is how it is pronounced).*

The phrase, "*have learners who are really slow, want them to feel as part of class, they do end up learning from others, as they are talking together*" in the quote suggests that he was assisting learners of different abilities gain competency in pronunciation of words. This quote suggests that Lethu also motivated learners' development of listening and speaking skills. This was also apparent in the questions asked after listening to the video clip in the instruction. Learners were asked to indicate anything they had watched. Lethu also exposed learners to multiple representation of educational information. He used ICTs to display information in text, pictorial and video play forms. He used YouTube videos that simulated concepts to enable learners understand abstract science concepts such as the invisible magnetic field and demonstration of how weathering happens in rocks.

Lethu also stressed that as he teaches, he considers integration of different subject areas as required by the Grade 7 syllabus. He stressed:

> *In the classroom the lesson is at least one hour. However, since we try as much as possible to do integration, a lesson can go beyond an hour depending on activities being done to promote integration. We are trying integration the best way we can, so we do not talk about the period.*

The phrase, "*since we try as much as possible to do integration, a lesson can go beyond an hour depending on activities*" in the extract shows that Lethu was not following a strict timetable in Grade 7. I experienced this classroom practice in the observed lessons; computer lab lessons were 45 minutes long, while the classroom lessons were about an hour. I also realised that learners freely expressed their views in Lethu's lessons. In most cases he was joking with the learners as he attempted to bring the concepts to their environment. For instance, when teaching learners about

rocks, he guided them to appreciate the types of rocks present in the neighbourhood of the school and along the paths to school. He also emphasised weathering taking place on the rocks along the paths to the school, sensitising learners that weathering in that case had mainly been caused by several generations that had been walking on the same rocks for many years as the school had been there for a century.

4.2.2.3 Using ICTs in Instructional practices

Lethu continued teaching the new concept using the projected slides for Lesson 1, the off-line Wikipedia for Lesson 2 and the computers combined with TV video play for Lesson 3. After reviewing the previous lesson's work, he continued the teacher-directed discussion probing learners about what they knew about the introduced concept. Lesson Segment 3 shows how Lethu further builds on the development of learners' knowledge about the three different topics in the indicated lessons.

EXAMPLES OF ICT INTEGRATION ACTIVITIES IN 3 LESSONS		
Date: 22/02/2022	**Date:28/02/2022**	**Date:07/03/2022**
Lesson 1: LO 31: Magnetism	**Lesson 2**: LO 15: Cell	**Lesson 3**: LO 35: Rocks
ICT Integration Activities		
The Projected Slides with embedded pictures and video	The Computers with offline Wikipedia & Notes in folders	The Computers & TV video play
T: This is our earth here on the slide I have cut it into half so that you can see the inner part that is the core of the earth is made up the called magma so this magma is rich in iron and it's magnetic. That is why it was said our earth is a very big magnet. … L(s): Yes sir. … (*Moving to the next slide*) T: You can read there (*instructing the class*) L(s): (reading) the earth's North Pole and South Pole are poles of magnet inside the earth. T: Again? L(s): (*shouting more again*) T: Yes we always say our magnet has North Pole and South Pole. … Then the North pole and South Pole are there in the core. Is it clear? L(s): Yes sir T: This is the example of the North and the South (*showing on the slide*) this is the magnetic field … L(s): Yes sir T: You can see here it is inside the earth *(showing on the slide)* L(s): Yes sir T: and here you can see we are outside the earth. … L(s): Yes sir T: So our earth is a big magnet, … So why do we talk about the magnet inside? (*A few learners raised their hands up*)	T: One person read for us, cell biology, read for us (*pointing at a learner*). L: A cell is the basic instructional, functional and biological unit of all known living organisms. T: Continue L: A cell is the smallest unit of life that can replicate independently and thus are often called the building blocks of life. … T: … Okay let us all read excluding all the things in the brackets. L(s): The cell is basic instructional, functional and biological unit of all known living things organisms. A cell is the smallest unit of life …. T: Which definition do you think you can remember, the easiest. … L1: (*repeats same definition*) T: … Highlight it. A cell is a smallest unit of life … (*Learners are highlighting and some seem struggling*). T: You don't know how to highlight? You forgot … You don't lift your finger before you reach where you want to be. (*He continues repeating cell definition*), independently means on its own. The blocks that have built us as human beings, a living thing. … L(s); yes sir T: … What other simple explanation do you get? L2: Cells are often called the building blocks of life. T: Yes but it is the continuation of what she (learner) said. The best one is the basics structural, functional and biological unit known. Write notes, … Highlight the definition, open office Libra writer and make your own notes in there. If you are in the computer lab, use a computer to write notes….	(*Each learner is seating in front of a computer*) T: Now search any other rock there, you choose one rock, … so that we can see the examples of each kind … You found one (*talking to the learner*)? L(s): Yes sir T: Does it have a picture? L(s): Yes sir T: … (*Learners raised up their hands and were telling the class what they found*). T: Speak aloud, … We found chalk, do not search chalk again, find another one (*talking to another learner*). L1: I found basalt T: We found basalt, what else, search another one L2: Marble T: Marble yes, where is marble, please be fast, search another one, there are so many. … L3: Breccia T: Let me see, … Is it this one? (whistles) fast please L4: Limestone T: limestone thank you, I found shale don't search it and chalk, leave it. L5: Silt stone T: … What did you find? L6: Marble (*learners continued the search*) L7: Diorite T: Diorite, … go around to see the pictures of rocks that others found. (*Learners moved around to see the pictures that other learners found*).
KEY: T: Teacher Using Browsed information		L: Learner Encouraging shouting responses together

LESSON SEGMENT (LETHU) 3: USING THE VARIETY OF AVAILABLE ICTS IN INSTRUCTION

Lesson 1 phrases such as, "*this is our earth here on the slide, (showing on the slide) this is the magnetic field, (Moving to another slide) Here is our earth's magnet surrounded by magnetic field*" in Lesson Segment 3 show how Lethu used the slides

with embedded pictures assisting him to explain the abstract aspect of magnetism to learners. He was able to shift from one slide to another to use the pictures to emphasise the information. I observed a similar pattern of minimal text and embedded pictures in Lethu's PowerPoint slides. This enabled a display of large and clear enough pictures visible to all learners in the classroom. The phrase, "*Why is it important that we know the earth does have the magnet*" in the extract shows critical questions Lethu asked learners to reflect on why they are learning about the earth's magnetic behaviour. However, Lethu did not give learners the chance to respond by combining these questions with a *yes* or *no* question, "*Do you think it is important that we learnt about this topic?*" that overshadowed them and they moved on to the uses of the magnets. This suggests that he missed a valuable moment of letting learners express themselves about this topic.

On the contrary, in Lesson 2, Lethu integrated the browsing for the definition of the cell with other ICT skills learners are expected to acquire at this level. He instructed them to create a folder for Science and Technology notes. He asked them to highlight the information found on off-line Wikipedia, paste and save them in Office Writer. Some learners seemed to have forgotten what to do, especially with copying and pasting. Many managed to highlight the definition. Lethu had to spend some time assisting individuals to succeed. Some were alternatively quickly typing instead of copying and pasting. He managed to realise some of them. However, due to a large class of about 30 learners in the computer lab, I realised that he did not manage to identify all who were typing instead of following his instructions.

This suggests that there are challenges attending individual learners in a large class. This is a class of about 60 learners and Lethu only managed to split it into two groups to suit the arranged computer and library timetables. A significant improvement in allowing learners express themselves was observed in Lesson 4, even though he missed an opportunity to pause the video on TV during the video-integrated assessment time to let learners respond before a solution is provided. He explained that he had a challenge of pausing the video because the TV remote control was no longer available, they had to plan for its replacement.

A similar pattern was observed with the rest of the observed lessons. Lethu continued the lessons, asking learners to read together information either projected on the slides,

the TV screen or the computer screen, clarifying elaborating the points on the slides. As indicated earlier, Lethu used his mobile phone to select videos to the level of learners and the videos also contained the assessment part of the lesson. This is what Lethu had to say highlighting how he accesses the videos from internet,

> *The video is from internet. I used my own phone to download it from YouTube. Then I transferred it to the computer. Then to the USB so that I play it on the screen. However, it took me some time to access the relevant video for the lesson. To find the clearest video. I had to listen to a number of them before choosing the appropriate one. That consumed a lot of my data.*

The phrases, "*use my own phone to download it, transfer it to the computer, took some time to access the clearest video, that consumed a lot of my data*" in this extract show how Lethu uses his mobile phone and data to find suitable videos for ICT integration. This was also highlighted by the principal, who indicated that teachers at his school use personal data to access internet for LO(s) such as sending e-mails and using the sunshine recorder that requires the use of the internet. The earlier lessons Lethu had a challenge of pausing the videos on TV to let learners respond before a feedback was given. However, during the last observed lesson on the excretory system, there was improvement. He strategized playing the videos monitoring using his laptop and was therefore able to pause the video for learners to respond to the posed questions.

The phrases, "*pointing on the slide, open office Libra writer, Learners moved from their computers to go see the pictures*" in Lesson Segment 3 show that Lethu uses a variety of devices in his school context. He is flexible depending on whether he has access to the computer lab or whether he uses them in the Grade 7A classroom. As indicated earlier, there are three classes in each stream, and Lethu teaches Science and Technology in Grade 7A. In the computer laboratory, in some observed lessons learners just used the computers to search for information or searched and then watched the video on the TV screen to summarise what they are learning about. For instance, in Lesson 3 in Lesson Segment 3, the lesson was started with asking for feedback from the learners about the homework given in the previous lesson. They were asked to Google examples of different types of rocks using their parents' phones at home as few examples were demonstrated projected in the classroom during the Science and Technology instruction.

However, the feedback reflected that not all learners were able to search for information on the internet due to reasons such as parents not having data; however, they used some textbooks to search for the relevant information. Those who managed to search on the internet had more unfamiliar examples of different types of rocks and the teacher highly appreciated that. The teacher also asked one student to lead the class to pronounce all the listed rocks. He confidently led the class and where some did not pronounce accurately, he pronounced the rocks and asked the class to pronounce after him. After giving feedback, learners were asked to search for one example of the stone from the list on the board using offline Wikipedia. The teacher monitored progress allowing learners to announce the found stones so that different types of stones are searched by others. He concluded the activity by checking those who did not manage to find the stones. Figure 4.13 shows learners searching stones in the computer laboratory.

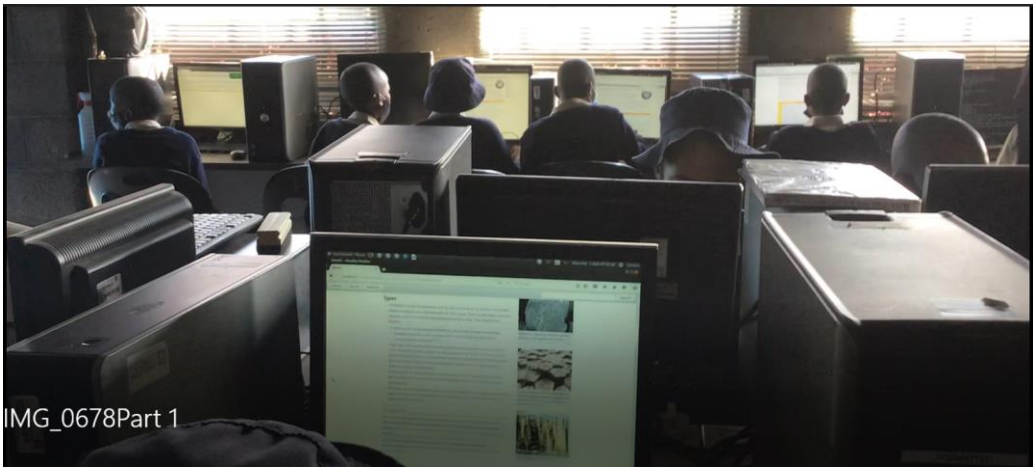


FIGURE 4.13: LETHU & LEARNERS SEARCHING DIFFERENT TYPES OF ROCKS

Figure 4.13 shows that learners succeeded to find the different types of rocks on off-line Wikipedia. It was after this browsing that Lethu asked everybody to move from one computer to another to see the variety of stones found so that they had an idea of the features of different stones. Everybody moved from one computer to another. This was followed by watching of a video summarising the different types of rocks demonstrated with examples.

Lethu continued the lessons; Lesson 1 on the earth and the compass incorporating playing the embedded video. Lesson 2 highlights how he further tested learners' ICT acquired basic skills such as creating a folder for notes, highlighting search results text

and pasting in the Office Libre writer as notes for Science and Technology. Lesson 3 also incorporated the use of video on TV screen summarising and assessing learners on rocks. Even when they indicated that they did not understand, he missed the opportunity to allow them express themselves what the challenge was. However, Lethu preferred engaging learners frequently on reading together information on the slides or on spelling out words throughout the observed lessons. Lesson Segment 4 is an extract showing the three indicated lessons.

LESSONS' CONTINUATION USING ICT IN INSTRUCTION		
Lesson 1: LO 31: Magnetism	Lesson 2: LO 15: Cell	Lesson 4: LO 35: Rocks
L(s): (reading the slide) Opposite poles, north and south attract, therefore, the earths North Pole is actually the south pole of the magnet inside the earth. T: Can you read more so that everybody can understand this. L(s): (*They repeat*) T: Here is our compass, can you see it? L(s): Yes sir Moving to the next slide T: Our needle is magnetic, to see how it works with the magnet under earth. We take this needle to see how it reacts to the magnet. The opposite, that is, North Pole and South Pole attract. That's true right? L(s): Yes, sir T: The earth's North Pole is actually the south pole of the magnet inside the earth. Do you understand that? L(s): No sir T: You don't? Tell me what you understand by this, these two attract that's true, it means the North Pole? Switched to previous slide T: On our compass, the north pole is on top of the south pole which is here (pointing on the slide), the opposite pole of the earth. North pole of the compass is actually attracting the south pole inside the earth …. … Can you read here? L(s): Will always point north towards earth's North Pole. T: Unlike poles attract. … but if it is north by north it means? L(s): They will repel... T: So I'm going to show you a video of how the compass is used. L(s): Yes, sir (*shouting with excitement*). T: …(*There is a video playing*)	T: … Highlight the definition and paste in office Libra Writer. You don't have applications, what happened to your applications (*finding no office Libra writer on the learner's computer*). You don't write, you paste what you highlighted (*confronting a learner not following instructions*). You didn't make a copy, copy first (*checking another learner*). … write science and technology notes, it is your notes. By show of hands let me see those who have done it. Learners raise their hands T: (*talking to a learner*) copy, you have opened many things and I don't know why, close these things, here is close button, enlarge. On top of it you write science and technology. (*Talking to another learner*): you didn't do as I said. … Did you all succeed? L(s) (*A few learners*): Yes, sir T: which of you are unable to do it? Then highlight the topic at the top, science and technology make it bold, that means you are going to (*showing a learner how it's done*) after highlighting it you copy and paste in Libra writer. …Make it in bold, thank you, then lick enter. Those who clicked enter let's make undo, go to edit and undo, is at the top. (*continue guiding learners experiencing challenges*) Are you done? L(s): Yes, sir	T: If you are done, turn your chair on this side, make sure where you are seating you can see the TV. Try to pay attention as much as you can so that whatever you learn from here you are going to make your own notes. Is it clear? L(s): Yes, sir T: yes, there will be questions on this. Try to listen. I hope it plays. (*The video is playing on TV showing how Sedimentary, metamorphic and igneous rocks form including examples of each and simulation of their properties*) T: can you all hear L(s): no sir T: … (*He increases the volume on TV*) (Video *on TV*): Geologists study earthquakes, volcanos, and many other elements of the earth. … It is important that we study the earth so that we know how it has changed or what changed over time …. Studying rocks, …, rocks are not all the same, the type of rock is determined by how rock is formed over time. There are three main types of rocks sedimentary, metamorphic, and igneous. Sedimentary rock is formed from particles of sand, shells, pebbles, and other pieces of material. All these parts together make up something called a sediment. … Sedimentary rocks are usually the only type of rock that contains fossils. Fossils are remains of dead animals or plants from long ago. Examples of sedimentary rocks include limestone, shale, sandstone, chalk and many others. Then metamorphic rock- under the surface of the earth, it takes millions of years as well as intense heat and pressure for metamorphic rock to be formed. … Igneous rocks are formed when magma cools and hardens. Magma is a marble rock deep within earth. It's the material inside the volcano …
KEY: ICT Resources using activities	T: Teacher	L(s): Learner(s)

LESSON SEGMENT (LETHU) 4: LETHU'S FURTHER ICT INTEGRATION PRACTICES

The phrases, "*moving to the next slide, paste in office libre Writer, there is video playing*" in Lesson Segment 4 continue to show that Lethu uses a variety of ICT devices in the observed lessons, as highlighted. For instance, in the lesson about rocks, the learners searched for rocks on the off-line Wikipedia in their computers and

then watched video on the TV screen. Figure 4.14 shows the collaged picture of learners listening attentively to the TV during assessment time as it displayed questions and responses.

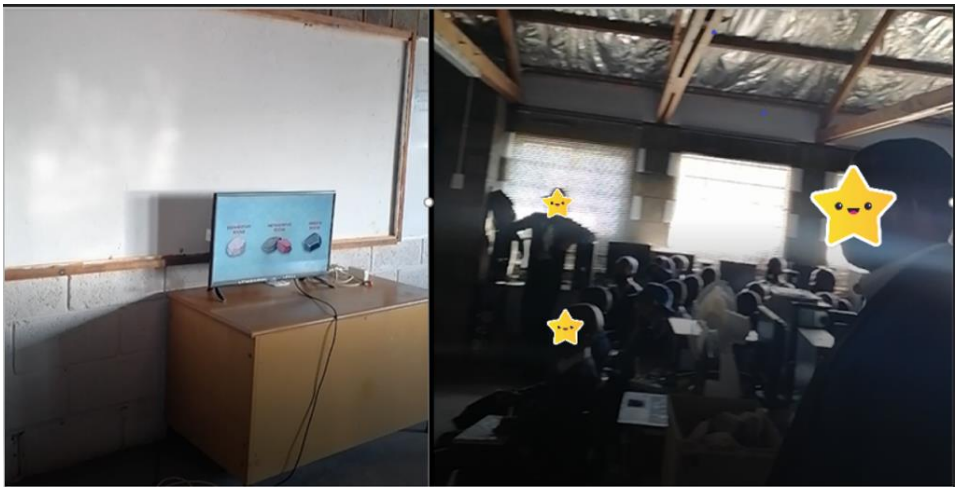


FIGURE 4.14: REAL-TIME ASSESSMENT IN LETHU'S LESSON

The picture in Figure 4.14 demonstrates that Lethu integrates teaching and assessment in instruction as advocated by the curriculum and assessment policy of 2009 indicated earlier in Table 4.1. The video posed some questions and demonstrated solutions on the content watched. Lethu also asked additional questions after the video. The principal considers his school to be lucky to have been listed by MoET in the 5 Hub Schools project and had donation of the 39 computers. He stressed,

> *We were lucky to have been identified for this partnership with Action Ireland Trust. One of the things they did after supplying us with the computers is that, we attended a one-week long training on the basics of the computer. And then we attended another week-long training session on how to integrate or use computers for teaching. So this second session, the teachers attended fairly well. But this level two proofed to be difficult for teachers, that was the session that was empowering us on integration of ICTs into teaching. I think we see the results now. Most of them are not actually doing what they were trained to do.*

The phrase in the extract, "*and then we attended another week-long training session on how to integrate or use computers for teaching*" show that teachers at Leratong PS benefited both the ICT resources and short-term training on ICT pedagogy. However, the phrases, "*level two proofed to be difficult for teachers, that was the session that was empowering us on integration of ICTs into teaching, most of them are not actually doing what they were trained to do*" in the abstract show that once-off training was not enough for many teachers in this school to develop confidence for using ICT in

instruction. Generally, in the classroom, Lethu uses his laptop projecting slides on the chalk board. Figure 4.15 shows a picture of the projected lesson on the earth and magnetic field in the classroom.

FIGURE 4.15: LETHU DEMONSTRATING THE EARTH AND MAGNETIC COMPASS

The projected slide in Figure 4.15 shows that Lethu demonstrated the inner parts of the earth using pictures and text to enable learners visualise it. He also demonstrated how the magnetic compass worked with the video in this lesson. Alternatively, Lethu also played a video on the TV screen in the classroom instruction. In this case, he downloaded the video using his mobile phone, transferred it to his personal laptop and used a USB/Flash disk to play it on the TV. It was interesting to see that learners preferred watching the video more than learning from the offline Wikipedia.

A debate emerged towards the end of this lesson about physical weathering, when Lethu reminded learners that they were revising for writing examinations after the lessons on weathering. The learners argued that they also wanted to watch the video on cells. He reminded them that they had learnt everything about cells but they emphasised that there was no part of it where they watched a video. He made them aware that he was using his data to access the videos; therefore, could not access them for everything. The learners were not convinced. He jokingly suggested that perhaps they could contribute data for him to access the videos. There were contradicting views on this matter and the teacher highlighted that he was joking, promising the learners that before the examinations they would have an opportunity to rewatch all the videos used in teaching the current topics and they would also watch the video on the cell. Even though Lethu is aware that the current curriculum requires

learners also to use mobile phones in instruction, learners are not allowed to bring mobile phones to school. This was also highlighted by the principal who stressed,

> *As for the cell phones, eeh, I think if we allow them to bring the cell phones here, there would be inequality, because most of the learners from our school come from impoverished families. Some are very poor families. The understanding is that they will not be able to bring the mobile phones. Or if they bring the cell phones, they will bring Masechocha (unsuitable cell phones). So another thing that made us prohibit them at school was that there would be a lot of stealing and a lot of misbehaviour on the part of learners. So even though I am not the one who made the resolution, it was the former principal, the use of cell phones was associated with negative behaviour of learners. So it was prohibited.*

The phrases in the extract, "*if we allow them to bring the cell phones here, there would be inequality, because most of the learners from our school come from impoverished families, that there would be a lot of stealing and a lot of misbehaviour on the part of learners*" show that there are various reasons for not allowing learners to bring mobile phones to school for learning. The expression, "*I am not the one who made the resolution, it was the former principal, it was prohibited show that the present principal inherited the practice of discouraging learners bring mobile phones to school from the former principal of this school*." This suggests that principals or management of schools take decisions about the use of mobile phones in teaching and learning. However, he further specified that one teacher was motivating the use of mobile phones at school. He indicated,

> *Interestingly one class, Grade 7C, the teacher there asked for permission to allow learners bring the cell phones to school. They are doing it in a controlled manner. The learners are doing advertisement. They recorded themselves on the phone and they are playing it on a blue tooth speaker. So I was invited to go and watch their presentations, it was interesting. But I also think that our possible resolution will eventually be to ask learners bring cell phones only when necessary.*

The phrases, "*Grade 7C, the teacher there asked for permission to allow learners bring the cell phones to school, recorded themselves on the phone, watch their presentations, possible resolution will eventually be to ask learners bring cell phones only when necessary*" in the extract show that perhaps the use of cell phones by the Grade 7C teacher may change the mind-set of the school about use of mobile phones. Presently, teachers just give learners assignments to Google using parents' phones at home. Lethu checked by a show of hands learners who managed to use the mobile phones for the assignment. In the observed lessons, it was apparent that not all

learners managed to access the mobile phones to find the solutions to the assignment, the major reason being the claim from parents that they did not have data. However, learners did attempt to use alternative means to find the relevant solution. It was also apparent that those who managed to use mobile phones at home had more information than the ones who resorted to using textbooks to find the solution.

Peak moments of the lessons

The teacher started the lesson on cells by probing the learners to indicate anything they know about the cell. Few learners raised hands. One of them mentioned the cell membrane, and another one mentioned the cell phone. Many had no idea about the cell. This suggests that learners were exposed to the scientific terminology of the cell in that lesson.

When learners were asked to browse offline about the cell, they obtained a variety of information not specifically the definition of the cell expected by the teacher, for instance, cell culture, cell cycle, and cell growth. Furthermore, there was no information specifically defining the cell. Some of the information was difficult for them to pronounce and Lethu eventually asked them if they understood the information they have found of which they indicated that they did not. Lethu then narrowed their search by guiding them search for “What is a cell?” He further guided them to search for cell, and then cell Biology. Learners then managed to find the relevant definition and pictures of cells. Figure 4.16 shows the search results displaying the cell information.

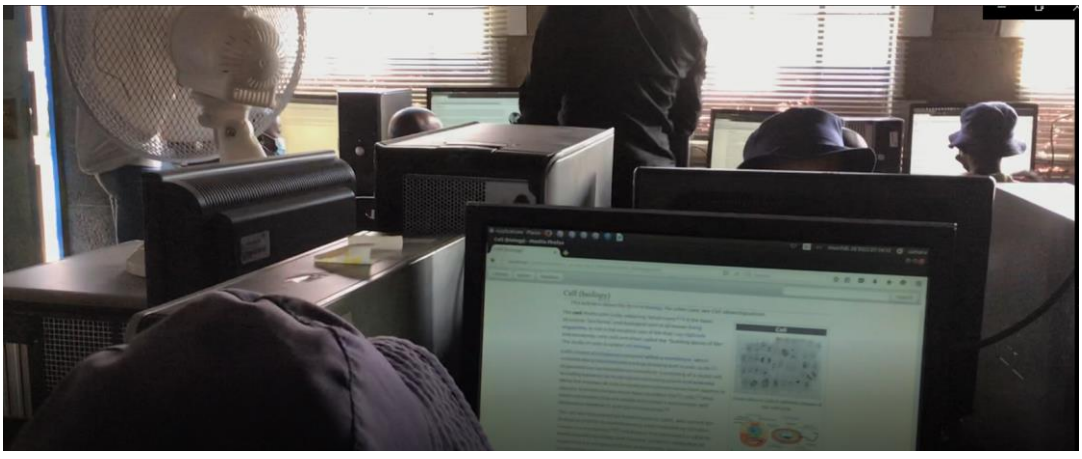


FIGURE 4.16: SEARCH RESULTS DISPLAYING THE CELL INFORMATION

It can be realised from Figure 4.16 that text and pictures about cells are also displayed to explain the abstract concept of the cell. This suggests that the computers provided

more information about the cells. Like with other lessons, Lethu asked learners to read together the definition found. It was apparent when they read that they got similar results. The teacher highlighted key issues through guided discussion and demonstrated the cell building blocks with the bricks of the computer laboratory wall. Lethu then guided learners to select and highlight the ideal explanation for the cell from the text displayed on the computer. He moved around the computer laboratory checking that learners managed to highlight the text and guided those who were struggling.

Lethu moved around frequently to check individual progress. He further tested learners' ICT skills by asking them to copy and paste the text and save as notes for future reference in the Office Libre writer. This suggests that Lethu attempts to integrate the technology domain into the science concepts. However, even though Lethu moved from one learner to the other, he did not realise that some learners who directly typed the notes in the Office Libre. When it was time for watching the videos, some learners even stood up to pay more attention. Simulation of the rock breaking into pieces cartooned within the video about weathering simplified the concept even further.

Formative Assessment in the ICT pedagogical lesson

The curriculum in the Basic Education in Lesotho stresses the use of formative assessment in teaching and learning to feedback both the teacher and the learner about the progress of attainment of competencies of learners. Lesson 1 and Lesson 4 had videos with embedded assessment tasks that required learners' responses instantly after watching the content part. On the contrary, the Lesson 2 extract highlights how Lethu assesses learners' acquired basic ICT literacy by instructing learners to use the search results to manipulate the computer to display the skills. Lesson Segment 5 shows how Lethu uses the available ICTs in the school to integrate learning and assessment in the instruction.

USING ICT FOR TEACHING AND ASSESSMENT		
Lesson 1: LO 31: Magnetism	Lesson 2: LO 15: Cell	Lesson 4: LO 35: Rocks
T: did you understand what we did today? L(s): Yes, sir T: besides what we talked about the South Pole and North Pole, the attraction and the magnetic field, what are other things we talked about? L: inner solid T: what do you remember about inner solid? … What is one use of magnet? What do we use magnets for in everyday lives? We explained the use of magnets just now. (*After a pause with no student responding*) What is the use of this (*pointing at the compass on the slide*)? L(s): it helps us to determine direction T: so you don't know the use of magnet even now?	T: … So let us save the work and write science and technology notes. You know where you were seated, don't write your name. science and technology notes, save it please. Next we are looking at plant cell, that is tomorrow. (*Talking to a learner*) did you do what I said you should do? You don't know how to highlight? (Talking to class): To those who didn't highlight and copy, we are going to fight … What are you doing today I have taught you so many times. Write Science and Technology at the top. Who didn't do all three things I want? Why are you writing in capital letters (*asking a learner*)? Write fast, Science and Technology. How many hands do we use for typing (*asking another learner*)? L(s): two hands T: Let me see (*talking to another learner*), yes here you write science and technology, don't get science spelling wrong. (*He continues helping individually those who are behind*) save and close Type science and technology notes, leave a mouse and type, … Do what you are told to do on time. Write what is a cell and close. When you are done please save and close.	(*Video play on TV*): … Ready for little review? let's get rocking. True or False: Geologists study the earth- true Geologists study the structure of the earth, how it was made and how it has changed over time – true What are three different kinds of rocks- did you remember sedimentary, metamorphic and igneous? There is only one type of igneous rock- false there are two types of igneous rocks intrusive and extrusive Fill in the line Marble is a type of … rock. Metamorphic What's one example of a sedimentary rock. Limestone, shale, sandstone and chalk. Well done everybody … T: Okay thank you. What have you learned from here? What is it that you have learned that is new? People who did not raise their hands up, does that mean you didn't learn anything? L(s): No sir. T: Yes, L1 (*pointing at a learner*). L1: I learned that igneous rocks are made by volcano T: Yes, igneous rocks are formed by volcano. Ke hona re tlo e etsa (*We are yet to do*) formation of the rocks … L2: I have learned that sedimentary rocks are rocks that are shiny and crumble easily … T: what did you learn from the short video? L3: I learned that not all rocks are the same, some we can use them to make things that can decorate in the house. T: Now we are going to talk about the uses of all these rocks and you can already see them here. Which means video contains everything I'm going to teach you and you did learn anything. L: sedimentary rocks are the only type of rocks that contain fossils … T: Your next homework is to bring different kinds of rocks, start collecting them today after school.
KEY: ICT Resources using activities Integrating assessment in teaching and learning Video embedded assessment tasks		T: Teacher L: Learner (s) LO: Learning Outcome

LESSON SEGMENT (LETHU) 5: EMBEDDED FORMATIVE ASSESSMENT IN THE LESSONS

The phrases, "*What do we use magnets for in everyday lives? (After a pause with no student responding), What is the use of this* (*pointing at the compass on the slide*)?" in Lesson Segment 5 show that learners did not fully grasp the uses of magnets relative to the compass. The response about the compass, "*it helps us to determine direction*" shows that learners understood the use of compass but disconnected it from the uses of magnets. This suggest that it may be necessary to spend more time on the magnetic concept to aid learners comprehend it. Phrases such as "*save the work and write science and technology notes, highlight and copy, how many hands do we use for typing, leave a mouse and type, save and close*" in the Lesson Segment 5 show that Lethu ensured that learners use their acquired ICT skills.

I observed in Lesson 4 in this extract that even though Lethu managed to download videos that incorporated the assessment of content learned, he was challenged by pausing the videos to enable learners respond to questions before the solution is provided. Some learners attempted to respond to some questions. However, Lethu did not encourage them to try more to respond to the questions. This suggests that Lethu missed the opportunity to motivate learners to respond faster to self-evaluate if they understood the video. Lethu mitigated that by guided discussions lead by the teacher after watching the video on the TV screen or on the projected slides.

I observed that the learners responded positively in most cases. However, it was apparent in some of their responses that they missed some information, some responding incompletely, while some were silent which may suggest that they missed some information. In some cases, the whole class had missed some information. This was the critical moment to replay the video to enable learners get the missed information. However, Lethu did not replay the video to enable learners access the missed information through the video watch mode. He provided the learners the missed information. This suggests that Lethu missed the opportunity to reinforce learnt information through using the video for learners to gather the information by themselves unlike when he projects where he shifts back and forth the slides, even the previous lessons' slides to re-affirm some previously learnt information.

When assessing the learners, pausing the video might have been a useful form of assessment in a large class. This could have benefited the learners and teachers as they get immediate feedback, which could be viewed as an added advantage for using

technology in the instruction. This suggests that Lethu, though very enriched with ICT pedagogy, may require CPD to empower him with more ICT pedagogical skills. However, Lethu stressed in the follow-up interview that the TV remote control was misplaced, making it impossible for him to pause the video. He stipulated that he was working on the plan to replace it. Alternatively, he planned to connect the TV screen to the computer so that he could manage to pause the video at intervals. This suggests that Lethu demonstrated knowledge of ICT pedagogy, but was limited by the school context constraints. It was also apparent in the observed lessons that Lethu uses his own data to access suitable videos that provides clear information and also have questions assessing what learners have acquired when listening to the videos. However, the main challenge was that the videos were displayed on the TV and there was no remote control device to pause the TV after a question was posed to enable learners respond before the solution was indicated. When asked how he could resolve this challenge, this is what Lethu had to say stressing this challenge,

> *I will not use the TV directly because of the challenge of pausing the video. So next time I will connect the TV to the desktop so that I manage to pause it.*

The use of the quote, "*next time I will connect the TV to the desktop so that I manage to pause*" in the quote show that Lethu's acquired ICT pedagogy enable him to be flexible when experiencing challenges in classroom practices of ICT integration. The quote suggests that Lethu is aware of what to do using ICTs to assess the learners, but he was prohibited by the challenges in his school environment. The lesson Segment 5 suggests that Lethu explored the available ICT facilities in his school context. It was apparent in the observed lessons that he is ICT skilled. He was able to resolve challenges that were emerging as he manipulated the ICT facilities. For instance, he realised that he could not pause the video played on TV from the flash disk. He then became flexible in the next lesson, connecting the TV to his personal laptop so that he could manage to manipulate the video as it was playing on TV. Additionally, he was supported by the principal, who also seemed to be technologically skilled and volunteered in the computer lab to assist with some of the challenges experienced.

4.2.2.4 Lethu's ICT integration collaboration practices

In the initial interview prior lesson observations, I asked Lethu about how he collaborates with teachers about use of ICTs in Science and Technology. He stated,

> *No outstanding collaboration mme (mam). I do the sciences my own way. I haven't heard of any other Grade 7 science teacher attempting to use them this year.*

The phrases, "*No outstanding collaboration, I haven't heard of any other Grade 7 science teacher attempting to use them this year*" in the quote show that the collaboration on use of ICTs in instruction is not significant at this school. The indication of no other Grade 7 teacher using ICTs was contrary to what the principal indicated about the Grade 7C teacher who is also using ICT in instruction. This further shows that there is limited collaboration on practices of ICT integration at Leratong PS. On the contrary, the principal stressed that elderly teachers who are not competent enough to use the computers, instead they ask the younger teachers to assist them when necessary. Lethu also highlighted that teachers who are not competent with using ICTs in instruction sometimes asked those who are frequently using them to teach their learners. The principal is struggling with establishing the cause of teachers' demotivation to use ICTs because he considered his school to have adequate ICT resources available even though the school does not have internet connectivity. He emphasised,

> *Most of the teachers are still using the traditional ways, of teacher talk, teacher and the chalk board, the theoretical approach. But there are a few that teach ST using the technologies available here at school. For instance, some teachers when they are talking about the circulatory system, they would take the learners to the computer lab. For instance, we have got the off-line Wikipedia there. There is a lot of information there. One of the teachers would ask learners to go over there to search for the information. For instance, when teaching about the heart. They would even demonstrate the blood circulation using the technologies we have. Whereas, the teacher in another class at the same stream would teach about the heart using the textbook, and telling the learners how the heart works and drawing it on the board.*

The phrases, "*most of the teachers are still using the traditional ways, of teacher talk, but there are a few that teach ST using the technologies available here at school, we have got the off-line Wikipedia*" in the extract show that the teachers are inadequately using the available ICT resources at Leratong PS. This may suggest lack of continual

professional development on ICT pedagogy as teachers in this school were exposed to once off training by the project that supplied the school with computers.

However, what was surprising was that the principal pointed out that all the teachers, including Lethu, were trained on ICT literacy and ICT pedagogy in 2019, and many teachers once prepared ICT-integrated lessons which he observed and were impressive, but that was a once-off done activity per the principal's instruction, even though they are currently using ICTs only insignificantly in their classroom practices. The principal stressed that he was ICT pedagogy skilled and was always advocating assisting teachers where they needed his support but unfortunately many of the teachers in the school did not integrate ICTs or sought assistance. He indicated that he was going to resolve this challenge by requesting the CPD support from the 5 Hub schools project that the school was currently part of.

4.2.2.5 The dilemma of the classroom context challenges

This section highlights some of the challenges Lethu experienced during the data collection period. The Science and Technology (ST) - in the classroom are supposed to be at least one hour. However, all the lessons observed lasted about 45 minutes. This was due to the fact that all the lessons could not start in time due to a variety of challenges encountered at the beginning of the lesson. For instance, the projector challenge: some of the lessons they had to wait for the projector borrowed from the neighbouring school when realising in the morning that the one usually used was not at school. Another challenge was the electricity. One of the observed lessons was delayed due to resolving the issue of the plug that did not work. However, it was quickly resolved. Sometimes when he intends to use the computers, the lesson is delayed when he cannot not succeed in securing the negotiated slot and has to wait for his allocated slot, which is once a week.

4.2.2.6 Synthesis of Lethu's classroom practices of ICT integration

Unique Practices

It was interesting to see presentation slides organised with less text and large displayed pictures and embedded videos sometimes with simulated and cartooned concepts. It was also interesting to see how attentive learners were when it was time to watch the video. This suggests that learners appreciate watching videos when

learning. The videos had incorporated assessment tasks and their solutions. These videos were carefully selected from YouTube using personal mobile phones and data. However, as mentioned earlier, the challenge was pausing the video to enable learners respond to assessment tasks before the solution is provided. The school strategized on handling the large class by dividing learners into two groups to enable learners work independently on the computers. When one group was in the computer lab the other group was in the library. This was the general arrangement for all grades.

It was interesting during one of the lessons to see learners demanding more videos for concepts demonstrated in PowerPoint slides or only searched on computers in the previous lessons. It was apparent that they enjoy the videos when they demanded to watch video on cells, emphasizing to Lethu that they had not watched any video in that topic. However, they had done the topic projected and they also explored the topic on offline Wikipedia in the computer lab. Whenever it was time to watch the video, some students would even stand up paying more attention. It was observed that teachers and learners at this school are at an added advantage of using a variety of available ICT tools. For instance, the computers, TV, and projected PowerPoint slides enriched with pictures and videos. Unlike the situation found at other schools about lesson planning, Lethu prepared lesson plans covering all the objectives of the Learning Outcome to be covered in a week. He also developed slides for all the objectives of an LO in one presentation that would be used the whole week.

Lethu allowed learners in the observed lessons to read information from the teacher slides or notes and also emphasised spelling of words with all learners talking at the same time most of the time. However, this suggests that some learners who struggle or are a bit slower in grasping the information might not be identified. However, Lethu considers his learners to be of different abilities and he also believes that asking learners to all shout the answer benefits the slow learners by learning from peers and building confidence as they gradually grasp the studied concepts. The differences in abilities were observed when they were asked to indicate in general what they had learnt from the video.

More also, learners revealed their inclination to watch the videos in the observed lessons. However, Lethu missed the opportunity to use videos to reaffirm what the learners had grasped, encouraging a learner-centred teaching approach. He missed

replaying the video to reinforce acquired content knowledge; instead he provided the expected responses when learners struggled to respond. Lethu's strategy for learners to share browsed information and taking of notes either from the slides or writing or saving notes in folders on the computers was also unique. For instance, in the lesson about types of rocks, he identified learners who were struggling finding examples of types of rocks. He then asked learners who had found the stones to highlight in the class the specific rock found and later allowed the whole class to rotate among the computers with displayed rocks. This suggests that learners were exposed to different types of rocks accessed by their peers. The use of the TV and the presence of the whiteboard in the classroom were also unique for this case.

4.2.2.7 Case conclusion

This case demonstrated that teacher Lethu has enriched ICT pedagogy and skills. He comfortably manipulated all the available ICT tools at his school without a struggle. However, his struggle was mainly accessing the projector for some lessons. He also believed that he could have more enriched lessons if the school could have internet connectivity as searching on the off-line Wikipedia has some limitations. In his view, it is a good thing to use ICT in instruction at this level. It is a valuable teaching aid learners are interested in and they are able to manipulate the ICT tools independently. However, he considered the main challenges as lack of resources in general at other primary schools and wished MoET could support all primary schools on ICT integration requirements. Lethu believes that currently learning is enhanced by ICT tools, even the environment where learners live is technologically driven. Therefore, learners need to be equipped with technology skills. The principal also shared the same sentiments.

4.2.3 The case of Nasi, the ICT on-the-job-trained teacher

> I acquired ICT skills and way of teaching using ICT tools through studying computer textbooks and through the help of teachers from here (at workplace).

4.2.3.1 Introducing Nasi and the Lebisang Primary School classroom profile

Nasi (pseudonym) has been a teacher at Lebisang Primary School (pseudonym) situated in the capital city of Maseru for about four years since 2016. He is a graduate of the University of Free State, majoring in Business Management and Technical Management from a college. He gained teaching pedagogy on the job training. Nasi

developed a passion to explore how the available computers at the school could be used for teaching and learning. He revealed that he learned ICT pedagogy from computer textbooks and from learning from colleagues as stated in 4.6. His transition to teaching using computers was also highlighted by the principal who said,

> *Nasi was interviewed like other teachers. E ne se ntse e le tichere ea rona mona. Ra mo tsamaisa methati e hlokahalang hore re khotsofale hore o tla khona ho ruta bana ka computer.*
>
> *(He was already our teacher here. We followed all the necessary procedures to ensure that he would manage teaching using computers).*

The phrase, "*followed all necessary procedures to ensure that he would manage teaching using computers*" in the quote shows that Nasi succeeded convincing the school administration about his potential for using ICT in teaching and learning. Nasi taught Grade 7 learners the Technology domain of the Science and Technology curriculum. The principal indicated that it is the practice of this school to allocate the strand to the teacher who is competent in ICT. This is what Nasi had to say, something that also reveals this practice of the school,

> *The other science teachers when doing the scheme, they exclude the technology part and I scheme it. They teach the other topics. We divide the work.*

The expressions, "*they exclude the technology part and I scheme it, they teach the other topics*" show that the school separates the Science and Technology syllabus into science domains and technology domains instead of integrating the technology domain within the science domain. The implication is that different schools interpreted the syllabus differently as this was not reflected in the other two cases.

The Lebisang Primary School setting and classroom profile

This is a combined primary and secondary private school, about 5 km from Maseru central. The school roll for the primary section is about 450 learners. The school also adheres to the curriculum regulated by the ministry like the government-owned schools. Learners from this school also sit for the National End-of-Level examination in Grade 7 in transition to the upper Basic Education level that leads to the LGCSE examinations in Grade 12. One computer laboratory is used by both the primary and the high school. However, the computers do not belong to the school. This is what the principal said when asked how they acquired the computers,

> *The computers are not ours; they belong to an independent company, and we are in agreement with the company to use them.*

The phrases, "*computers are not ours; they belong to an independent company, we are in agreement*" in this extract shows that the school leadership strategised to support teachers with ICT facilities for teaching and learning. It was further evident from the interview that the school has a contract with this private company, which also maintains and repairs the computers, whenever necessary.

There are 58 Grade 7 learners at this school in one classroom. Nasi divided them into three groups, each having 45 minutes in the computer laboratory during the Computer Laboratory lessons for this class. He stated,

> *Learners want to be in the computer room, but we have fewer computers than learners. So, I take them in groups to enable each learner to access the computer. After 45 minutes we take another group so that everyone can have access to computer.*

The extract shows that learners are very eager to use ICTs in their daily instruction. The eagerness is shown when the teacher said, "*Learners want to be in the computer room*." This was also supported by the principal when she stated,

> *Number of computers is limited, we need more. Bana ba bile ba aroloa ka ligroup hore ba mpe ba tsebe hoba le access ho tsona.*
>
> *(Learners are divided into groups to enable access for all)*

The phrase in the extract, "*number of computers is limited, we need more*" show that the school has a challenge of inadequate ICT resources and needs to strategize to improve the computer laboratory and increase number of computers. There is also a timetable that enables a smooth transition between the primary and the high school sections as they share the computer laboratory. This implies that schools can manage ICT integration with what they have available in their different contexts.

4.2.3.2 Nasi's Initial preparations for using the Computers in instruction

> *They (learners) cannot use the cell phones on all the topics because some topics like manually need a computer not a cell phone. Some of the tasks cannot be performed using cell phones.*

Nasi is the ICT and Arts & Entrepreneurship teacher allocated the LOs of Technology in the Science and Technology curriculum in Grade 7. This was the typical practice of this school in the implementation of the current curriculum during data collection for

this study. I was introduced to Nasi by the school principal after requesting authorisation to interview the Science and Technology teacher who uses ICT tools in classroom instruction. The teacher is a university graduate but has not been exposed to any teaching pedagogy courses at university level. He had been a teacher at this school for about four years by 2019 and had been teaching Grade 7 since January 2019. The Learning Outcomes (LOs) for Technology in the Integrated Science and Technology syllabus have been separated from other science LOs and are taught by this teacher, while the other LOs are taught by another teacher. The implication is that even though ICT and other subjects have been merged into the Science and Technology learning area, the impression of teachers at this school is that the technology part of this curriculum is clearly marked and hence they teach it separately. This suggests that Nasi's competencies on Science and Technology curriculum may be limited to the Technology domain strand.

Nasi highlighted in the interview that he learned ICT pedagogy from studying Computer Education textbooks and through collaboration with teachers at this school. He observed the teachers in classroom instruction and consulted when he encountered challenges in his classroom instruction. He stipulated,

> *If ever there is something one does not understand, we freely ask other teachers. At times we just discuss how to easily access learners through that topic to make them understand.*

The phrases, "*If ever there is something one does not understand, we freely ask other teachers, at times we just discuss how to easily access learners through that topic*" in the excerpt show that Nasi interact with colleagues to improve his ICT pedagogy. This was supported by the principal in the interview, stating that Nasi did not start teaching at this school as computer teacher; however, because of his interest and passion they observed as administration, he was given the computer-related lessons. The principal stipulated,

> *He was already a teacher here. We then realised the potential he has for teaching learners using computers ... However, he was interviewed to qualify to teach using computers. We had to be satisfied that he will manage to cope with learners.*

The phrase, "*he was interviewed to qualify to teach using computers*" in this extract shows that the administration is confident that Nasi uses computers effectively for

teaching and learning. The implication is that teachers' initiatives of developing ICT pedagogy could benefit learners.

Available ICT tools

ICT is utilized in teaching at this primary school from Grade 5 to Grade 7. There are computer desktops and sometimes learners' mobile phones are used. Almost all learners in Grades 6 to 7 have their own mobile phones. The phones are usually connected to the computers to access internet during the days when they have brought them to school. However, the common practice is predominantly the use of computers. The school uses the Wi-Fi router and the modulator for internet connectivity, whenever the teachers and the learners require to use internet. When asked to elaborate on why he considered the computer fit for the purpose of teaching the Technology domain concepts, Nasi indicated that even though the curriculum recommended that mobile phones also be used for teaching, there are challenges with some activities. He stated,

> *Though learners have cell phones, they cannot use the cell phones on all the topics because some topics like manually need a computer not a cell phone. Some of the tasks cannot be performed using cell phones.*

The phrases, "some topics like manually need a computer not a cell phone, some of the tasks cannot be performed using cell phones" in this quote shows that Nasi prefers the use of computers over the mobile phones. This suggests that, according to Nasi, learners are able to perform all the requirements and relevant activities of the current curriculum using computers. The main question is, could the learners who manage to access only mobile phones not be able to cope with ICT integration according to the current curriculum?

This may suggest the need for continuous professional development for Nasi and other Science and Technology teachers to sensitise them about diversity of ICT pedagogy opportunities on devices such as the mobile phones so that they appreciate that a mobile phone is a portable computer. Realising the need for learners to fit into the global world, the administration installed 20 computers to equip learners with ICT skills. During the interview, the principal highlighted that even though computer tools were expensive, it was the school's mandate to support teachers to function effectively to improve teaching and learning. A company contracted by the school is responsible for the maintenance of the devices. However, it was evident during the interview with

the principal that they encountered challenges. Sometimes the computers were slow or did not work, and the company sometimes delayed attending them. She emphasised,

> *Electricity cut offs, li re hlokisa botsitso. WiFi e ea re sokolisa le eona, signal in most cases is weak. Licomputer tsena tseo re li sebelisang ke tsa company, re kene selekaneng. Joale ha computer li na le bothata ba lieha ho re phallela ho li lokisa e be e setisa tsebeliso.*
>
> *(We are unstable due to frequent electricity cut offs. The Wi-Fi is also not reliable; in most cases the signal is weak. The computers we are using are also not ours, we are contracted. When the computer has a technical problem sometimes they delay to attend it. This disrupts our daily use of the computers.)*

The phrases in the quote, "*We are unstable due to frequent electricity cut offs. The Wi-Fi is also not reliable, in most cases the signal is weak, when the computer has a technical problem sometimes they (contracted company) delay to attend it*" show that the daily use of computers is frequently affected by several challenges at Lebisang PS. In the meantime, the school had plans to improve further. The administration had a plan to buy laptops for teachers who use ICTs in instruction to facilitate lesson preparations for effective teaching and learning and to encourage the teachers integrate ICTs. The school administration also provided teachers with the modulator they could freely access whenever they required the internet connectivity for teaching. The school had also authorised the use of mobile phones as required by the current curriculum. However, the principal did not like the idea of mobile phones being used at school. She stated,

> *Cell phone li ka etsa mosebetsi oo li o reretsoeng hore li o etse, bana ba ka li sebelisa hantle kapa hampe. Bana ba ka nka monyetla oa ho li sebelisa hampe. Empa joale haeba ke ntho e teng ka syllabuseng tjena eo bana ba tlo server information ba sebelisa lintho tse teng malapeng kannete ha ke tsebe ho ka etsuoa joang. Ea li cell phone kannete nna ha ke e khothaletse ha e etse bana ba hantle. … neng neng e mong o sa buile ka motsoali oa e mong, o sa itseng, e se le khathatso e ngata feela. Le mona sekolong e se e re bakela moferefere.*
>
> *(Cell phones can be used to do the targeted work efficiently, or they can be misused by the learners. Learners can take advantage of the fact that they have them and start misusing them. However, now that it is the requirement of the new syllabus, really I don't know what could be done. Especially when it requires them to use materials that are readily available at homes. The issue of cell phones by learners at school, really, I do not recommend, it contributes to learners' misbehaviour … Sometimes one talks about the parent of the other, information that causes tension. We have already encountered such problems here at school).*

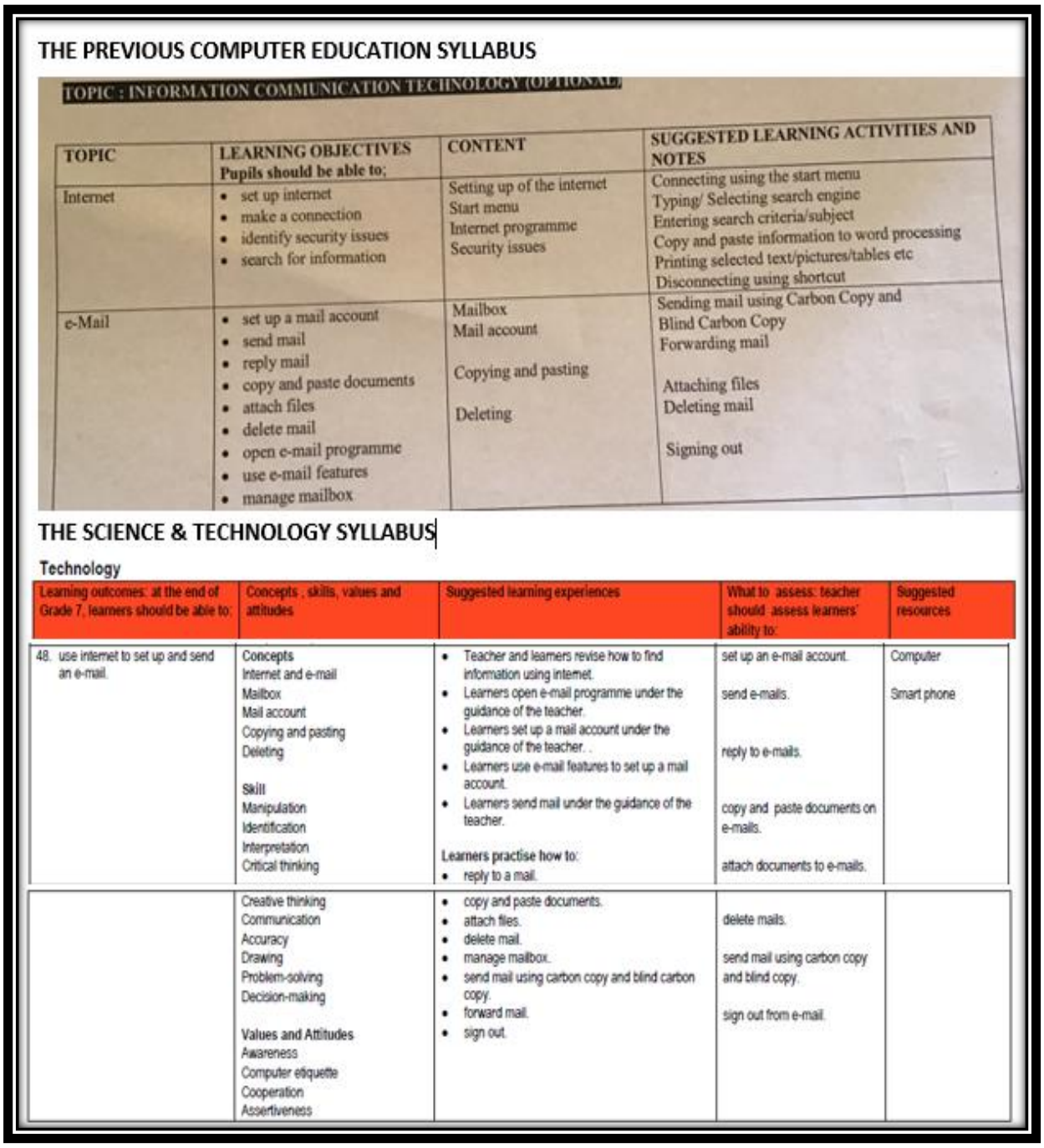
The phrases, "*learners can take advantage of the fact that they have them (mobile phones) and start misusing them, the issue of cell phones by learners at school, really, I do not recommend, it contributes to learners' misbehaviour*" in the quote show that the principal considers the use of mobile phones at school causing more trouble than learning and causing different challenges, some of which they had encountered when learners brought mobile phones for learning. The principal's concerns show some of the discourses about ICT integration in primary schools in the country.

Struggling to let go of the past computer education syllabus

Nasi relies on the Science and Technology curriculum and the previous Computer Education curriculum in planning instruction. He indicated that the current curriculum only briefly indicates the topics in the Technology domains and the former Computer Education curriculum is still relevant. He emphasised,

> *I get more details about how I should guide them acquire technology content in the computer education syllabus. Science and technology syllabus does not give details.*

The phrase, "*I get more details about how I should guide them acquire technology content in the computer education syllabus*" in the quote shows that Nasi still uses the old computer education syllabus to support him with ideas about activities he can use in instruction. Figure 4.17 indicates an example of the presentation in the current curricula and in the old computer education curriculum.



THE PREVIOUS COMPUTER EDUCATION SYLLABUS

TOPIC : INFORMATION COMMUNICATION TECHNOLOGY (OPTIONAL)

TOPIC	LEARNING OBJECTIVES Pupils should be able to;	CONTENT	SUGGESTED LEARNING ACTIVITIES AND NOTES
Internet	• set up internet • make a connection • identify security issues • search for information	Setting up of the internet Start menu Internet programme Security issues	Connecting using the start menu Typing/ Selecting search engine Entering search criteria/subject Copy and paste information to word processing Printing selected text/pictures/tables etc Disconnecting using shortcut
e-Mail	• set up a mail account • send mail • reply mail • copy and paste documents • attach files • delete mail • open e-mail programme • use e-mail features • manage mailbox	Mailbox Mail account Copying and pasting Deleting	Sending mail using Carbon Copy and Blind Carbon Copy Forwarding mail Attaching files Deleting mail Signing out

THE SCIENCE & TECHNOLOGY SYLLABUS

Technology

Learning outcomes: at the end of Grade 7, learners should be able to:	Concepts , skills, values and attitudes	Suggested learning experiences	What to assess: teacher should assess learners' ability to:	Suggested resources
48. use internet to set up and send an e-mail.	Concepts Internet and e-mail Mailbox Mail account Copying and pasting Deleting Skill Manipulation Identification Interpretation Critical thinking	• Teacher and learners revise how to find information using internet. • Learners open e-mail programme under the guidance of the teacher. • Learners set up a mail account under the guidance of the teacher. . • Learners use e-mail features to set up a mail account. • Learners send mail under the guidance of the teacher. Learners practise how to: • reply to a mail.	set up an e-mail account. send e-mails. reply to e-mails. copy and paste documents on e-mails. attach documents to e-mails.	Computer Smart phone
	Creative thinking Communication Accuracy Drawing Problem-solving Decision-making Values and Attitudes Awareness Computer etiquette Cooperation Assertiveness	• copy and paste documents. • attach files. • delete mail. • manage mailbox. • send mail using carbon copy and blind carbon copy. • forward mail. • sign out.	delete mails. send mail using carbon copy and blind copy. sign out from e-mail.	

FIGURE 4.17: COMPUTER EDUCATION SYLLABUS VS TECHNOLOGY DOMAIN SYLLABUS

Figure 4.17 shows the LO 48 that was observed in the classroom instruction. Even though Nasi believes that the Computer Education curriculum is more detailed about how to go about teaching LO 48 than the current Science and Technology Curriculum, it seems they contain similar information arranged in different headings. However, the current curriculum has additional information about the targeted competencies and skills, as well as resources, though briefly stated. This suggests that sometimes it is difficult for teachers to let go of what they are used to. Nasi is struggling with letting go

of the previous Computer education curriculum. This was recognised by Cohen (1990:323) in the case of Mrs O who had a mixture of traditional teaching and learner-centred teaching when implementing a new reform in teaching of mathematics. He stated, “After all teachers and students who try to carry out such change are historical beings. They cannot simply shed their old ideas and practices like a shabby coat.” This suggests that Nasi may need support to shift.

Incorporating ICT into lesson planning

Figure 4.18 shows part of three lesson plans of Nasi with impression of use of ICTs.

NASSI’S LESSON PLANNING		
Date: 13 August 2019 **(Grade 7)** **Class Size:** 29/58	**Date: 16 August 2019** **(Grade 7)** **Class Size: 29/58**	**Date: 25 February 2022** **(Grade 7) Class Size:** **Class Size:**
LO		
LO 48: Use internet to set up and send e-mails Concept: Creating e-mails	**LO 47:** Format text on a slide using PowerPoint. Concept: Presentation	**LO 46**: Perform basic functions of excel programme. Concept: Spreadsheet
Objectives: By the end of the lesson, learners should have begun to:		
i) Create e-mails	i) Create objects like pie, bar graph, line graph	i) Fill in the spreadsheet
Materials		
Computer	Computer	Computer
Methods		
Discussion	Discussion & Observation	Discussion
Assessment Criteria		
E-mail	Presentation	Presentation
Assessment Method		
Observation & Discussion	Observation & Discussion	Observation & Discussion
Lesson Plans ICT integration activities		
LO 48 : Creating e-mails	**LO 47 :** Presentation	**LO 46 :** Spreadsheet
Teacher (T): Explains what is an e-mail The benefits of the internet Show how to create e-mail **Learners (L)**: Explain the benefits of the internet Learners create e-mails	**Teacher (T)**: Explains what is presentation Discuss different types of presentations **Learners (L)**: Show different presentations	**Teacher (T)**: Explains what is spreadsheet How to fill in the cells **Learners (L)**: Fill in the spreadsheet

FIGURE 4.18: SNAPSHOT OF NASI’S LESSON PLANS

The material stated in the extract as, “*computers*” show that Nasi incorporates the use of ICT resources in lesson planning. The phrases, “*showing how to create e-mail, benefits of internet, show different presentations, fill in the spreadsheet*” in the planned teacher and learners’ activities show that Nasi was going to have ICT integration in these lessons. Though very brief, the lesson plans show that Nasi incorporates ICTs in his planning for instruction.

Figure 4.18 highlights lesson activities stipulated in the lesson plan. The lessons were on the LOs from the Technology domain of the Science and Technology syllabus for Grade 7. Though briefly stated, the teacher had indicated how the computers were going to be used in the instruction under teachers and learners' activities. The objective clearly stated what is expected of the learners by the end of the lesson. Moreover, the teaching material was stipulated as computer in these lessons. For the first lesson on creation and sending of e-mails, the assessment criteria were indicated as e-mail. Learners were expected to send one another developed documents through e-mails. However, there was a challenge of availability of internet that day and learners could not send one another e-mails. The teacher indicated that he would assess that part in the form of an assignment. For the second lesson, on preparation of the PowerPoint presentation, the assessment criteria were indicated as presentations, while the third lesson about spreadsheet also had presentation as assessment criteria. However, the lesson plans seemed to be lacking thorough details of how learners would be involved. The lesson observations helped to unpack the plan.

The Initial Introduction phase

Like other participants in the study, before observing Nasi's lessons, I had an initial interview, which provided an overview of how Nasi generally integrates ICTs in his classroom practices. Observing Nasi in the computer room, I could notice his passion for using computers in the instructional practices. Nasi' allowed the learners to manipulate the computers the basic ICT skills acquired in previous lessons. I observed Nasi in five lessons from 2019 to additional observations in 2022, which were done to provide more evidence of the teachers' practices of use of ICTs in instruction. Two lessons were presented to a Grade 7 class of 58 learners in August 2019, which had 26 boys and 32 girls and three lessons to a class of 90 learners in February/March/April in 2022, which had 35 boys and 55 girls. The schools' activities including the Easter break in 2022 could not allow a continuous three weeks of observations. The lessons were consistently presented after morning break during the computer lab slot for Grade 7. In 2019,

I observed one third of the learners in the computer laboratory as the learners were divided into three groups to enable effective hands on exposure for all. Nasi would have 45 minutes, which he would use to teach these learners, then in the next days,

he would take the other groups to the computer laboratory for the same lesson. Nasi ensured that there were no more than two learners on a computer in 2019. In 2022, Nasi slightly changed the approach. He had one slot per week for Grade 7 learners, due to the growing demand of use of the computer lab as the primary and high school sections share the same computer lab. Therefore, in 2022, struggling with sanitizing learners first before they entered the computer due to Covid-19 preventive measures that needed to be considered, learners came into the computer lab still in groups, but in such a way that all groups came in one period. Nasi let those who finished quicker leave the computer lab and kept on allowing others to come in to use the free computers until all managed to visit the computer lab. However, the challenge was that many had to wait in the queue outside the computer lab while awaiting the free computers. This suggests that the 2022 plan may require to be reviewed. Lesson Segment 1 shows Nasi's directed introduction which happened in three lessons.

INTRODUCING THREE LESSONS		
Date: 13/08/2019	**Date: 16/08/ 2019**	**Date: 25/02/2022**
Lesson 1: LO 48 : Creating e-mails	**Lesson 2: LO 47:** Presentation	**Lesson 3: LO 46:** Spreadsheet
INTRODUCTION		
Teacher (T): You are going to have your lesson in three phases. The first phase is developing an invitation card. (He writes Phase 1Invitation card; on the chalk board). You are inviting a friend to your end of year grade 7 graduation ceremony. (Learners use different templates from Microsoft Outlook) **T**: Remember the invitation card has date and venue. **T**: U ka se meme motho u sa mo fe date le ho mo joetsa o ea hokae (You cannot invite a person without indicating where the person should go to). **(Background**: Learners are murmuring engaged in discussions as they share computers in pairs). **T**: (*Checking progress*) This is not a letter, it's an invitation card (*Warning some learners who write more details*). Shorten your messages. **T**: If text does not fit, you have to improvise. Shorten your message.	Nasi is sorting learners to share the computers in pairs. There are 29 learners in this group. **T**: You are going to use the computers to develop a presentation (*He writes on the board, then moves around to check as he instructs the learners. He continues*). You log on the Microsoft PowerPoint. **T**: (*Addressing a pair of learners looking at their computer*). No, no, you are not yet at the PowerPoint. Next time you click the start button, then you can see it over here (*pointing at the displayed menu*). (*Some learners have succeeded they have displayed the first slide*). **T**: Microsoft office, it includes PowerPoint. Then after clicking PowerPoint, click insert. (He moves around to check that learners are succeeding). You go to insert (*He repeats*). **T**: Now after insert, I am sure everybody is on insert now. **L(s)**: Yes, sir. **T**: After insert, left click chart. Left click chart (He repeats, then calls a learner pointing at her computer). Here it is. Click chart. You go to that picture of the chart. (*He checks learners' computers nearby*). There you go. And then you go to bar, on the left. On the left panel you see some options there. You go to Bar. Do you all see Bar? **L(s)**: Yes, Sir. **T**: (*Moving around checking progress*). Then you choose line graph. (*He corrects a group*): No, the lines are here why take the zig-zags? You choose no 4. You choose no 4 (He repeats). **T**: (comments at another pair of learners): No, no, this is not the line graph, select no 4 over here (*pointing at the line graph, then moves to other groups*). **T**: (*At another group*) Close, you choose a bar graph, not a line graph. Can you start afresh. **L (s)**: Yes, sir. (He asked a few more learners to make a correction, to choose the line graph, then continues).	Learners are in the computer lab. They are given work to do, they are sharing computers in pairs. **T**: Open the spreadsheet, fill in the information on the board, let's not be noisy, you have only twenty minutes to finish. You have to calculate the totals. (*A table of 4 learners and their marks in 4 subjects is displayed and additional column where they need to calculate the totals and average*). **L**: sir (calls for help) **T**: After calculating you present the information on a pie chart or a bar chart
KEY: Manipulating Available ICT Resources — T: Teacher Nasi's directed instructions — L: Learner(s) LO: Learning Outcome		

LESSON SEGMENT (NASI) 1: INTRODUCING LESSONS

Lesson Segment 1 shows how Nasi introduced three of the observed lessons in the computer laboratory. The phrase, "*First phase is developing the invitation card, you are inviting a friend to your end of grade 7 ceremony*" in Lesson 1 shows that learners were designing an invitation card for a graduation ceremony. During the course of the lesson, the learners created e-mails to send the invitation card to friends. Nasi was teaching LO 48 of Science and Technology curriculum in this grade where the

objective of the lesson is to create and sent e-mails attaching documents. Nasi thought of a suitable document that these learners could create and attach to the e-mail. This suggests that Nasi attempted to develop a suitable task within the learners' context, as these are the Grade 7 learners who are graduating soon. Phrases in Lesson Segment 1, "*learners use different templates from Microsoft Outlook, they share computers in pairs, use computers to develop presentations, log on the Microsoft PowerPoint, Open the spreadsheet*" show that Nasi was using a variety of ICT application soft wares available in the computers in the context of Lebisang PS. This showed Nasi's competencies of manipulating ICT for teaching and learning.

4.2.3.3 Using ICT in instructional practices incorporating formative assessment

The learners looked excited to design beautiful invitation cards in lesson 2. Figure 4.19 shows learners creating the invitation card.

FIGURE 4.19: NASI'S LEARNERS ENGAGED IN AN ACTIVITY IN THE COMPUTER LABORATORY

Figure 4.19 shows different groups using different templates. This can be considered as a conducive atmosphere for instilling creativity and collaboration skills among the learners as some of the requirements for the current curriculum. This suggests that Nasi encouraged learners use technology to improve their creativity. Most of the time, Nasi facilitated teaching by giving instruction to the learners for using the computers.

As indicated in Lesson 1 Segment 1, Nasi emphasised the insertion of dates and venues as he noticed that some left out that important information. I observed that learners used a variety of templates and different formats of text and colours to decorate their cards. Moreover, learners worked at different paces, and he kept checking progress, sometimes asking those who had finished to indicate so that he

could guide them to continue. He frequently moved around to check progress and he was conscious not to confuse the few learners who were a few steps behind. He was frequently at their desks to assist them with catching up without wasting time for others.

Lesson 2 in Lesson Segment 1 shows learners developing a presentation for parents about four learners' performance. Nasi guided learners to present the learners' marks using the line graph and to write comments to the parents interpreting the line graphs. The assessment criteria was the slide show presentation. This is **LO 47:** Format text on a slide using PowerPoint in the Grade 7 Syllabus while Lesson 3 in Figure FF is **LO 46**: Perform basic functions of excel programme

Figure 4.20 shows the teacher attending learners.

FIGURE 4.20: NASI ATTENDING LEARNERS CHALLENGES IN THE INSTRUCTION

The picture in Figure 4.20 shows that both Nasi and the learners focused on the computer as he helped them. I observed that the learners were working independently on the computers as he verbally instructed them, without doing any demonstration and learners were free to call him any time, when encountering challenges.

Lesson Segment 2 shows how the three lessons continued.

CONTINUATION OF THE THREE LESSONS		
Date: 13/08/2019	**Date: 16/08/ 2019**	**Date: 25/02/2022**
Lesson 1: LO 48 : Creating e-mails	**Lesson 2: LO 47:** Presentation	**Lesson 3: LO 46:** Spreadsheet
T: (moving around to check progress, commenting as he passes along) By show of hands, how many are in phase 2 (*written on the chalkboard*)? When you are done with phase 1 safe the document as invitation card. Once you have opened Micro soft Outlook, wait for me. (Some learners seemed to have forgotten how to safe. He reminded them) T: Click the safe icon. E tla u botsa (It will ask you), then click yes and safe it as invitation card. (*He moves around to check progress. He checks if they are opening micro soft outlook. He finds some opening the PowerPoint. He directs them to micro soft office, frequently reminds them that this is not a letter but an invitation card*). T: For those who have opened Microsoft Outlook, Click next, except you (*calling a learner by name*). Then you click no. After pressing no, click next then you click continue with no e-mail support. Then you click finish. T: (*After a pause*) Then enlarge the window. And then click safe, It will give you an option of yes, no or remind me later. And click remind me later. So the Microsoft Outlook you have opened, do you see it? That is how an e-mail account looks like. So you are going to send that invitation card to a particular friend. T: (*He continues*): So we are now in Phase 3. On the left, you have inbox, sent, (*ie etc*) Then you click new. Do you see where it leads to? That's where you write the address of the person you want to send the e-mail.	T: On top for Category 1, you write names, type names. Type names (He repeats, moving around to check progress). Underneath names, you type in the names over there, on the board. (*He moves around, help some who are behind. He continues writing on the board, the marks for the indicated subjects.*) T: Are you aware that the lines keep changing as you type in the information?) L: Yes, sir. T: When you are done entering the marks for these particular learners, then click the exit button on Microsoft office excel. It will show graph only. (*Looking at the computer of two learners*). Exit guys… (He moves around to check progress, then comments) It will give you an option to click to add title on the graph. L: Sir, where is exit? T: (*points on the computer*) Over there, top right. (He moves around and emphasises again) Click to add title. (*Learners are typing, he continues stressing clicking next line and typing the title*). T: Type June examination (*pointing at one computer*). T: Click to add text. As a teacher of those four students, write your own comments in 5 minutes. T: (*He continues after a pause*) Or let's make it easy (*He writes guidance on the board*). On the first slide where you write comments, click to add text about the first learner. Let's do that. The first page you talk about Lindy, when you are done commending about Lindi, …. (He moves around and stressed) You commend based on the results and your graphs. (*Learners are on the second slide writing commends for the first learner Lindy*). T: You commend on Lindy's work or performance. (*Nasi moves around guiding individuals according to stages where they are)* T: When you are done with Lindy, click new slide again. Click New slide. Click to add title, Enter the name of the second learner, Siswe. Click to add title and type Siswe (He repeats). If you are on the third person, that would be your third page. Is it? **L(s)**: Yes sir	T: You are left with ten minutes. You present your work on a pie chart or bar chart and when you are done please raise up your hand. And when you have presented your work you may leave. Only few learners are done T: You are left with five minutes. You may leave (talking to *those who have finished*) (*The first group, all are done and they leave the computer room. Another group comes in, Nasi sanitizing all the learners as they enter*) T: (*Highlighting the activity on the chalkboard to the incoming group*) We have Sello, Limpho, Lesego and John. We have subjects Sesotho, French, maths, English and you fill in totals and average on your own in less than … minutes. You start with names. We all participate. We use both hands when typing, you have 15 minutes to finish. When you are done calculating the totals and averages, you present your work on a pie chart or a bar chart. When you are done you may leave. You did not highlight the correct information. Highlight the right information L: Sir (calling for Nasi's attention)
KEY: Manipulating available ICT Resources T: Teacher L(s): Learner(s)		

LESSON SEGMENT (NASI) 2: GUIDING LEARNERS IN THE COMPUTER LAB

Lesson Segment 2 shows how Nasi integrated teaching and assessment in instruction as advocated by the current Curriculum and Assessment Policy (MoET, 2009) of Lesotho. Once the majority had completed the design of the invitation card, he wrote phase two of the task on the board. Phase two of Lesson 1 was where they would create e-mails to attach the invitation card. The phrases in Lesson 1, "*those who have*

opened Microsoft Outlook, click next, click continue with no e-mail support, type names, click add title, click add text, click exit button on Microsoft excel, click new slide, present your work on a pie chart or bar chart" show how Nasi guided learners step by step to manipulate the application software in the ICT integration classroom practices. Regardless of the challenges with internet connectivity Nasi guided the learners to use the Microsoft computer software to create e-mails offline.

In lesson 1, learners could not access the internet because the modulator had a technical problem. These are some of the challenges experienced at primary schools attempting ICT integration with limited capacity of internet connectivity and other ICT resources. In Lesson 2, they have to write comments to parents about performance of the learners, interpreting the line graphs emerging as they fit in. Information about these learners' scores is fitted in the line graph selected from the PowerPoint slide. Learners move at a different pace, successfully reaching the presentation stage. In Lesson 3, learners explore using the spreadsheet to draw either the pie or bar chart, which they also did successfully. Lesson Segment 3 (Nasi) shows how Nasi completed the lessons with checking learners instantly whether they achieved the objective of the lesson as indicated in Figure 4.1.8.

ASSESSING ACHIEVEMENTS IN THE THREE LESSONS		
Date: 13/08/2019	**Date: 16/08/ 2019**	**Date: 25/02/2022**
LO 48 : Creating e-mails	**LO 47:** Presentation	**LO 46:** Spreadsheet
Challenging learners to work independently		
(*The learners were then puzzled. He gave an example of e-mail address on the board).* T: Create e-mail addresses. Use your imagination for now. *(Some were wondering where to get the @ sign, but he asked them to find for themselves. They struggled to access it as there are two numbers on that key. One learner quickly found it and share with the class. Nasi and the class clapped to congratulate her).* T: What do you think should be written on the subject? L: We are supposed to write invitation card. T: Very good, (*and the class clapped in appreciation.*) When you (*class*) are done with the subject, up there (*pointing at menu*), there is message, insert, format text etc. Then left click insert. Do you see attach file? **L(s)**: Yes sir. T: Then left click and insert file. Where it is blinking file name, you type invitation card. (*He moves around to check progress and helped some learners. He repeatedly indicated that they click insert file and write invitation card. Some were struggling to access the card*). T: Probably you did not safe it as invitation card. (*He identified some who did not safe it as Invitation card as the message was showing that file not found. He warned them that as they type invitation card before finishing the present options will appear and they click one of them. … He moves backwards to guide others*). T: If now we had internet access, and were using real e-mails, then we would be sending the e-mails. (*The learners were happy and they clapped for themselves*). T: We are going to create real accounts when there is internet.	T: (*Pointing at the chalk board*) Here it is, Siswe, write the spelling correctly. When you are done with Siswe, click to add title on the next page and write Siswe. … After writing Siswe, you know what to do. T: (*He checks one computer and commends*) You have written enough about Siswe, go to the next learner. T: You don't have to wait …, you know what to do now. (*Pause, he commends guiding those left a bit behind as he checks their computers*) Yes, you click title, add … Whom are you going to talk about. (*The lesson continues with learners' differing paces. Some on the 2nd, 3rd or 4th learner*). T: What do you think you have to do after the last learner? (*No response, he directs them*) You go to slide show. T:(*He writes on the board as he talks*). Phase 3; Slide Show. You click slide show and then click from beginning. You click from beginning (*He repeats*). It will give you slide show. That's how you are going to present your comments to the parents, on a slide show presentation. (He moves around to check all managed to have slide show). T: When you click the forward arrow on the keyboard, it has to change. The forward arrow on the keyboard (*He repeats*). Or you can even do the same by doing the left single click, it will change. T: (*Pointing to the computer*) I said click the forward arrow, on those four arrows, these ones (*pointing at the arrows*). T: … When you want to talk about Lindi, you click forward, Lindi's comments appears. (*Learners are clicking arrows exploring*). (*He moves around stressing what to do for learners left behind. Some have finished and are exploring the presentation, some are still finishing comments for the last 2 learners, reaching slide show through his guidance)*	Learners get settled. T: These computers are not working, let's go back to class. (*Some learners are in the computer lab, some had to go back to class*) T: Yes you may start, open the spreadsheet. Copy words on the board, you have Sello, Limpho, Lesego and John. You have subjects Sesotho, French, maths, and English, all you have to do is to fill in the totals and average on your own. You calculate the totals and then average. Which group is done? Some groups are done T: Okay you are also done, you may leave (*They are done. Another group is in following the same pattern until the whole class is done)*
KEY: Manipulating the ICT Resources — T: Teacher Challenging learners thinking skills — L: Learner LO: Learning Outcome		

LESSON SEGMENT (NASI) 3: NASI ASSESSING LEARNERS IN REAL TIME

Lesson Segment 3 shows how Nasi attempts to guide learners to work independently to complete the exercises in the three lessons. Phrases such as, "*Create e-mail addresses, insert, format text, left click and insert file, click slide show and then click from beginning, Learners are clicking arrows exploring, Open the spreadsheet, copy*

word son the board" continue to show Nasi's instructions allowing learners to explore the Application soft wares for educational use. Phrases such as, "*Use your imagination for now, what do you think should be written on the subject, what do you think you have to do after the last learner? (No response, he directs them) You go to slide show*" in the extract show that Nasi monitored learners closely to establish the achieved competencies and to offer assistance accordingly and intervene where they encounter challenges. However, the challenge with the lessons observed in 2022 were that some learners spent some time on queues outside the computer lab awaiting their turn into the lab and sometimes the teacher was sanitizing those entering as others left the computer lab. This led to some inconsistency in guiding the incoming learners about the task of the day. This suggests that Nasi might have handled the situation better if he had an assistant in the computer lab. A similar pattern was observed in all observed lessons.

Enabling opportunity of learners' access to computers

The computers in this school were fewer in number compared to the number of learners per classroom. To overcome this challenge, Nasi had a strategy. The group of 58 Grade 7 learners was divided into three groups and each group was allocated 45 minutes in the computer laboratory for a lesson. This was to grant all learners access to the computers. This reflected Nasi's CA, enabling all learners to access the computers for learning Science and Technology. This is what Nasi indicated in the interview when I was interested to know how he coped with 58 learners and 20 computers available in the computer room,

> *I take them in sessions/groups to enable each learner to access the computer. After 45 minutes we take another group so that everyone can have access to computer. There are 58 Grade 7 learners. I have three groups, each taking 45 minutes in the computer lab.*

The phrases in the extract, "*I take them in sessions/groups to enable each learner to access the computer, I have three groups, each taking 45 minutes in the computer lab.*" show that even though Nasi has a large class, his strategy of dividing them into three groups, going to the computer laboratory in shifts, enabled him to focus on few learners working in pairs at a time. This was corroborated by the principal who said,

> *Bana Ba bile ba aroloa ka ligroup hore ba mpe ba tsebe hoba le access. Ligroup li nkuoa ka mekhahlelo ho fihlela bohle ba khonne ho ea computer lab.*

> *(The learners are divided into groups to ensure access to all. They take the groups in turns until all managed to be in the computer lab).*

The phrase, "*they take the groups in turns until all managed to be in the computer lab*" continues to show that the teachers planned accordingly to ensure that learners in large classes also acquire ICT skills for survival in the global world. This was also evident in the observation lessons where there was just about a third of learners in the computer laboratory. This suggests that Nasi plans ahead of time how he could use the computers effectively to reach all the learners. This also suggests that teachers could assess conditions at their respective schools and strategize to ensure that all learners benefit from using the ICTs in teaching and learning.

However, challenges experienced in 2022 allowed some groups to have three to four learners on one computer in some lessons. For instance, in a lesson about the spreadsheet, the first group completed the task successfully. When more learners continued coming in as those who had finished the task left the computer lab, some computers just turned off due to an electricity supply challenge Nasi could not resolve. He had no choice but to have many learners on the computers that were still working. In the observed lessons, Nasi guided learners with instructions presented on the chalkboard for reference written gradually for learners to follow and manipulate the computers. In 2022, when a pair or three learners working on the computer had finished, Nasi deleted the work done to enable the incoming learners find the computers ready. He would then sanitize a few more learners to occupy the available computers. They also attended extra lessons after school, especially learners who did not cope during the lesson. Nasi underscored,

> *I believe the extra classes helped them. We do practical work after school in groups.*

The phrase, "*I believe the extra classes helped them*" in the quote shows that Nasi is committed to ensuring that all learners understand what was covered in the lessons and master use of ICTs in learning to prepare them for fitting in the global world. Nasi further indicated that some days they asked learners to come to school with mobile phones to show them that they could use them as well for accessing educational information. He said,

> *Some parents even sacrifice and lend the children their mobile phones for the particular days when they are needed.*

The phrase, "*lend the children their (parents) mobile phones*" shows the collaborative support of parents for successful ICT integration in this school. The parental involvement was also highlighted by the principal in the interview when she said,

> *Boholo ba nako, ngoana e mong le e mong mona sekolong kannete ba tla le cell phone. Haholo-holo Grade 6 le 7. Ka nako e ngoe motsoali o bile o tella ngoana oa hae ea hae hore feela le eena a be le eona joalo ka ba bang mohla li hlokoang.*
>
> *(Most of the time, almost all learners I think they bring cell phones. They have very advanced cell phones especially in Grades 6 and 7. Some parents even sacrifice and lend the children their cell phones for the particular days when they are needed).*

The phrases, "*they (learners) have very advanced cell phones especially in Grades 6 and 7, some parents even sacrifice and lend the children their cell phones*" in the extract reflects the principal's appreciation of the parents' commitment to supporting ICT integration at Lebisang PS. This suggests that learner's exposure to the use of mobile phones in an educational context could enables learners to continue working on concepts, even at home beyond classroom boundaries.

Discourses about mobile phones

The principal of Lebisang PS does not support the idea of learners coming to school with mobile phones. She expressed her concerns with this part of the new curriculum. This is what the principal had to specify,

> *What I do not support, is the fact that according to the new curriculum learners need to come to school with mobile phones. Mobile phones can be used to do the targeted work efficiently or they can be misused by the learners. … This is not adding any value to their education.*

The phrases, "*they can be misused by the learners, this is not adding any value to their education*" in the extract show that she believes that mobile phones are sometimes a distraction; learners use them beyond what is expected in the curriculum by disseminating unexpected information. These are some of discourses around use of ICTs in classroom practices. However, she appreciated that using mobile phones in this curriculum encouraged learners to use what was available at home when she stressed,

> *However, now that it is the requirement of the new syllabus, really, I don't know what could be done. Especially when it requires them to use materials that are readily available at homes.*

The phrase in the extract, "*now that it is the requirement of the new syllabus, really, I*

don't know what could be done" suggests that for the principal there was more risk than benefit of the use of mobile phones in teaching and learning. When sharing challenges encountered when learners brought mobile phones, the principal indicated that mobile phones distracted learners. She highlighted that they had once dealt with disciplinary measures on the misuse of mobile phones on matters not related to education. For instance, they had to handle a case where learners talked about parents of another learner. This is what the principal said in the interview,

> *Sometimes you find that they create groups, and one talks about the parent of the other, information that causes tension. We have already encountered such problems here at school.*

The phrases, "*one talks about the parent of the other, information that causes tension, have already encountered such problems here at school*" in the quote further show that the principal sees more threats than opportunities for learners' use of mobile phones at school. This issue did not emerge in any of Nasi's interviews. It can be argued that Nasi sees more good opportunities than the challenges, to such an extent that the good opportunities override the challenges.

To overcome the mobile phones' distractions, it was evident in the interviews that the school had developed control measures. The principal highlighted,

> *We control the use of mobile phones here at school by the fact that if the teacher has asked learners to bring mobile phones in a particular day, the mobile phones are kept by the teacher until the time to go to the computer lab. After use in the lab the teacher collects and keep the mobile phones until after school when learners collect them to take them back home.*

The phrases in the extract, "*we control the use of mobile phones here at school, the mobile phones are kept by the teacher until the time to go to the computer lab, keep the mobile phones until after school when learners collect them*" show that although mobile phones could be used for effective learning and teaching, their presence in the school requires closer monitoring of learners to avoid unanticipated distractions. However, learners did not use mobile phones in the observed lessons, they only used computers.

Like other participants, the school relies on the Science and Technology curriculum for integrating ICT into teaching and learning. The teacher does not have the MoET (2009) document and the other policy framework documents that informs the curriculum. He stipulated,

To my knowledge they (supporting documents from the ministry) are not there.

The quote suggests that Nasi is unfamiliar with the policy documents informing ICT integration. This is typical of most teachers in Basic Education, as they are usually provided with the syllabus as the implementing tool for policies in education.

The next session elaborates on how the school operates with ICT integration.

4.2.3.4 The school's adaptation to the current curriculum

This school has two teachers for the Science and Technology curriculum in Grade 7. One teacher is allocated all the science domains of the syllabus and Nasi is allocated the Learning Outcomes (LOs), specifically in the domain of Technology, which are LO 44 to 48. Nasi displayed adequate knowledge of these LOs in the observed lessons. I observed him handling LO 46, 47 and 48 in classroom instruction in the computer laboratory. The content for LO 47 requires of learners to do the following on the slides: format text, apply background colours, font, its colour and size, set time and sound effects, and apply design templates and present information using slides.

One of the lessons was introduced with a task about the performance of four learners in a June examination. Nasi introduced the lesson, indicating that they were going to prepare presentations. It was further revealed in the step-by-step instruction provided to learners for developing the PowerPoint presentation slides. Learners followed directions to develop slides and the teacher frequently moved around to check whether they were following.

Nasi was able to guide learners to use the computer desktops to analyse the performance of learners in a given scenario. He was also able to assist learners to use the computers, guiding them overcome challenges of connection or the use of irrelevant software. After the learners had fit in the information into tables on the computer and generated the graphs, they had to analyse the graphs. Learners were further asked to imagine themselves as teachers of the learners in the task and write comments to the parents about these learners' performance. Nasi stipulated,

> *Write your comments as teachers of those learners. First page comment about the first student. Bulletin your comments. Look on the menu where you can get the bulleting. Talk about the student based on the performance … When you are done write about performance of the second person in the next page and so on. You act as their teacher; those are your students.*

The phrases in the quote, "*talk about the student based on the performance, act as their teacher*" show that Nasi guided learners to use information achieved through ICT to facilitate their development of critical thinking skills. Figure 4.21 shows the summary of instruction at one point in the lesson.

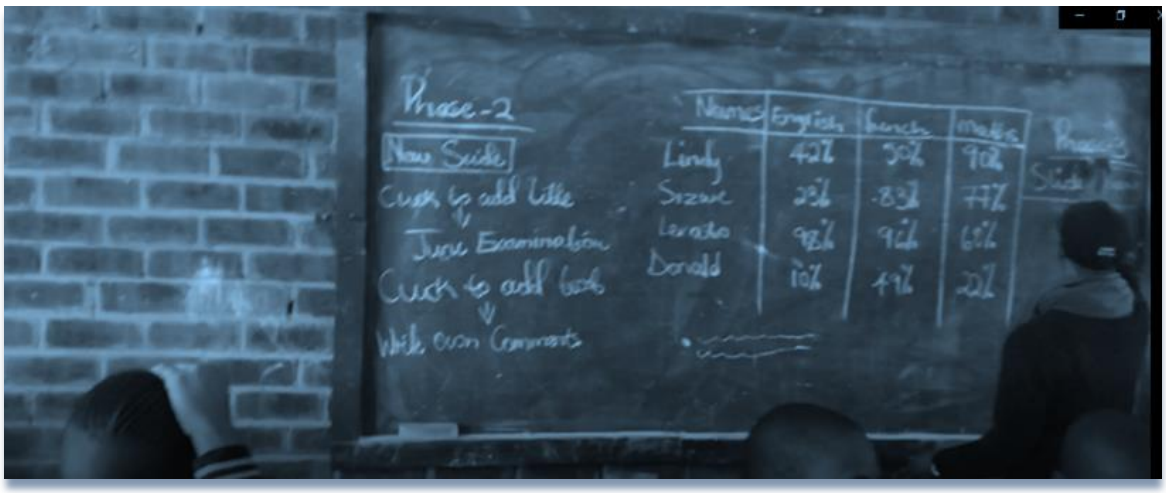


FIGURE 4.21: SUMMARY OF KEY POINTS NOTED ON THE BOARD FOR REFERENCE

Figure 4.21 shows the summary of activities done in the lesson as Nasi writes the instructions in phases on the chalkboard. The purpose of this picture is to show that Nasi organised his instruction in a way that would enable even slow learners to catch up as they realise the stage at which they are. He used scenarios about common events in learners' context. For instance, learners had an idea of what the June examinations entailed and the fact that performance was reported to parents. At that moment, pairs critiqued the results, writing comments about them, sharing ideas about the performance in the given scenario, using statistical diagrams to make comparisons.

The use of the scenario in this lesson suggests that Nasi developed learners' critical thinking skills using computer software to draw graphs and analyse results. That was also reflected in his instructions that allowed learners to do practical work on the computer throughout the five lessons observed. He provided the instruction in phases and would repeat the instruction every time, and as the learners worked, he would write the summary of it on the blackboard.

In another lesson, LO 48 requires of learners to set up an e-mail account and do the following: send and reply to e-mails; copy and paste documents; attach documents; delete e-mails; send an e-mail using carbon copy and blind copy; and how to sign out from e-mail. It was evident that Nasi was conversant with the use of e-mails. His

approach to introducing how to set up e-mails enabled learners to understand what is expected of them. He used a scenario that suited the learners' contexts as they are in Grade 7 and are looking forward to their graduation by the end of the year. He managed to trigger their creativity by guiding them to use different templates and colouring to create a variety of attractive invitation cards in the observed lessons. He managed to guide them in the right direction. He had thought of what all learners would be familiar with and be motivated to do. When I asked Nasi what he considered as benefits of using computers in his instruction in one of the interviews, he said,

> *Using ICTs makes the work easier; it makes them more interested in their schoolwork.*

The phrase, "*it makes them more interested in their schoolwork*" in the quote shows that learners become passionate about learning when they use ICTs in instruction. When asked what he considered successes of the lesson where learners designed invitation cards and sent e-mails to friends, Nasi emphasised that all learners reached the objective of the lesson. They managed to complete the invitation cards, even though some did not reach the stage to send the e-mail to friends after attaching the invitation card. However, they finished during the remedial lesson after school. The remedial lesson shows that Nasi accommodated the variety of learners' abilities. He was aware that all the learners would not finish the task at the same time. This suggests that teachers should strategize to cater for learners varying paces as they use the ICTs.

When asked how he would assist learners to use e-mails beyond the classroom practice, Nasi explained,

> *Once we are done with creating e-mail accounts, I will send assignments even the notes through the e-mails and they are free to ask me questions through e-mails whenever they did not understand anything.*

The phrase, "*send assignments even the notes through the e-mails and they are free to ask me questions through e-mails*" in this quote shows that Nasi assist learners retain the concept learnt by having practical application of it beyond classroom instruction. This suggests that learners are supported to explore further affordances of the acquired ICT skill.

Nasi already had plans for extra lessons for slow learners to complete the work later. He confirmed during the follow-up interview that all learners had successfully completed the task in the extra lesson when he said,

> *We had the extra class already, so they have already completed the exercise.*

The phrase in the quote, "*we had the extra class already*" shows that Nasi abides by the requirements of the new Grade 7 curriculum, which promotes the use of remedial lessons to cater for all learners, as indicated in Table 4.1 on content analysis of CAP of MoET (2009). This suggests that teachers have a responsibility to support all learners to cope with teaching and learning.

However, Nasi was not happy that, in the particular lesson requiring sending of the e-mails, the modulator had a technical problem and deprived them of the opportunity to complete the planned exercise. He emphasised that it was on such days when he struggled with internet access, even though the administration tried to provide them with internet. He elaborated,

> *The challenge I faced is the access to internet, because I wanted to create the e-mails on that particular day. So that we can do something that is very practical. Because sending an e-mail offline is very impossible … Our Wi-Fi modulator has a technical problem, so its' not working.*

The phrases in the quote, "*the challenge I faced is the access to internet, I wanted to create the e-mails on that particular day*" suggests that the school sometimes struggles to have effective ICT integration due to limitations of internet connectivity. This was also evident in the observed lesson when Nasi highlighted that they are creating e-mails offline and will therefore not be able to use the e-mails efficiently on that day. The principal also stressed,

> *Internet is a serious problem. We have challenges with the internet. The companies that we negotiated to install internet for us were expensive, they were beyond what we can afford. So the internet we have is not up to the required level.*

The quote suggests that even though this primary school is willing to use ICT, they struggle with internet connectivity. This view is evidenced by the use of the phrases, "*internet is a serious problem, the internet we have is not up to the required level*". Struggling with the internet and ICT devices is typical of schools in developing countries, as emphasised by Buabeng-Andoh (2012). However, it is through practice

that the learners would master and appreciate the use of e-mails in teaching and learning.

Moreover, it was indicated in the interviews that learners worked independently on the computers developing their projects for the science club, for competing with other schools. They applied skills learned from the technology domain lessons to research for ideas and design models to be presented in the subject of Arts and entrepreneurship. Nasi emphasised,

> *I can see the difference. We have projects in Arts and entrepreneurship. It's much easier, for learners are able to research about their projects because they are doing different projects and get more ideas about their projects from the internet. There is improvement on learners' performance.*

The phrases, "*I can see the difference, learners are able to research about their projects, doing different projects, there is improvement on learners' performance*" in the quote show that use of ICT in classroom practices improves learners' ICT literacy and skills and improves their acquisition of knowledge. This was also supported by the principal when she stressed that learners perform better in Learning Outcomes related to ICT. The implication is that learners acquired relevant skills from science and technology domain lessons to develop meaningful projects.

The collaboration on ICT integration at this school is internal. Teachers at this school help one another to develop ICT skills. This was evident when Nasi indicated in the interview that he had developed ICT pedagogy from reading computer education books and through the help of teachers at this school. This is what he said when asked how he acquired ICT skills,

> *Through studying computer textbooks and the help of teachers from this school.*

The quote shows that Nasi developed ICT pedagogy through on the job training mode. This was also supported by the principal, who indicated that they saw the interest of the teacher and decided to allocate the Technology domain of the Science and Technology curriculum to him after realising his competencies of ICT integration. The principal articulated,

> *He was already a teacher here. We then realised the potential he has for teaching learners using computers.*

The phrase, "*we then realised the potential he has for teaching learners using computers*" show that the school administration realised Nasi's voluntary actions of

professional development on ICT pedagogy in the school context. When inquiring further about the school's collaboration with teachers from other schools, it was evident that even though the school collaborates with others on issues of science club, literacy and reading, there is insignificant collaboration of teachers regarding ICT integration. Nasi stipulated,

> *It's really difficult, because at times you like to meet a teacher from another school, you have to set up a meeting, it takes too long. So it does not happen at all.*

The phrases in the quote, "*It's really difficult, you have to set up a meeting, it does not happen at all*" show that Nasi and colleagues are not really collaborating with teachers from other schools. This was also confirmed by the principal who stipulated that they are planning for teachers to share ICT ideas with other schools. This is what she had to say,

> *Re ntse re lokisa hore Matichere a rona a kopane le a likolo tse ling for empowerment.*
>
> *(We are in the process of preparations for our teachers to collaborate with teachers from other schools for empowerment).*

The phrase, "*preparations for our teachers to collaborate with teachers from other schools for empowerment*" in the quote suggests that the principal realises the need for teachers to improve their teaching strategies. However, Nasi further emphasised that teachers from this school who had gone to further their studies at institutions of higher learning frequently visited the school to share the experiences and ideas of ICT integration with teachers and learners.

Unlike many schools, this school has a strategy to motivate teachers to use ICT. The teachers were usually given awards for the effort, as indicated by the principal,

> *What I usually do through the support of the school board is to buy some presents for the teachers. The purpose is to motivate them, to encourage them handle learners and computers in a satisfactory way … We encourage them to be patient with the learners and to report in time when there are problems with the computers so that they can be attended.*

The phrases, "*buy some presents for teachers, to motivate them, to encourage them handle learners and computers in a satisfactory way*" in the extract show that the school administration recognises efforts of teachers who use ICTs in instruction and

motivates them. The principal further indicated that the administration was currently working on buying laptops for the ICT teachers. She said,

> *We are working on buying laptops for computer teachers as motivation to work with at home to prepare lessons before coming to class. This will avoid teachers encountering problems in front of learners because of lack of practice of what is going to be taught before the lesson begins. The teacher will come to class having practised what he/she is going to teach and will not fear to fail in front of the learners.*

The phrases in the abstract, "*working on buying laptops for computer teachers as motivation to work with at home to prepare lessons before coming to class, avoid teachers encountering problems in front of learners because of lack of practice*" show that the school administration is committed to supporting teachers for effective ICT integration in classroom practices. Drawing from the above extracts, it can be realised that the administration of the school is responsible for supporting teachers sustain ICT integration. The school is coping with these initiatives since it is a private school and learners are paying school fees, unlike most primary schools in the country which rely on subvention from the government.

4.2.3.5 Experienced challenges and mitigation strategies in classroom practices

Struggles with ICT integration

Characteristic of most primary schools in Lesotho, the classroom was overcrowded. There are 58 learners in this class and 20 computers in the computer laboratory. The teachers could not accommodate all learners in the lab at the same time. As a resolution to this situation, learners are divided into three groups to work in pairs or individually at a computer. The principal stressed in the interview that sometimes the contracted company delayed repairing computers. The principal stated,

> *When some of them have problems, the company delays attending to them. We end up with shortage as there are many learners in our classes … currently three are not working, it is a serious gap.*

The phrases, "*When some of them have problems, the company delays attending to them, currently three are not working, it is a serious gap*" show that delay in technical assistance of computers interfered with the effective use of the computers in teaching and learning at this school. There are also other challenges beyond the teachers' control. This is what the teacher indicated,

> *The main challenge is supply of electricity by LEC. Sometimes while the lesson is still on in the computer lab, the electricity just cuts off. Sometimes the Wi-Fi is also on or off. Sometimes it cuts off while learners are still surfing information as a result of weak signal.*

The phrase, "*Sometimes while the lesson is still on in the computer lab, the electricity just cuts off*" in the quote shows that sometimes the electricity supply was not reliable, and learners had to stop in the middle of the exercise. The phrase, "*Sometimes the Wi-Fi is also on or off. Sometimes it cuts off while learners are still surfing information*" further shows that they also experience challenges with internet connectivity which disrupts lessons. Then it was not easy to return to the computer laboratory when the electricity returned, because of the tight timetable schedule for primary and secondary learners. This was corroborated by the principal when she had to say,

> *Electricity cut-offs, li re hlokisa botsitso. Wi-Fi e ea re sokolisa le eona, signal in most cases is weak.*
>
> *(Electricity cut-offs make us unstable. Wi-Fi also troubles us with weak signal in most cases).*

The phrases, "e*lectricity cut-offs make us unstable; Wi-Fi also troubles us with weak signal*" in the quote suggest that electricity and internet connectivity need attention at this school to enable the school sustain ICT integration. Moreover, during one of the observed lessons, the modulator malfunctioned, and learners could not complete the objectives of the lesson. They were creating e-mails designing invitation cards to send to friends. They had to stop after attaching the document offline because the mail could not be sent offline. These are some of the main barriers to ICT integration at schools in developing countries such as Lesotho. Schools do not have backups for unreliable Wi-Fi access. The implication is that dealing with such barriers consumes instruction time that could be used innovatively.

The digital divide concerns

Though technology has proven to be beneficial to teaching and learning, one cannot ignore the fact that the digital divide hits hard on some learners as learners come from different backgrounds. This was highlighted by Nasi when he emphasised that some learners were at a disadvantage, not benefiting equally from ICT integration. He further indicated that they usually closed the gap for learners without devices at home by affording them time in the computer laboratory to practise after school hours or during

break times to close the gap. The teacher also resolved this inequality by giving written assignments that did not require the use of ICT to a great extent. This is what he said,

> *I usually give learners a written homework not a practical one.*

This quote shows that Nasi is considerate about catering for all learners, even in assessment. After school, the learners join in groupwork to share skills and experiences so that no-one is left behind. This shows that Nasi was strategizing on how to use the technology to avoid disadvantaging some learners. Nasi also shared challenges experienced with some of the leaners who are unfamiliar with the computers. He explained,

> *For some of the learners it's their first time to use a computer because they come from other schools which do not have computers. Others have no computers at home, they only access them at school. Some will be much ahead of others because there is computer at home, so they continue doing work at home.*

The phrase in the quote, "*some of the learners it's their first time to use a computer because they come from other schools which do not have computers*" shows that some primary schools are challenged to expose learners to use of ICT in instruction. The phrase, "*some will be much ahead of others because there is computer at home*" in the extract shows that some learners extend the learning beyond classroom instruction using ICT resources available at their homes. It is clear from this conversation that the teacher had to be flexible to accommodate all learners. Learners struggling to cope with the pace of others are given first priority in the extra classes to assist them be at equivalent level to the rest of the classmates.

4.2.3.6 Synthesis of Nasi's practices of ICT integration at Lebisang PS

The synthesis in this case is also based on evidence from data gathered from the teacher's interviews and principal's exit interview, the classroom observations and the document analysis of the same selected policy framework documents used in the other two cases.

Like the other participant teachers, Nasi did not have access to the National policy documents up to the Curriculum and Assessment Policy. He had the syllabus that was developed taking the mandate from the CAP (2009). This is not surprising; the common practice at most schools is to supply the teachers with the syllabus to implement the requirements of the education policy. Teachers are considered to be at

the implementation stage in the classroom instruction and the working document at that stage is the syllabus supported by the prescribed textbooks for each subject. Like the other participants, during the time of data collection in 2019, the Grade 7 textbook was not yet at schools, even though the Grade 7 syllabus of the current curriculum had been implemented in 2017. Nasi also relied on the information from the Science and Technology textbook of Grade 6 and educational information from the internet to facilitate teaching and learning.

At this school, Nasi was allocated only the Technology domain of the Science and Technology curriculum in this class. He also supplemented the Technology domain syllabus content with the content from the Computer Education Syllabus of the previous curriculum. It seems this arrangement creates a gap on the intended integrated Science and Technology curriculum. It limits opportunities of using ICTs in the other science domains. However, though to a limited scale, Nasi developed tasks that integrate what learners learned in Mathematics and related Science concepts in enhancing understanding of the Technology domain under study in a lesson. For instance, the use of graphs and interpretation of data from graphs and tables engaged learners in critical thinking processes in a lesson. It was also highlighted that the learners use skills acquired from the technology domain lessons in development of the science projects for competing with other schools and they also use the acquired knowledge and skills in the Arts and Entrepreneurship lessons. It is apparent that this reflects the intended integration of the curriculum.

However, it was evident from the interviews that the other Science domains are treated separately without being integrated with the Technology domain by the other science teacher, who never goes to the computer laboratory for a Science instruction. However, this is the arrangement of the school for streams doing Science and Technology. The Technology domain is handled by a teacher coping with ICT tools and technology knowledge while the other Science domains are handled by another science teacher. It seems this limits learners' broader exploration of science concepts using ICTs as not all learners are engaged in the science projects for competitions with other schools. However, when I observed Nasi in the computer lab, I realised that these learners were used to the computer laboratory. This suggests that they have acquired basic ICT literacy skills.

4.2.3.7 Case conclusion

Basic Education requires committed and flexible teachers like Nasi. He displayed creativity in development of tasks that are not abstract but suited the context of learners. This is very critical for effective teaching and learning. Learners become motivated and, without realising, develop multiple skills that are necessary to prepare them for future learning and for fitting into the global world. In this case one realises that if teachers are determined to make a difference in the way they teach, it is possible. Nasi had a desire to know how to teach learners using computers and mobile phones. Through commitment, he made efforts to learn from others and to read computer education textbooks. Because of this commitment to ICT integration, learners are motivated in his teaching instruction, and he is enjoying teaching more than before. The following subsection presents data about emerging discourses of ICT integration from the policy documents.

4.2.4 The National Policy Framework informing ICT integration

4.2.4.1 Introducing the Policy Documents

This sub-section presents the National Policy Framework that guides teachers on the use of Technology in Education in general and specifically in Basic Education, the target level for this study. Nine policy documents are analysed with the intension to interpret and understand the discourses that inform ICT integration in Basic Education in Lesotho context in order to answer the first research question. This includes the Science and Technology textbooks for Grades 6 and 7, to understand how they support teachers on ICT integration. The nine documents that were analysed for ICT integration discourses include:

i) The Lesotho Vision 2020 published in 2004.

ii) The National ICT policy (2006–2011), published in 2006

iii) Lesotho Education Sector Strategic plan (ESSP, 2005–2015), published in 2005.

iv) The Curriculum and Assessment Policy (CAP, 2009), published in 2009

v) The Lesotho National Strategic Development Plan (2013–2017), published in 2013

vi) Lesotho Country Analysis Working Document final draft, 2017

vii) Integrated Primary Curriculum Grade 7 Syllabus, inclusive of Science and Technology Curriculum for Grade 7, 2017

viii) Education Sector plan (2016–2026), published in 2016.

ix) Science & Technology Textbooks for Grade 6 & 7: *Hands-on Scientific and Technological Learners Book*, Oxford, 2016. *Hands-on Science and Technology Learners Book*, Oxford 2020. Published in 2016 and 2020, respectively.

These nine documents form the basis for understanding and interpreting the discourses that inform ICT integration in Lesotho. Other minor documents such as the school-based ICT policy, where it was available, and the teachers' lesson plans are analysed in the respective cases of individual teachers. The content analysis protocol for ICT integration in Basic Education (Appendix E), guided the process of analysing these documents. This was part of the triangulation of instruments to collect rich data to understand discourses informing teachers' practices of ICT integration in classroom instruction in Basic Education in Lesotho context.

Table 4.1 presents the comparative framework of these National documents for analysing the emerging data about technology plans informing ICT integration for Education Sector, Basic Education, and the teachers in classroom instruction. In general, Table 4.1 presents data in two columns. Column one shows the policy document, year of publication and name of proprietor of the document. Column two displays data emerging from the policy documents in relation to ICT integration, directly or indirectly implied. The second column is further sub-divided into three columns: (i) General emerging data about technology plans for the education sector; (ii) Key technology plans for Basic Education/Primary; and (iii) Emerging data related to teachers and learners on ICT integration into classroom practices. The first developed national policy documents generally indicated plans for the education sector, which then developed policies to unpack the mandate for the education sector sequentially until the development of policies that were directly expected to guide teachers on ICT integration.

The document analysis highlights the country's background to the journey towards implementation of ICT integration in Education. Section 4.2.1 elaborates discourses that led to implementation of ICT integration in Education emerging from each policy

document. This aid in answering the first research question that explores the discourses that inform teachers practices of ICT integration in science and technology in primary schools, to establish the kind of support teachers sustaining use of ICTs have in schools' contexts.

TABLE 4.1: CONTENT ANALYSIS OF POLICY FRAMEWORK DOCUMENTS

ICT-related Policy Documents, Date & Publisher	EMERGING FROM RELEVANT POLICIES IN RELATION TO ICT INTEGRATION IN EDUCATION		
	General data emerging about Technology plans for Education sector	**Key Technology Plans for Basic Education/Primary Schools**	**Emerging data related to teachers & learners on ICT integration in classroom practices**
1. The Lesotho Vision 2020; 2004, Government of Lesotho. The vision was formulated at the first National Dialogue by more than 500 representatives of the key stakeholders in the country.	This is the basis for policies developed beyond 2004 to move Lesotho forward to fit in the global world. All key stakeholders in the country were engaged in building a long-term vision about where Lesotho should be in 2020. Amongst others, the policy advocates for well-established advanced technology in the country by 2020. The 7th pillar emphasises the Lesotho schools' curricula incorporation of science and technology and enabling citizens' access to communication and development technology for economic development.	_____	_____
2. The National ICT Policy (2006–2011) This policy was developed drawing mandate from the seventh pillar of Vision 2020 to ensure technology integration	Sections 1.2, 2.3 to 2.5 of the policy emphasise the persistent gap in demand and supply of Science and Technology skilled workforce and inadequate ICT facilities and reiterates the widest integration of science and technology into curricula for schools. It further commits the government to the provision of adequate technological	**5.1 Sector strategies to integrate Science and Technology** The policy advises that the content of science and technology theory and practice for subjects in the education curriculum for schools from basic to tertiary levels be increased and policy reforms integrating. The policy advocates for harmonising S & T	**1.3 (b) Sector strategies** The policy calls for an increase in the number and quality of teachers trained in science, technology, mathematics and computer literacy, as well as a fair distribution of these instructors across the country's educational system.

in all sectors of the government.	infrastructure in education and attention to the brain drain by attracting and retaining S& T skilled labour force.	education programmes and delivery strategies to promote interest in science and technology field.	
3. Lesotho Education Sector Strategic plan (ESSP, 2005–2015) by MoET The policy draws from the Lesotho Vision 2020, National ICT policy and other policies such as Poverty reduction strategy, Public Sector Improvement and Reform Programme and international and regional conventions and treaties such as Millennium Development Goals and Education for All (EFA) to which Lesotho subscribe, to implement the National Plans into the Education system. The ICT policy for Education is currently at draft stage during the writing of this report.	**2.1 Mission, Goals and Objectives** The policy strived to make Lesotho more technologically advanced by encouraging effective research for application of science and modern technology, allocating resources for the implementation of ICT programme for schools and health institutions, promoting IT applications, and bridging the digital divide between Lesotho and the advanced world. **2.3 Vision**: The mission of the Ministry of Education and Training's objective is that by 2020, Basotho will be a functionally educated society with well-grounded moral and ethical principles, as well as competent social, scientific, and technological knowledge and skills. **2.4 Education Policy:** This part focuses on providing facilities such as teaching and learning materials as well as suitable school infrastructure and curriculum reform at all levels of schooling and training, in order to increase quality and	**4.1.1 Primary education:** Reiterates the government's commitment to providing teaching and learning resources, facilities and services to improve primary school learners' educational outcomes. The strategic plan echoes the EFA Goal 2 that motivates that by 2015, all children would have access to good quality Basic Education, improving basic education holistically to encourage critical decision making and policy formulation in basic education. The approach also includes developing curriculum and assessment methods that assure learner's human, practical vocational relevance. Priority areas: **4.5** (2.1.3.1.) Evaluate the basic education curriculum and incorporate practical/ technical disciplines into school programmes. **4.5** (2.1.5.3) Reiterates the government commitment to supporting basic education with education materials (target, 70 % by 2015). **4.6.2 Free and compulsory quality basic education on an equitable basis**	**2.4 Education Policy** The plan is to increase the quality of instruction by putting a greater emphasis on teacher development and learner-centred teaching methods. Furthermore, the quality of education will be increased by equipping schools and educational centres with the necessary abilities by investing in teacher training and professional development. **4.5 Matrix on strategic goals and activities:** The policy calls for evaluating and designing instructional materials that are sensitive to the country's increasing technology needs and for ensuring quality delivery of basic education by providing in-service training for teachers. **4.6.5 Facilitation of quality assurance systems and processes:** Improvement of quality of teaching: The policy advises that the government should provide quality pre-service education for teachers at elementary level, with a focus on … as well as in-service training for serving teachers to ensure quality basic education delivery and the promotion of opportunities for teachers to pursue further education.

	strengthen the education system's developmental relevance.	The additional support from the government would be in the form of goods, services, and professional support. **4.4 Critical challenges**: Quality: Improvement in the quality of teaching, the learning process and nature of classroom interaction. Provision of improved teaching and learning conditions at all schools.	**4.6.7 Offer relevant curricula: Curriculum review** Instructional materials shall also be reviewed regularly to ensure that they respond positively to the changing technological world in order to bridge the 'digital divide.'
4. Curriculum and Assessment Policy (CAP, 2009) Developed by NCDC in collaboration with ECoL using panellists, different stakeholders in the Education sector, including teachers.	The policy withdraws its mandate from the ESSP (2005–2011) to unpack plans for Basic and secondary education level. It enables development of curriculum at this level that responds to cross-cutting issues in the country **National Goals of Education** **2.** Lesotho's requirements and development needs will be reflected in educational programmes; it is recommended that more emphasis be places to problem-solving, scientific thinking, entrepreneurial and technological skills; linking learning and productive skills; and the practical application of knowledge to improvement living conditions.	**Curriculum Aims of Basic Education**: The policy proposes that learners should have gained scientific and technological knowledge and competencies to adapt to social, economic, and technological issues after completing ten years of Basic Education. This is expected to be accomplished through many learning areas, one of which is Scientific and Technology learning area, which focuses on the acquisition, comprehension and application of scientific and technological concepts, principles and procedures.	**Pedagogy** Though not explicitly referring to ICT integration, it echoes for a shift in teaching methodology. Teachers are encouraged to shift pedagogy to develop learners' creativity, independence, and survival skills. Teachers are encouraged to move from teaching to facilitating responsibility in the instruction, enabling learners to construct knowledge and have integrated knowledge. Teachers are further encouraged to shift from didactic teaching to participatory, activity-centred, and interactive methodologies.
5. The Lesotho National Strategic Development Plan (2013–2017), 2013 by Government of	**5.2.4 Information and Communication Technology (ICT)** The document emphasises the valuable role of ICT amongst others in improving access and efficiency of	_____	_____

Lesotho, Ministry of Development Planning	educational information and facilitation of global networks. It further stresses that majority of Lesotho's population has access to mobile phones though there are limitations with access to owned computers with note that access to internet using smartphones is expected to improve. The policy further reiterates need to support schools with ICT infrastructure and improve ICT literacy.		
6. Lesotho Country Analysis Working Document final draft, 2017	**3.1.5 Access to Education in Lesotho: Science, Technology and Innovations:** The document stresses the country's weak research capacity and adaptation to new innovations and technology. Highlights the low intake of Mathematics and Science students at tertiary. Encourages the prioritisation of ICT skills and emphasises the lack of computer literacy among primary and secondary school learners, despite the fact that young people quickly learn to utilise digital technology, such as mobile phones and social networking platforms, and other web-based apps. It is stated that there are numerous and evolving innovations for acquiring both ICT and soft skills of which Lesotho advocates for their use.		

7. Integrated Primary Curriculum Grade 7 Syllabus, 2017, Developed by NCDC using panellists from different stakeholders of MoET including teachers. The document contains all the subjects done at this level. The current syllabus reached Grade 7 in 2017. Science and Technology Curriculum, 2017 This is included in the indicated Grade 7 Syllabus.	**1. Introduction to the Revised Syllabus for Grade 7**: It is specified that the syllabus is part of the new primary school integrated curriculum designed to respond to the changing needs of education in Lesotho, and to provide education for individual and social development, drawing mandate from the 2009 Curriculum and Assessment Policy.	At the end of Grade 7, learners are expected to have developed the following core competencies: effective and functional communication, problem-solving, scientific, technological, and creative skills, collaboration and cooperation, functional numeracy, and learning to learn. **4. Science and Technology**: In this syllabus, learners are expected to develop positive attitude towards science and technology and to acquire and understand scientific and technological concepts, principles, and skills to apply in everyday life challenges and in understanding and addressing environmental issues. In Grade 7, Science and Technology is divided into six domains, namely: Inquiry Process, Science in Personal and Social Perspective, Life Sciences, Physical Sciences, Earth and Space Sciences, and Technology.	Teachers are advised to monitor their learners' usage of communication technologies, such as social media, online forums (such as YouTube), blogs, and social networking sites (such as Facebook). For recording and sharing teaching and learning experiences, portfolios, posters and PowerPoint presentations are also encouraged. **Grade 7 Science and Technology Activity Plan** In other domains other than Technology, for instance, LO 2, 11, 16, 18, 24, 25, 28, 33, 34, 35 36, 37 and 43, internet is just mentioned as one of the suggested resources, additionally, projector is mentioned in LO 28. In the following LOs of Technology domain, ICT tools such as computer and/or mobile phones are mentioned among the suggested resources: LO 46, LO 47 and LO 48. **LO 46:** Perform basic functions of excel programme. Creating and using spread sheets; **LO 47:** Format text on a slide using PowerPoint and **LO 48:** use internet to set up and sent an e-mail
8. Education Sector Plan (2016–2026), Ministry of Education and Training. This is a continuation of improved ESSP	**The foreword highlights:** The document motivates the provision of teaching and learning materials to schools and education centres, reforming of the curriculum, investing in teacher training and development.	**5.5 Priority Matrix: Lower Basic Education** Strategic Objectives: To strengthen the delivery of quality free and compulsory lower Basic Education.	**10. Teacher Development, Supply and Management:** The policy stipulates lack of Continuous Professional Development (CPD) Policy as a critical challenge to the ministry. This leads to uncoordinated training. One of the

92005 – 2015), identifying shortcomings, failures and successes of the previous strategic plan and addressing cross cutting todays challenges in the education system.	**Section 2.3**: Strategic Objective Emphasises the reformation of the national curriculum and assessment system including lower Basic Education to address the gap of the low utilisation of ICT and other issues and reiterates government commitment to support basic and secondary education with materials.	Strategy: build and upgrade education facilities that are child, disability and gender sensitive. Avail emergency materials and equipment for schools with the need at all times. **One of the strategic actions for Secondary Education:** Provision of ICT solutions at selected schools.	critical challenges highlighted is that teachers are not fully equipped in ICTs-based pedagogy and there are no allocated funds for CPD. Main strategies emphasise amongst others integration of ICT into teacher training programmes and Coordination of participation of all teachers in Continuing Professional Development.
9.Science & Technology Textbooks: **Grade 6** *Hands-on Scientific and Technological Learners Book.* Oxford, 2016 Grade 7 textbook written by the same authors and publisher.	The textbooks implement the objectives of the Curriculum and Assessment Policy regarding primary education at this level. The textbooks are developed in alignment with the syllabus. The Science and Technology Grade 6 book reached the schools in 2017 and the Grade 7 textbook reached schools in 2021. Participants relied on Grade 6 textbook and the internet to teach learners Science and Technology during data collection period.	Learners are asked within given tasks in different science topics to use internet to find more information. The Chapters of the LOs from the Technology domain are broadly explained and learners are introduced to how they could use multimedia and internet in investigations of different science topics.	All chapters are demonstrating concepts with colourful photographs. Some concepts are introduced with zoomed out pictures providing finer details accompanied by text explaining concepts. For instance, a diagram demonstrating causes of Anaemia (*Hands-on Science and Technology*, 2020: 125). There are activities such as investigations, design and problem-solving tasks that encourage learners to use internet (almost all chapters), sometimes links to some websites. In some activities the learners are encouraged to use presentation slides (e.g., Chapter 35, Activity 2) for sharing their findings in classroom discussions and to upload files (to presentations/website). The textbooks in some cases provide examples of links for educational information.

4.2.4.2 Interpreting Policy expectations on use of ICTs in classroom practices

It is apparent that the policy framework documents at national level, as presented in Table 4.1, generally had a mandate for the integration of Technology in Education and therefore gave the MoET the responsibility of diffusing technology content knowledge and skills across the citizens of Lesotho at different levels of education. **The Lesotho Vision 2020** formed the basis of policies developed beyond 2004, to inform ICT integration and other economic developments in the country. One of the seven pillars of this policy talks directly to technology in education. It stipulates that Lesotho curricula should be developed targeting the science and technology and that Basotho shall have access to communication and development technology.

The analysis of the **National ICT Policy (2006–2011),** usually referred to as the S & T policy which also appears in Table 4.1, draws its mandate from the Vision 2020 and stresses the need for government sectors in Lesotho to incorporate ICT integration in their daily functions, including in the education sector. Thus section 3.7.1 of the policy states that:

> **3.7.1 Ministry Responsible for Education and Training:** The ministry responsible for Education and training has a fundamental role to play in the S &T policy implementation, especially for the effective integration, adaptation, delivery and promotion of science and technology education in the country …

The phrase, "*for the effective integration, adaptation, delivery and promotion of science and technology education in the country*" in the extract shows that the MoET is tasked with a specific responsibility to ensure effective ICT integration into the schools of Lesotho.

The MoET, through its different departments, had to unpack the Vision 2020 mandate and the National ICT policy into sub-policies that can be implemented in departments and at school level. The **ESSP (2005-2015),** also referred to in Table 4.1, was subsequently developed and also reiterates the goal of ICT integration in schools. The policy emphasises the need for provision of ICT infrastructure in schools. Thus Section 1.3 of the strategic plan states:

> **1.3. Sector Strategies:** a) Increase the content of theory and practice of science and technology for subjects in the education curriculum of schools from basic to tertiary levels through positive curricula reform and development. b) Improve on the number and quality of teachers trained in science, technology, mathematics and computer literacy, and facilitate their equitable spread throughout the

> country's education system … e) Provide technical and financial support for the local publication of science and technology teaching materials, books and other ventures aimed at creating or stimulating a science and technology culture …

The phrase in the extract, "*increase the content of theory and practice of science and technology for subjects in the education curriculum of schools from basic to tertiary levels*" shows that the MoET had plans to encourage teachers use ICT in instruction from Basic Education level which includes Primary Schools. The phrase, "*provide technical and financial support for the … ventures aimed at creating or stimulating a science and technology culture*" shows that the strategic plan clearly stated the government commitment to supporting ICT integration. Because of the mandate as stipulated in the extract above, the MoET engaged in various initiatives and projects from 2007 to date, designed to empower pre-service and in-service teachers with ICT pedagogical skills. One participant in this study explained how he benefited from the initiatives.

The NCDC, in collaboration with ECoL, developed the Curriculum and Assessment Policy (CAP, 2009), which recommends the integration of technology in basic education. The policy reiterates the development of learners' scientific and technological skills for survival in the global world. Thus, the section on aims of basic education, which was the target level for this study, amongst others, speaks about:

> 2. Equipping learners with knowledge, attitudes and skills which enable them to respond to socio-economic and technological changes … 6. Developing scientific, social, entrepreneurial, and technological skills to promote independent and critical thinking in solving socio-economic problems.

The phrases, "*skills which enable them to respond to socio-economic and technological changes, developing scientific, social, entrepreneurial, and technological skills to promote independent and critical thinking*" in this extract from CAP, 2009 show that the MoET intended to implement ICT integration in schools, including at the Basic Education level. It gave a mandate to syllabus developers to unpack this extract so as to ensure that teachers would use ICT facilities in their classroom practices. As the country review progress on the developments in the country, policies such as **The Lesotho National Strategic Plan (2013–2017)** and **the Lesotho Country Analysis Working document of 2017**, which are also listed in Table 4.1 were also developed. The latter documents confirm that in recent times Lesotho continues to struggle with ICT integration and adaptations to new innovations

and technology, due to challenges such as citizens' limitations of access to ICT devices.

Table 4.1 further shows **the integrated curriculum for Grade 7** as another regulatory document of interest. To address the aims of Basic Education referred to previously, the CAP (2009) was used to develop the current integrated curriculum for primary education, including the Science and Technology curriculum, the target for this study that has replaced the science curriculum of the previous syllabus. The curriculum was gradually introduced into the primary schools with Grade 7 implemented for the first time in 2017. When data were collected for the present study the implementation in Grade 7 was in its third year. The curriculum promotes, amongst others,

> learners' competencies such as critical thinking, technological and creative skills, and effective and functional communication while acquiring and understanding scientific and technological concepts principles and processes for socio-economic development (Government of Lesotho, 2017: iii).

The phrase, "*learners' competencies such as critical thinking, technological and creative skills, and effective and functional communication*" in the quote shows that the curriculum encouraged teachers to assist learners develop the 21st-century skills required for survival in the global world and higher levels of education. Teachers are encouraged in the Grade 7 syllabus to develop learners' independent learning skills and to act as facilitators in instruction. It is generally stated that teachers should support learners' use of the internet and ICTs, including social media, social networking sites, content communities (e.g. YouTube) and others **(Table 4.1: Integrated Primary Curriculum Grade 7 Syllabus, 2017)**.

Table 4.1 also shows another important regulatory document, the **Science and Technology syllabus** within the integrated curriculum for Grade 7. In this syllabus, teachers are expected to use a variety of teaching strategies to assist learners to acquire, amongst others, an understanding of scientific and technological concepts, socio-economic and technological dimensions of environmental issues, scientific and technological skills to solve everyday life challenges, and create positive attitudes and values towards the use of science and technology in everyday life. At the end of Grade 7, learners are expected to have developed core competencies such as "functional communication, problem-solving, collaboration, scientific, technological and creative skills" (Government of Lesotho, 2009: 17). The syllabus emphasises development of

instruction that caters for all learners and reiterates use of social media, blogs and micro-blogs, social networking sites (e.g. Facebook) and content communities (e.g. YouTube). Posters, portfolios and PowerPoint presentations are also emphasised. However, it can be observed from data presented in Table 4.1 that there may be a gap in translation of the mandate from the CAP to the developed syllabuses, especially the Science and Technology syllabus. In some topics, the internet is just mentioned as just but one of the resources. No elaborate explanations are provided about how the ICT facilities should be used in science domains. Schools therefore use their own discretion and interpretations on how to integrate technology into the science lessons.

Recently, MoET reviewed the ESSP (2005–2015) to reflect on the successes and failures of the strategic plan and is currently implementing **the new Education Sector plan** (2016–2026). This sector plan also emphasises the need to improve the quality of education in Lesotho. Section 2.3 of the plan states, amongst others the strategic objectives as:

> To reform the national curriculum and assessment system to meet the needs of Lesotho … To increase access to quality free and compulsory lower Basic Education …

The phrase, "*increase access to quality free and compulsory lower Basic Education*" in the quote suggests that primary schools will also be recognised in the provision of quality basic education, which requires ICT integration in the 21st century. The plan further states that the Government of Lesotho will continue to support teaching and learning at the Basic Education level. The implication is that as ICT integration is one of the issues in the current curriculum, primary schools will be supported for its implementation. The policy highlights the insignificant use of ICT within the sector, together with the insignificant production of Mathematics and Science experts in the country. What is surprising is that Section 5 of the sector plan, focusing on Lower Basic Education, is not as explicit about how ICT integration will be supported, as the Ministry continues to support teaching and learning at this level. None the less, the sector plan does advocate the integration of ICTs into teacher training programmes and participation of all teachers in Continuous Professional Development. This reading suggests that primary school teachers will also benefit, as some of the participants clearly wished for more Continuous Professional Development, while others voluntarily engaged in the CPD on their own.

It is also evident from data in Table 4.1 that some of these policy documents are not as specific about how teachers should be guided for ICT integration. The CAP (2009) and the curriculum for Grade 7 simply stipulate expectations about acquisition of technology content knowledge and skills at Basic Education level. The documents, however, do briefly encourage the teachers to use ICT and give examples of digital tools and recommendations on the use of social media and networking sites to share information, but not within the context of the science content. It seems to me that the prescribed learners' textbooks came close to addressing the gap. The tasks are developed in such a way that they instruct learners to use ICT tools and to apply what they have learned in the technology domain in other science topics. For instance, chapter 21 of the Grade 6 learners' textbook has Activity 1, which reads (Drew *et al*., 2016: 104):

> *Activity1: Investigate pollution from industries*
>
> *A field trip to industrial area is arranged by the teacher. Learners are warned that they would need a camera or cell phone to take photos…*
>
> 1. Take notes (and photos) about the air, or land pollution that you see.
> 2. Prepare a slide presentation of your findings so that you can show the rest of the class…

The phrases, "*they would need a camera or cell phone to take photos, prepare a slide presentation of your findings*" in the textbook extract show that the task requires of learners to use digital tools to collect data, including taking photos on air pollution and the use of slides to communicate the findings. A general observation, as elaborated in my content analysis of the textbooks in Table 4.1, in almost all the chapters of the textbook, there is a task which directs learners to the use of the internet or a labelled ICT tool to get solutions to investigations or research-oriented tasks.

4.4 CHAPTER SUMMARY

This chapter presented the case by case narratives of the ICT integration practices of three participant teachers and the discourses informing ICT integration in the context of Lesotho from the relevant policy documents and the teachers expressions of how they cope with ICT integration. The teachers' classroom practices at the three participant schools reflect that they had acquired ICT pedagogy and skills applied in their classroom instruction. However, the three cases had different contextual

backgrounds with a varying level of availability of ICT devices. What was interesting was that the individual teachers had adapted to their contexts. The teachers' ICT integration practices reflected that the learners are exposed to ICT integration, trying to equip them with ICT skills to promote authentic learning and creativity, preparing them for globalisation. The cases imply that there are teachers in Lesotho who integrate ICT within different contexts at primary schools. Chapter 5 that follows, presents the cross case analysis, and summary of findings of the study. The chapter draws conclusions and recommendations for future studies.

CHAPTER 5: CROSS-CASE ANALYSIS, SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

This chapter presents a cross-case analysis of the three cases outlined in Chapter 4. The chapter then summarises the key findings of the study and highlights the conclusions and recommendations reached in relation to the study. The cross-case analysis unpacks the commonalties and differences in the three cases of teachers from different school contexts. These commonalities and differences are discussed in the context of the first two sub-research questions. Sub-research question 1 relates to discourses informing teachers practices of ICT integration. The sub-question 2 focusses on teachers' practices of ICT integration in classroom practices. The cross-case analysis is concluded by explanations leading to answering the third research question of the study, which is about constructing an account on why ICT integration takes place the way it does within the Basic Education context in Lesotho. Several themes emerged from the study to guide the cross-case analysis and discussion:

- ICT integration discourses at the selected schools
- Teachers exposure to productive discourses of ICT integration
- Teachers classroom practices of ICT integration in Science and Technology curriculum,
- Teachers' patterns of assessing learners in ICT integrated lessons

The concurrent discussions on these emerging themes with explanations towards accounting for the ICT integration practices of teachers in Basic Education within the Lesotho context is possible due to the cross-cutting nature of the third sub-research question which accounts for the teachers' practices of ICT integration in the context of Lesotho. This is then followed by presentation of the key findings. Conclusions are then drawn and recommendations for future studies presented. The chapter closes with a reflection on the limitations of the study.

5.1.1 Summary of the study

This section recaps the summary of the present study. The call for teachers to draw on the available ICT resources to improve teaching and learning in Lesotho, especially

in the sciences, has been out for more than a decade now. The question of how teachers cope with ICT integration in the current curriculum is yet to be explored qualitatively, as there is limited, though growing literature on technology in education in the country. The Science and Technology syllabus implementation reached Grade 7 in 2017. As such, we still know little about how teachers cope with the use of ICT in teaching and learning as guided by this syllabus. A multiple case study (Johnson, 2014) of three teachers was used in the present research to provide an in-depth interpretive analysis of how the teachers integrate ICT into the Science and Technology curriculum in Lesotho. The relevant policy framework documents were analysed to establish how they inform ICT integration in education, and how teachers are supported for the effective use of ICT in classroom instruction **(See Table 4.1)**.

Interviews and classroom observations were also used to harvest rich data on the teachers' practices of ICT integration **(See 3.5)**. Data about teachers' practices of ICT integration were presented case by case and discourses informing ICT integration were discussed from the document analysis of relevant policy framework and from the teachers' views **(See 4.2)**. A summary of key findings and accounts for the teachers' practices of ICT integration in the context of Lesotho were discussed **(See 5.2 and 5.6)**. The conceptual framework for effective ICT integration within the Lesotho context was also suggested informed by key findings of the present study. The proposed extended framework intends to reveal other contextual factors that are key to effective ICT integration within different schools' contexts.

5.2 CROSS-CASE DATA ANALYSIS AND DISCUSSIONS OF KEY FINDINGS

The cross-case analysis focuses on the common and varying practices of ICT integration of the three participant teachers, Thupa, Lethu and Nasi and the discourses of ICT integration in the context of the selected participant schools and relevant policy documents in Lesotho. Four major themes were generated from data and guide the cross-case analysis and discussion in this section. The themes are ICT integration discourses for primary schools; teachers' exposure to productive discourses of ICT integration; teachers' classroom practices of ICT integration in Science and Technology curriculum; and teachers' patterns of assessing learners in ICT-integrated lessons.

5.2.1 ICT integration discourses for primary schools

The first sub-question of the study focuses on discourses informing ICT integration in Lesotho. The relevant policy framework and views of the selected teachers about ICT integration shows a number of mutually reinforcing and sometimes competing discourses of ICT integration in basic education in the context of Lesotho. Content analysis of the policy framework shows that there was an ICT integration policy message in the nine relevant national ICT policy documents specified (**Refer to Chapter 4 & Table 4.1**), even though some gaps were observed in translation to classroom practice. The selected schools had access to the syllabus document with just general knowledge of requirements for ICT integration from other policy documents which were not available at the schools.

The three teachers used and taught the Science and Technology syllabus, which promoted ICT integration at Grade 6 and 7. The syllabus was available as hardcopies at the selected schools. In other words, of the nine relevant national policy documents, which carried ICT integration stipulations, teachers had access to the syllabus document. Further discourses of ICT integration were gathered from teachers' expressions of how they feel about using ICTs in classroom practices, which informed findings of the present study. Generally, the teachers and principals were aware of the policy requirements for ICT integration at primary schools. The policy documents had the notion that learners benefit largely when exposed to ICT integration in classroom practices.

All the three participant teachers, Thupa (**See 4.2.1.3**), Lethu (**4.2.2.3**) and Nasi (**4.2.3.3**) echoed the benefits of use of ICTs in classroom practices. However, the three teachers complained of unsatisfactory teachers' guidance on the use of ICTs in instruction especially in the Grade 7 Science and Technology syllabus which communicates the present curriculum to teachers. It is noteworthy that the teachers, Thupa (**See 4.2.1**), Lethu (**4.2.2**) and Nasi (**4.2.3**) were of the view that generally teachers who did not have exposure to ICT pedagogy would struggle to strategize to use ICTs in instruction drawing from the syllabus. Lethu's comment was,

> *[I] am able to use ICTs because I already have computer skills … Most teachers here do not manage to use the available ICTs.*

The teachers' views align with studies on the theory of TPACK, which stresses that the integration of ICT in teaching and learning is successful if there is considerate integration of technology and pedagogical processes and the commitment for every teacher to possess TPACK in the present period of education (Santos & Castro, 2021). The TPACK framework highlights that teachers can use ICT effectively in lessons if they possess an amalgamation of seven knowledge areas; TK, CK, PK, PCK, TCK, TPK and TPACK mentioned earlier in literature review. Extant literature further attests that teachers are prohibited from displaying their acquired TPACK due to several barriers to ICT integration, such as availability and access to ICT infrastructure and ICT pedagogy (Gunes & Bahcivan, 2016; Margolin *et al*., 2019; Ngwane, 2017). It was observed that the three teachers had exposure to ICT pedagogy through varying modes; Thupa through pre-service training and voluntary PD; Lethu through in-service training; and Nasi through observing colleagues on the job-training.

It was learnt in this study that Thupa acquired ICT pedagogy at a teachers' training institution during the early years of his teaching, which exposed him to a range of ICT resources. This exposure was from a School of Technology Innovation Centre (STIC) at one of the teachers' training institutions in the country that focuses on training pre-service and in-service teachers on ICT pedagogy (**See 4.2.1.1**). It was also evident from the interviews when Thupa stated, "[I*] signed in … learning about innovative means of using ICTs in teaching*", empowering himself with emerging ICT pedagogies by frequently engaging in online activities with global teachers and local teachers on a voluntary basis. Lethu obtained the same diploma as Thupa and from the same teachers' training institution (**See 4.2.2.1**).

However, what is surprising is that he graduated after Thupa, but did not have exposure to STIC. Fortunately, Lethu was exposed to ICT pedagogy at the primary school in South Africa where he volunteered to work for two and half years before starting to work at Leratong PS. "*I used the smartboard in South Africa* …", echoed Lethu in an interview. He was exposed to different strategies of ICT integration and was then engaged in projects that revealed the skills acquired (**See 4.2.2.1**). On the contrary, Nasi stated learning ICT pedagogy from colleagues. It was evident in this study that Nasi took the initiative to empower himself with ICT pedagogy by reading ICT books and lesson observations of experienced teachers. In other words, he acquired ICT pedagogy through self-study. Drawing from their different modes of

exposure to ICT pedagogy it can be concluded that the three teachers have varying levels of ability to use ICTs in instruction. However, it is worth noting that the three teachers were willing and eager to learn about the effective use of ICT in classroom practices.

The three teachers further embraced a discourse on the promotion of learner-centredness through the use of ICTs in classroom practices. It was noticed that all teachers were aware that the current curriculum required of them to use ICTs in instruction in learner-centred lessons. The implication is that teachers are expected to be facilitators of learning, enabling learners to develop independent competencies for acquiring knowledge. The three teachers succeeded in engaging learners in a variety of activities using available ICT resources. However, there were signals of mixing teacher and learner-centred approaches within the teachers' lessons. For example, Thupa (Lesson Segment 4), Lethu (Lesson Segment 2) and Nasi (Lesson Segments 1 and 2) did more talking than learners or probed learners insufficiently to express themselves. This is alluded to by Chigona (2018:377) who cautions, "most teachers are stuck in their old ways of teaching … they lack the skill and knowledge on how and when to integrate the digital classroom into their pedagogy". This is also highlighted by the Lesotho Education Sector Plan (2016–2026) policy document, which stipulates that there is "lack of Continuous Profession Development" on issues of teacher development, supply and management (**See Table 4.1**) in Lesotho.

The theory of TPACK and the HPC model informs us that the use of ICTs in instruction promotes learner-centred teaching approaches and encourages teachers to shift from the old ways of teaching. The HPC model suggests the teaching and learning strategies and practices that could be observed in teaching and learning in ICT pedagogy lessons (Hunters, 2017). Some traces of the strategies were observed in the classroom practices of the three teachers.

It also appeared that all the teachers also benefited from the support of the heads of the schools, which enabled them to overcome some of the challenges of ICT integration within the context of the schools. The support included, amongst others, mobilisation of parents to support schools on ICT integration initiatives, which promoted building of communities of practice and enabling access and working environment in the computer labs in the case of Lethu and Nasi. It is worth noting that

not all the three schools had computers as discussed earlier in chapter 4. Only two schools had computers. At Sentleng Primary school, where Thupa taught, the parents were involved in the founding of the Bring-your-own-device initiative, promoting learners' digital literacy and skills. Nasi used a computer lab supported with a modem for internet connectivity, when required. Lethu used multimedia such as the computers, TV screen, offline Wikipedia, a laptop and a projector to promote learner-centred activities in classroom practices.

The study found a shortfall framed from policy and practice with regard to supporting teachers on ICT pedagogy and preparing them for using ICTs in classroom practices as required by the current curriculum. The common impression in the syllabus in most cases was the use of the internet as one of the resources for the lessons. The three teachers attribute their ability to cope with ICT integration to their previously acquired knowledge of how to use ICT resources in classroom practices. The implication is that teachers who are not exposed to ICT pedagogy and were not trained to use ICTs in classroom practices may not cope with implementing the curriculum accordingly. This has a bearing on learners' acquisition of expected competencies at this level.

5.2.1.1 Explaining discourses of ICT integration within the context of the selected schools

A conclusion that could be drawn from findings of this study on discourses of ICT integration is that there are stated ICT integration policy messages (**See Table 4.1**) that motivate ICT integration into Basic Education in Lesotho. However, there are gaps identified in translating policy to practice by teachers, for instance, limited guidance of teachers as implementers in classroom practices, struggles with ICT pedagogy, readiness of teachers, and struggles with availability of ICT resources in primary schools. The implication is the inadequate execution of teaching and learning according to the requirements of science and technology syllabus, which contributes negatively to learners' development of necessary competencies to follow science-related careers at a higher level of learning.

The result is a situation akin to what scholars describe as barriers to effective ICT integration, which impact negatively on teachers' initiatives of using ICTs in classroom practices (Jita & Akintunde, 2021; Jita & Munje, 2020; Margolin *et al*., 2019). In other words, the ICT integration policy stipulations were explicit in many of the relevant

policy documents, but may not have been fully implemented by actors such as curriculum developers and teachers.

The requirement to integrate ICTs into classroom practices as stated in the national policy framework is not new in Lesotho. The LGCSE syllabus for secondary schools has been motivating the use of ICT in classroom practices (Lisene & Jita's, 2018). The curriculum of CAP (MoET, 2009) stresses ICT integration at lower Basic Education. In other words, primary schools' teachers are expected to develop learners' digital literacy and skills (**See Table 4.1**). This is part of countries' commitments to preparing learners develop 21st-century skills to prepare them for the world of work and for higher levels of education. The assumption could be that prior to implementation of the curriculum, teachers have developed digital literacy and skills in order to cope with assisting learners to develop the skills akin to what UNESCO (2011) describes as an ICT competency framework for teachers, which provides guidelines for ICT integration for the kind of teacher ideal for 21st-century learners.

The Covid-19 pandemic also became a signal for primary schools' requirement for using ICT in teaching and learning. Schools were closed and teaching and learning were interrupted. The majority of Lesotho primary schools with no exposure to ICT integration were affected more, as it was impossible to have remote contact with learners. Some schools started initiatives of teaching learners remotely during the Covid-19 school shutdown. As earlier narrated in the literature review, what works for effective ICT integration is training of teachers on ICT pedagogy in addition to the availability of ICT resources at schools (Jita & Akintunde (2021). This view resonates with the TPACK framework expectations of teachers, which shows seven knowledge areas teachers should be equipped with in order to cope with ICT integration. As earlier shown in literature, ideally, what works is that teachers are key to ICT integration in classrooms and they should be equipped with resources and ICT pedagogy to deliver effective instruction. Studies in the era of Covid-19 considered the pandemic to be a wakeup call for all teachers to develop TPACK and be ready for ICT integration to avoid school closure disruptions incurred (Juanda, Shidiq & Nasrudin, 2021).

Literature contends that there are benefits of ICT integration such as promoting learner-centredness, development of high-order thinking skills and self-directed learning (Fu, 2013; Ngwane, 2017 & Trust, 2018). Continuous Professional

Development programmes for in-service teachers could benefit them to develop suitable teaching practices of ICT integration. To address the policy-practice gap, recommendations are presented in **section 5.9** of the present study. What also works for effective ICT integration in the present study is principals and parents' support for teachers' initiatives of ICT integration.

The observation by Tsakeni and Jita (2019) on ICT integration classroom practices of pre-service teachers vis-à-vis in-service teachers seems to apply to the implementation of ICT integration in primary schools in Lesotho. This is especially with regard to ineffective ICT integration in ICT-resourced schools, due to limitations of ICT pedagogy among the teachers. One of the primary schools in the present study had a variety of ICT resources with a limited number of teachers using them in classroom practices.

The need for equipping teachers with continuous ICT pedagogy to deliver the curriculum to meet the current needs of learners seems to have been overlooked, resulting in low ICT integration efforts in schools. Furthermore, a major concern from recent studies about ICT integration using the TPACK model is that constraints of ICT resources within the context of a school disadvantage teachers from utilising the acquired ICT pedagogy. This is to an extent that it is challenging to map their espoused TPACK and the ICT integration classroom practices observed (Tsakeni & Jita, 2019). This disconnection between teachers who acquired ICT pedagogy and working school environment contributes to teachers' decisions on use of ICTs in instruction. The presented submissions from literature assist in understanding teachers' readiness for ICT integration vis-à-vis policy framework stipulations.

5.2.2 Teachers' exposure to productive discourses of ICT integration

Drawing from the first research question, which focused on discourses of ICT integration, data from initial interviews and follow-up interviews were further triangulated with lesson observations to establish how the teachers were exposed to ICT pedagogy. This was meant to examine the teachers' knowledge areas of TPACK and HPC from their classroom practices of ICT integration qualitatively. It was apparent from narratives in Chapter 4 that the teachers' ICT pedagogy was derived from different sources, explicitly stated as pre-service training for Thupa **(See 4.2.1.1)**,

in-service PD for Lethu **(4.2.2.1)**, and apprenticeship of observation of colleagues at work for Nasi **(4.2.3.2),** which enabled them to cope with ICT integration.

Moreover, it was apparent in data that the teachers succeeded with the implementation of ICT integration due to varying communities of practices at their respective schools. On the contrary, Lethu was exposed to different strategies of ICT integration and was then engaged in projects that revealed the skills acquired (**See 4.2.2.1**). Nasi, on the other hand, initiated his empowerment on ICT pedagogy by reading ICT books and lesson observations of colleagues. The learners' excitement and motivation in Nasi's class showed that learners appreciate using ICTs in instruction. The study found a divergence with regard to how teachers used ICTs in instruction and the way the teachers acquired ICT pedagogy in the country. All three teachers complained of inadequate Ministry of Education and Training (MoET) exposure of primary teachers to ICT pedagogy, which is required for the implementation of the present curriculum, as presented in Section 4.2. In their views, they cope with ICT integration because of their background experience. In the case of Thupa and Lethu they had PD about ICT integration and in the case of Nasi, it was because of his initiative learning on the job from colleagues. The implication is that teachers in Lesotho require continuous training on ICT pedagogy in order to cope with ICT integration.

5.2.2.1 Explaining teachers' uneven exposure to productive discourses of ICT Integration

A conclusion to be drawn from teachers' exposure to discourses of ICT integration is that the teachers are not equally exposed to productive discourses of ICT integration. The three teachers managed to use ICTs in classroom practices due to acquired ICT pedagogy from varying sources such as pre-service training from a School of Technology Innovation Centre (STIC), in-service training as a volunteer teacher at a primary school in South Africa and on-the-job training through observation of colleagues for Thupa, Lethu and Nasi, respectively (**See 4.2**). Studies on ICT integration through the TPACK lens stress that its implementation is successful when there are ICT resources and teachers' support, especially leadership support. The observed teachers were supported by the principals and colleagues for overcoming experienced ICT integration challenges in classroom practices. There was a difference

in the support also, one principal had exposure to ICT pedagogy and could easily resolve challenges experienced while the other two principals could support with mobilisation of availability of ICT resources and data only. This suggests that teachers require support in order to sustain ICT integration. It is therefore necessary to ensure that principals are continuously sensitised about the requirements of changing curriculum during the implementation process. The principals may have had once off sensitisation workshops like teachers who had once off training workshops. This has a negative impact on teachers and principals who are employed some years after the implementation year.

What enabled the participant teachers to cope with the demand of ICT integration in the curriculum appeared to be engagement in communities of practice, which supported them within the context of their schools. What also contributed to the success of ICT integration of the three teachers was their competency and access to the available ICT resources at the respective schools, as attested by Chigona (2018). It is important to realise that the three teachers experienced several challenges of ICT integration within the context of their schools. What enabled them to sustain the challenges was the collaborative practices with colleagues and school communities and the determination to continue using ICT in classroom practices. Extant literature views teachers' exemplary practices of ICT integration as characterised by individuals' ability to engage in CoPs for sharing ICT pedagogy skills (Hunters, 2017; Padayachee, 2017). Of the three teachers in the present study, Thupa was exemplary in participation in the CoPs with colleagues from other schools. Lethu and Nasi were active in CoPs within the context of their schools. The CoPs initiatives assisted the three teachers in the study to cope with ICT integration adapting to the context of their schools.

It is apparent in the relevant policy documents supporting ICT integration that there was inadequate information informing the preparation of teachers for ICT pedagogy. The question is how to explain the teachers' initiatives of ICT integration at the observed schools. Extant literature accessed shows that teachers with developed TPACK have the ideal potential to develop lessons that integrate ICTs (Graham *et al*., 2009; Rosenberg & Koehler, 2015). High Possibility Classroom (HPC) model further provides teaching strategies and activities teachers with developed ICT pedagogy apply in ICT-integration lessons. Extant literature further shows that even if ICT

resources are available in schools, teachers' access to such resources contributes to the teachers' decisions to use the ICT resources in classroom practices. It was apparent at the three schools observed that teachers freely access the available ICT resources supported by the school administration.

5.2.3 Teachers' Classroom Practices of ICT Integration in the Science and Technology Curriculum

The second sub-question which framed the present study was on teachers' practices of the integration of ICT into the teaching of specific science concepts in Grades 5 to 7. The sub-question entailed exploring how teachers use ICT resources in ICT pedagogical lessons as part of meeting the demands of the Science and Technology syllabus in the present Grade 6 to 7 syllabus. The common and varying practices of the three teachers use of ICT in classroom practices are discussed in this section. Data answering the question were mainly derived from content analysis of Lessons 5 to 7 observed video-recorded and transcribed lessons for each participant teacher.

As highlighted earlier, in the previous section, all the three teachers declared using the available ICT resources in classroom practices within the context of their schools, although this was not necessarily because they were well trained/sensitised adequately on ICT pedagogy in preparation for implementing the present curriculum that advocates ICT integration. The teachers' strategies/approaches of using available ICTs in lessons are narrated in individual cases in Chapter 4. In summary, it was observed that the teachers at the selected primary schools used ICT resources in lessons engaging learners in common and varying patterns of practice.

All three teachers used several ICT pedagogical teaching styles such as groupwork, presentations, searching information online, projected lessons and the integration of videos in lessons. These teaching styles were observed in lesson segments such as for Thupa (Lesson Segment 5 and 6); Lethu (Lesson Segment 3 and 4) and Nasi (Lesson Segment 2 and 3). The weakness observed was that the deliberations in these lessons were characterised by teacher-talk-dominated dialogues, except in few cases, even though learners were engaged in learner-centred activities. Groupwork tended to encourage collaborative practices and motivated learning from one another.

It was observed that all three teachers succeeded in planning activities that promoted collaboration and accountability on browsed information (Thupa and Nasi) and developed tasks on the computers (Nasi). For instance, Thupa's lessons were characterised by allocating to groups different topics that were presented in whole-class discussions. Lethu's lessons were characterised by allocating similar tasks to all learners, but monitoring flow of responses to avoid getting the same feedback, and later asking learners to move around to see information accessed by other learners.

Nasi on the other hand did not always use large groups for ICT-integrated lessons, in his small computer room. Instead, he preferred dedicating learners to work in pairs. However, his lessons were characterised by encouraging creativity and promoting competitive rate of completing tasks to encourage acquisition of digital literacy and skills in the learning process. Studies using the lenses of TPACK and HPC inform us that practices such as group work in ICT-integrated lessons contribute positively to the development of learners' 21st-century skills (Ghavifekr *et al*., 2014).

Furthermore, as indicated in **Section 4**, the three teachers' lessons were characterised by the presence of some learners who could access the ICT resources at school and could not continue practising at home due to learners' disadvantaged family backgrounds. This is contrary to Santos and Castro's (2021) study in which learners who could not access ICT resources at school due to the limited number of available resources and internet connectivity could successfully use ICTs that were available at home, including internet connectivity, to respond to assignments by pre-service teachers in Philippines.

In the present study, the teachers used group work to cater for such learners to have access to the use of available ICTs. For instance, Thupa's predominant use of group work catered for all learners' access to mobile phones, as some learners could not afford to bring them to school, as discussed in **Section 4.2.1**. On the other hand, Lethu's (**Lesson Segment 3**) lessons were branded by learners' advantage of exposure to a variety of ICT resources even though some learners could not perform assignments that require browsing due to disadvantaged family backgrounds. The weakness observed was the overuse of the group work approach. Learners who could be uncomfortable in this style of teaching were disadvantaged to demonstrate what they could achieve when working independently.

The browsing exercises at all three schools were characterised by the teachers' provision of guiding keywords or questions. This was evident for Thupa in his lessons where he provided different concepts for individual group browsing. Each group shared accessed information through presentations during the course of the lesson. Lethu's lessons were also characterised by allocating learners tasks or key words for searching using offline Wikipedia. What was unique in the case of Lethu was combining strategies such as learners searching information individually, watching a video presentation or learning browsed content in the form of text or video on projected slides and then sharing ideas through class discussions. It was apparent that Lethu worked at an advantageous school with a variety of ICT resources, while Thupa had limited the choice of using mobile phones and Nasi used only computer desktops.

5.2.3.1 Explaining teachers' practices of integration of ICTs

Drawing from the discussions in Section 5.4 and from earlier discussions in Chapter 4, it can be concluded that teachers at the selected schools integrated ICTs into classroom practices, even though there was limited guidance in the Grade 7 Science and Technology syllabus about how they could use ICT resources in different topics. Individual teachers used their own means of coping with ICT integration. The syllabus at this level usually outlines the suggested activities for teachers and learners across all the concepts to support teaching and learning. It could be expected that in the curriculum advocating ICT integration, the activities would include suggestions on how ICTs could be used to demonstrate some concepts, which is not the case in the suggested activities.

Extant literature attributes teachers' ability to use a variety of ICT resources to their developed TPACK. Chigona (2018) and Chai *et al*. (2011) show that TPACK enables teachers to identify suitable ICT resources, knowledge of curriculum content and what is worthy of learning. This, according to Mishra and Koehler (2006) and Koehler *et al*. (2013), entail presenting concepts using technology to make it easy for learners to understand and to confront problems encountered in understanding concepts. Literature further contends that ICT resources available in schools should further match with ICT pedagogy skills teachers have acquired to enable effective ICT integration. Moreover, the emphasis in extant literature is that teachers' TPK

contributes to their decision to use ICT in classroom practices, showing the need to strengthen teachers' ICT pedagogy.

The teachers' competency of ICT pedagogy determines their decisions of ICT integration, even if schools are enriched with ICT resources. The three teachers demonstrated competencies of ICT pedagogy, though to a varying degree, and depending on the available resources at each school. It was apparent in the case of Lethu that the one to two weeks' training on ICT pedagogy did not benefit many teachers at the present school, since even though the school has reasonable ICT resources, not many teachers were using them in classroom practices.

Existing literature describes how to examine practices of teachers qualitatively with developed TPACK in ICT integration lessons. Juanda *et al.* (2021) and Santos and Castro (2021) explain how the seven teachers' TPACK knowledge areas could be examined in classroom practices; PK could be examined from the teacher's ability to encourage learners to build their knowledge, develop and acquire several skills such as thinking skills. The three teachers' ability to innovate to deliver their lessons to reach out to all learners, even those that did not have adequate access to the ICT resources implied their PK. The teachers' CK could be examined from the teachers' demonstration of knowledge of content, concepts, facts, theories and procedures of specific field area, in this study, Science and Technology knowledge area. The teachers' facilitation of learning, presenting relevant science and technology content in accordance with the Grade 6 - 7 syllabus demonstrated their CK. On the contrary, TK could be examined from the teachers' ability to use various technologies and media demonstrating the diverse ICT skills acquired in classroom practices. The participant teachers' demonstration of technology skills and knowledge regarding the available ICT resources in their schools' contexts implied their TK.

The PCK could be examined from the teachers' ability to choose learning methods suitable for concepts presented. For instance, using WhatsApp and YouTube for learning relevant content, in this case of Science and Technology. The teachers use of varying methods, showed that they managed to present content simplifying it for learners to understand it, monitoring the progress and intervening where necessary as facilitators. TCK could be examined from teachers' ability to choose suitable technologies and presented content that could be understood by learners, modifying

where necessary for easy comprehension. The three teachers' choice of use of ICT resources available in the context of schools and facilitation of their use demonstrated their TCK. On the other hand, the TPK could be examined from the teachers' use of technology in teaching and learning methods, specifically in accordance with the content objectives. The teachers' ability to use the available ICT resources to demonstrate content according to the syllabus, selecting content and videos learners could comprehend at this level showed their TPK. Lastly, the TPACK could be examined from the teachers' ability to integrate ICT in classroom practices through the use of diverse learning resources and platforms, providing learning materials that could be accessed by learners individually or in groups using opportunities afforded by the emerging technologies. The teachers use of available ICT resouces especially in the case of one teacher who used multiple representation of content using the variety of resources while others just indicated their knowledge of using the varying resources, constrainted by access to ICT resources, showed that the teachers had TPACK even though there were limitations.

The teachers' practices of ICT integration are elaborated in the HPC model, which contains 22 themes showing the teaching strategies and learning practices that could be observed in an ICT-integrated instruction. The themes are categorised under five constructs: theory-driven technology practice, creativity, contextual accommodation, public learning, and life preparation (Hunters, 2017). The constructs are coded TDT, CT, CA, PL and LP, respectively in the study. Hunters (2017) shows how the constructs could be examined in classroom practices; TDT could be examined in the teachers' attempts, for instance, to encourage construction of learning, to shift conversation and learning and to teach learners in authentic ways. CT could be examined from classroom activities that boost creativity, unleashing learners' playful moments and differentiating learning. CA could be examined from teachers' attempts to nurture community, defining how the technologies could be used in teaching and learning. The PL could be examined from efforts to unpack knowledge encouraging sharing of ideas. Lastly, LP could be observed from teachers' attempts to enable learners operationalise the real world, reveal their voice and own learning process.

I observed Thupa nurturing the use of variety of ICT resources in classroom practices, though he could only use the devices brought to school, limiting him to display his espoused knowledge of ICT pedagogy. His ability to use mobile phones assisting

learners with challenges encountered on different types of mobile phones and the facilitation of Skype lessons using his laptop showed his competencies in respect of ICT integration.

Thupa also nurtured using the mini projector on an improvised white board to display pictures learners downloaded in different lessons, promoting the sharing of ideas and a collaborative working environment. This demonstrated the teachers' initiative of driving construction of knowledge to enrich the subject matter of science and technology in accordance with the TDT of the HPC framework. His lessons demonstrated the acquisition of ICT pedagogy which could not be fully displayed in instruction due to limited resources. On the contrary, I observed Lethu using a variety of ICT resources in different lessons demonstrating his acquired ICT pedagogy in an enabling environment. He nurtured a multiple representation of information. Lethu demonstrated the LP of the HPC framework using available ICTs for effective delivery of the science and technology concepts to learners. Learners could use a combination of available ICT resources to access and share information and visualise the real world. He could innovate to enable learners to quickly share accessed information in the computer laboratory.

Lethu demonstrated his ICT competencies and pedagogical practices to handle the large class in ICT-oriented instruction. Though he complained of struggles with a lack of internet connectivity at school, Lethu demonstrated his acquired ICT pedagogy skills. Nasi, the third teacher, who acquired ICT pedagogy from on-the-job training, was examined using the available computers to enable learners acquire ICT skills. I observed Nasi strategised to enable all learners access the computers in pairs by dividing learners into three groups. He demonstrated the CA and CT of the HPC framework when encouraging group or pair work in the context of his school, creating opportunities for effective learning of science and technology. His school's unique arrangement of the allocated Technology domain of the Science and Technology syllabus prohibited determining the extent to which he could integrate ICTs into other content areas. In some lessons, Nasi encouraged learners to work independently on the computers, motivating them to compete to finish first. The teacher and the learners demonstrated the acquisition of ICT skills and Technology content knowledge as the learners manipulated the computers and Nasi guided them.

Drawing from the discussion, it can be concluded that there were shared patterns of ICT integration at the three schools, to some extent due to the varying contexts of the schools. The weakness in the dominance of teacher talk in discussions shows that teachers required CPD to cope with a learner-centred teaching approach more effectively, especially in ICT integration. The weakness in the overuse of groupwork could suggest the teachers' desperate efforts to ensure that all learners access the ICT resources to develop 21st-century skills. It can also be concluded that there were differing patterns of ICT integration. This could be attributed to uneven access to the variety of the ICT resources at the individual schools and the level of acquisition of ICT pedagogy for individual teachers.

5.2.4 Teachers' patterns of assessing learners in ICT integrated lessons

Drawing again from the second research question focusing on teachers' classroom practices of ICT integration, this theme reveals the teachers' patterns of using ICTs to assess learners 21st-century skills in the selected schools in Lesotho. The CAP (2009) emphasises the intertwining of teaching and formative assessment in daily classroom instruction. However, as discussed earlier (**See 4.2.4**), the policy and the Grade 7 syllabus drawn from this policy are silent about guiding teachers on how they could use ICT resources to teach and assess learners. It only mentions ICT resources that could probably be used (see **Table 4.1**).

What was differing was the teachers' approaches in assessing learners by incorporating the use of the available ICT resources within the context of the three schools. Thupa assigned groups of learners different tasks to browse information which is later shared through presentations and discussions. Lethu assigned individual learners the same tasks to browse and share information, sometimes by timely movement from one computer to another. Lethu also used embedded assessment tasks within selected YouTube videos for assessing the learners to conclude the lesson. On the contrary, Nasi provided similar task to pairs of learners, instructing them to use, for instance, different templates or formats to find solutions to the given task.

Explaining the teachers' initiatives of assessing learners in ICT pedagogy lessons, extant literature shows that the use of ICTs in classroom practices contributes to the development of 21st-century skills. Literature further shows through the lens of the TPACK that in ICT integration lessons, teachers could plan assessment tasks that

promote the development of 21st-century skills, especially when the teachers were trained on ICT pedagogy (Erdem, 2019; Chigona, 2015; Jita & Akintunde, 2021).

In this regard, a gap is realised in the present study that some teachers within the context of Lesotho were exposed to once-off, in-service training, if not exposed at all to ICT pedagogy training. Lack of exposure to continuous training seems to be one of the barriers to effective ICT integration. Several studies show that teachers at the schools were using the available ICT resources in the schools inadequately, due to several barriers such as challenges of ICT pedagogy and lack of competence to date, even in schools in South Africa (Jita and Munje (2020). Scholars realised the link between the use of available ICT resources and the CPD on ICT pedagogy, which could be beneficial to schools.

5.2.4.1 Explaining teachers' espoused ICT Integration proficiency vis-à-vis observed ICT integration practices

The divergence between teachers' espoused and observed ICT integration practices can be seen as an issue of how the teacher manoeuvres lessons with available ICT resources within the context of schools and how the decision to use the ICT resources is affected by affordances of individual schools. Thupa and Lethu vocally expressed different ways of using ICTs in instruction, some of which were not observed in the lessons. Thupa and Lethu specified knowing how to use ICT resources such as the smartboard, which was unavailable at their schools. In the case of Nasi, he specified knowing how to use different software in ICT pedagogy lessons, some of which were not observed being used. Similar cases of knowing how to use ICT resources not available within the context of the schools were reported in literature. Studies also showed teachers' concerns of their incompetency for coping with ICT integration. The studies help to explain the classroom practices of the teachers in the present study.

The teachers in the present study seemed to have had exposure to ICT pedagogy, even though in an uneven manner. A similar mixture of reform and old ways of teaching was observed in Cohen's (1990) case of Mrs Oblier, who believed her classroom practices have been transformed, only to find that she could not let go of some of her old teaching strategies. Moffitt *et al*.,(2023) further stress the challenges of implementing reforms as planned. The teachers in the present study also seemed to mix teacher and learner-centred methods, as explained in the cross-case analysis.

Moreover, even though learners were engaged in activities, teachers seemed to be doing more talking than learners, a situation akin to Makuru and Jita (2022), who observe that teachers in Lesotho continue to use teacher-centred approaches, even at the schools equipped with ICT resources. Studies on TPACK inform us that teachers' knowledge areas of the TPACK and HPC constructs contribute to effective ICT integration, but barriers within the context of schools prohibit teachers. A similar situation was observed by Tsakeni and Jita (2019) with in-service teachers struggling to demonstrate acquired TPACK due to constraints in the context of schools. On the contrary, barriers such as lack of ICT resources and the internet did not prohibit the participant teachers from integrating ICT; rather, they adapted to use the available ICT resources and initiatives possible within the context of their respective schools in accordance with the CA of the HPC framework. They also strategised to cater for disadvantaged learners who could not be provided with ICT resources by parents. This shows the teacher's initiative to enhance purposeful learning of science and technology for all learners to enrich subject matter as required by the TDT construct of the HPC model. Presently, the MoET policy on ICT integration is at draft stage and teachers have no guidance about how to cope with disadvantaged learners with regard to ICT integration at schools. This has implication on the already digital divide existing among the learners.

The ability to sustain ICT integration, even at the challenged schools in the present study, suggests that teachers could cope with ICT integration in any situation. What was unique in this study was parents' commitment to supporting schools with ICT resources, to the extent that parents provide learners with their personal mobile phones when they are required at school, which was observed in the case of Thupa and just indicated in the interview in the case of Nasi. In the case of Lethu, the mobile phones were used at home for assignments. It was apparent that the parents who could afford also bought quality smartphones for learners supporting the initiatives of ICT integration. What was also surprising was teachers' willingness to freely allow learners to use the teachers' phones for learning in ICT-integrated lessons in the case of Thupa. This shows teachers and parents' commitment to creating opportunities for effective learning in science and technology lessons in accordance with the CT of the HPC framework.

5.3 KEY FINDINGS

This section presents the key findings relative to the discussions from Chapter 4 and the cross-case analysis. The study investigated the teachers' classroom practices of ICT integration at primary schools in Lesotho. To unpack this objective, research question 1 documented the discourses initiating ICT integration at primary schools. Research question 2 focussed on establishing ICT integration classroom practices of the teachers of science and technology at primary schools in the country. The last research question, which requires accounting for teachers' practices of ICT integration in science and technology in the context of Lesotho, is interwoven within the discussions of findings of the first two research questions to give a thick explanation. The following key findings emerged from the study:

- Lesotho has a number of mutually reinforcing and sometimes competing discourses shaping ICT integration in primary schools.
- Unevenness of Teachers' exposure to productive discourses of ICT integration.
- Diversity in common and varying patterns of ICT Integration practices at selected schools.
- Unevenness of teachers' patterns of assessing learners in ICT pedagogy lessons.

Key Finding 1: Lesotho has a number of mutually reinforcing and sometimes competing discourses shaping ICT integration in primary schools

The first major finding is that there are several discourses of ICT integration in Lesotho, but the teachers' practice is shaped by a number of mutually reinforcing and sometimes competing discourses. Unpacking this finding, the identified discourses include

- Teachers' benefits of using ICTs in instruction;
- Learners collaborate and benefit when using ICTs;
- ICT as an affordance for remedial sessions;
- Building Communities of practice (CoP);
- Gaps in the current discourses as framed by policy and practice; and
- The digital divide and mixed thoughts about mobile phones at schools.

Discussing the first discourse, the three teachers were of the view that there are a number of benefits when ICTs are used in classroom practices. Teachers shift from teacher-centred to learner-centred approaches, reducing teachers' workload. Subsequently this motivates learners' development of independent learning skills. The teachers' notion of the contribution of ICT integration to a shift in pedagogy is in line with Ngwane (2017), who emphasises that using ICTs in classroom practices promotes a learner-centred approach. However, Makuru and Jita (2022) are concerned that teachers at secondary schools in Lesotho continue to use teacher-centred approaches, even in ICT-enriched schools. The participant teachers' complaint of lack of guidance on ICT integration in the Grade 7 syllabus in this study shows that the necessary preparations for the implementation of the syllabus, which required teachers to have developed ICT pedagogy, had gaps. The observed weakness of teachers talking more than learners in their lessons suggests that while teachers may embrace a discourse on learner-centredness, there are gaps in their pedagogy. The teachers may benefit from Continuous Professional Development (CPD) programmes to harness the latest teaching strategies incorporating the use of ICT. The significance of this finding is that the teachers in the study appreciated the contribution of ICT integration in the shifting of pedagogy to the required direction; however, the policy documents guided them inadequately as discussed earlier. Consequently, the teachers are not using ICT effectively to promote learner-centred approaches.

Another discourse that is promoted in the country's policy documents and has been seen to influence ICT integration practices in Lesotho is the notion that learners benefit a great deal from ICT-integrated classroom practices. This aligns with Fu (2013:113), who indicates several benefits of ICT integration for learners as "support[s] student-centred and self-directed learning, produce[s] a creative learning environment …", also emphasising communicating globally to share diverse learning experiences. It was observed in the study that learners were collaborating, in all three cases, working in groups and sharing information (**Refer to 4.2**). Another benefit suggested in the study is a discourse that argues that using ICT motivates learners to cope with remedial lessons. It was observed that learners volunteered to continue working during their break times to catch up with what was expected to be completed during the classroom instruction. Remedial lessons are recommended in the policy documents, specifically

the Science and Technology syllabus, as indicated in **Table 4.1,** but it is not suggested how teachers can use ICT to handle the remedial lessons. It appears that using ICT in remedial lessons promotes teaching and learning beyond the classroom scheduled times and benefits both the teacher and the learners. The significance of this finding is that while curriculum policy messages advocate remedial lessons for supporting learning, lack of ICT resources in some schools may hinder their implementation.

There was also a discourse on building CoPs, important for teachers to be willing to learn from others to make ICT integration a success. The three teachers benefited from collaborative practices with colleagues and the community around the schools. However, the teachers were engaged in varying patterns of collaboration practices. Only one teacher, Thupa, was involved in collaborative practices beyond his school. Extant literature offers an explanation of how teachers benefit from ICT pedagogy from CoPs. Hunters (2017) and Padayachee (2017) argue that teachers share ICT pedagogy in CoPs for effective ICT integration. Thus, teachers need professional development on ICT pedagogy before implementing ICT integration. “Teachers’ knowledge and skills on using technology in the classroom should be developed”, echoes Erdem (2019:149). The significance of this finding is that there could be cost-effective ways of promoting CoPs to achieve ICT integration; that is, learning from experienced teachers on the ground who have already established some of the resolutions to schools’ context challenges.

Another discourse that emerged in this finding is the gap framed by the policy and practice as teachers implement ICT integration. While many of the discourses from policy documents seem to emphasise that learners should be equipped with scientific and technological skills and knowledge, the three teachers were of the view that the curriculum did not provide adequate guidance on how teachers should assist learners to acquire the technological skills. The policy framework (**See Table 4.1**) includes the Grade 7 Science and Technology syllabus which the teachers complained did not guide them adequately. Traces of mismatch between policy intentions and teachers’ enactment go way back to previous reforms. Lisene and Jita (2018) established that secondary schools’ LGCSE syllabus demands ICT integration, even though there is persisting underutilisation of the available ICT resources at some schools. In a study about enablers and constraints of ICT integration Jita and Munje (2020:115) made a similar observation,

> ICT facilities were available in the schools but were not in use. Teachers at these schools were either not interested to integrate ICTs into teaching or did not have the skills to do so.

The implication is that teachers who have not been exposed to ICT pedagogy and are not guided about how they can engage learners in ICT-oriented instruction, may not be able to facilitate ICT-oriented instruction if the curriculum is not detailed, even if the ICT resources are abundant.

The discourse of digital divide and mixed feelings about the use of mobile phones at school also emerged in this finding. The teachers were of the view that using ICTs in classroom practices increases the existing digital divide between learners from different family and socio-economic backgrounds. The principals from Lebisang PS and Leratong PS complained about the syllabus requirement of learners bringing mobile phones to school. The principals stressed that their schools did not comply with the demand, for various stated reasons. On the contrary, the principal for Sentleng PS embraced the use of mobile phones, which enabled the school to integrate ICTs through the bring-your-own-device initiative.

Existing literature offers an explanation as to why the teachers were concerned about the digital divide. Gudmundsdóttir (2010) and Bladergroen *et al.* (2012) established that ICT integration sometimes creates a digital divide, disadvantaging learners. The significance of this finding is that even though policy messages require that learners have access to mobile phones at schools, negotiations for an enabling environment may have not been fully disseminated and some schools are not complying, disadvantaging learners to acquire digital literacy and skills. However, if access is negotiated accordingly, mobile phones could be an affordable ICT resource for ICT integration,n as their penetration in the country is high. Gillwald and Mothobi (2019) attest that Lesotho ranks among the top three African countries surveyed for mobile phones penetration at 79% and 107% for After Access and ITU Statistics surveys respectively even though ranked very low for internet penetration (32% & 27%, respectively).

Key Finding 2: Unevenness of Teachers' exposure to productive discourses on ICT integration

Not all teachers in the country seem to be equally exposed to productive discourses and exemplary practices to enable them to be competent and knowledgeable about how to integrate ICTs into their teaching of science. This finding continues to answer the research question 1 on the discourses motivating ICT integration in Lesotho. In spite of the uneven opportunities to learn how to integrate ICT in science teaching, the three cases suggest that those who manage to integrate ICTs draw from a variety of sources, including pre-service training for Thupa **(See 4.2.1.1)**, in-service PD for Lethu **(See 4.2.2.1)**, and apprenticeship of observation of their colleagues at work for Nasi **(See 4.2.3.2)**. What seems to distinguish the successful implementer of integration from their counterparts who might also be similarly exposed, appears to be the stronger Communities of Practice that exist to support them at each of the three schools studied.

The theory of TPACK informs us that teachers integrate ICTs effectively if they possess TPACK knowledge areas (Santos & Castro, 2021; Margolin *et al*., 2019). Tsakeni and Jita (2019) attribute the failure of effective ICT integration to constraints in-service teachers experience within the context of schools, even if they developed TPACK during pre-service. Thus, the teachers in the study espoused knowing how to use a variety of ICT resources in ICT integrated lessons, which could not be observed in the classrooms to varying degrees due to different constraints at each school. The significance of this finding is that there are teachers enriched with ICT pedagogy at primary schools in varying ways, who are prohibited from using their acquired skills for the benefit of learners due to challenges experienced in the context of schools.

Key Finding 3: Diversity in common and varying patterns of ICT Integration practices

The key finding in this case is that teachers at the selected primary schools in Lesotho engaged learners in common and varying patterns of ICT integration practices. It responds to research question 2, “How do teachers across different school contexts in Lesotho practise the integration of ICT into the teaching of science and technology in Grades 5 to 7?” The three teachers’ patterns of ICT integration practices in classroom instruction are unpacked and categorised into common and unique ICT integration practices.

The study found that, by way of practice, teachers in Lesotho commonly engage learners in group work on ICT tools. For Thupa, spreading learners evenly according to available mobile phones enabled ICT integration. For Lethu and Nasi, individual or paired learners at each computer desktop was more ideal. The three teachers consider mobile phones as one of the ICT tools that can be used effectively in science instruction. They all engaged learners in the use of mobile phones to browse for scientific information and for sharing information. For Thupa, mobile phones were used in classroom practice through the 'Bring-your-own-device' initiative, which was the only source of ICT resources at Sentleng Primary School. Lethu and Nasi used computers in the classroom and providing learners with assignments for using mobile phones at home. Ghavifekr *et al*. (2014) attest that teachers use group work in ICT integration to its positive contribution to development of learners 21st-century skills. Thus, teachers can use readily available mobile phones most families have to integrate ICT integration in classroom practices. The significance of this finding is the sensitisation of teachers so that they could use mobile phones or other available ICT resources in the context of their schools to facilitate ICT integration. The principals' support to teachers on enabling environment for ICT integration shows that principals contribute positively to the success of use of ICT resources in classroom practices.

The study further found that the three teachers provided guiding key words or questions for learners to browse for scientific information, though in different patterns in ICT integration. The observed lessons were characterised by the teachers' movement around the class, checking learners' progress as they performed given tasks. The lessons were also characterised by learners' ability to use the ICT tools beyond classroom periods and supporting some learners through remedial lessons, even though not all learners could access mobile phones at home to do assignments. Accessed literature offers an explanation why the teachers commonly provided key words, phrases or tasks for ICT integration. Trust (2018) attributes guiding learners to qualities of good ICT pedagogical teachers. There are several distractors on the internet that learners at this age should be protected from, as we use ICT resources for teaching and learning. Some principals did not allow mobile phones at schools in this study because of fear of unanticipated distractors that could ruin discipline. The significance of this finding is alerting teachers of the requirement to guide learners in

a browsing space to avoid accessing irrelevant information that could confuse or distract them.

The study also found unique ICT integration practices of individual teachers. The finding is that, depending on available or lack of ICT resources within the context of schools, teachers used varying strategies for ICT integration in classroom practices in primary schools. For Thupa, using the bring-your-own-device strategy after mobilising the community commitment to support the school was unique for this study. ICT integration was successful at Sentleng PS because of this initiative. It was also interesting to see the colleagues' support of the initiative by allowing learners to use the teachers' mobile phones in lessons and by sharing other personal devices such as mini-projectors. What was also unique for Thupa was the observed Skype lesson with an international school in the USA enabling learners to share experiences, even advising one another on issues of the Covid-19 pandemic. There was also unique interaction between the teacher and learners as they intervened during the lesson, creating an enabling environment for all.

At Leratong PS, what I found unique was the way Lethu prepared the lesson plans. Lethu prepared a weeklong lesson plan covering all the objectives of the LO taught in a week. However, the lesson plans incorporated both the Assessment criteria and Success criteria. The other two teachers did not indicate the success criteria. These are requirements of the curriculum in schools in Table 4.1, which emphasises formative assessment in classroom practices. The curriculum advocated the integration of teaching and assessment in instruction to improve learners' acquisition of concepts. Lethu's lesson plans clearly stated these principles of formative assessment. Moreover, he carefully used YouTube videos with embedded assessment tasks. Learners would listen to the content and then questions and solutions would be posed to test the extent to which they understood the information displayed. The Lesotho ICT integration policy framework explains the teachers' initiatives of assessing learners during the course of instruction. The policy advocates formative assessment, even though it is silent about how ICTs could be used for this purpose. Thus, there are several ways ICT resources could be used to provide rapid responses in formative assessment in classroom practices, which teachers could use if they had exposure to them.

At the beginning of observations Lethu was challenged to pause the video for learners to respond before feedback was provided, but he later resolved the challenge by connecting the TV to the laptop for displaying the videos in later lessons. What was also unique was the school's strategy for handling the large classes for the effective use of computers. When half of the class was in the computer room, the other learners were in the library. However, it was surprising, seeing that only a handful of teachers in this school claimed to use ICT in instruction effectively; yet after getting the computers from the project in 2019, they were trained on basic ICT literacy and pedagogy. The school, through the encouragement of the principal, also worked out the implementation plan to accommodate all the teachers. The principal even observed all teachers' initial ICT-integrated lessons. Unfortunately, that was a once-off exercise for the majority of the teachers. The principal is still struggling to understand what hinders the teachers from using the ICT and with developing strategies for reviving the effective use of the ICT. Existing literature attributes teachers' reluctance to use the available ICT resources to teachers' incompetency and lack of CPD on ICT pedagogy and ICT resources (Tsai, 2015; Chigona, 2018). The implication of this finding is that teachers could benefit from exposure to professional development programmes to equip them with emerging strategies of using ICT resources for assessment and for teaching purposes.

For Nasi, what was unique was the teacher's mode of acquisition of ICT pedagogy by means of on-the-job training. The school's arrangement of separating the Science and Technology syllabus domains such that Nasi teaches only the Technology domain, while the other domains are taught by another teacher, was also unique in this case. The strategy for grouping large classes into three groups to ensure that learners work either individually or in pairs in a limited-space computer laboratory was also unique in this case. I found Nasi very particular about individual successes in the use of the computer. By the end of the lesson, he was usually very aware of challenges encountered by individuals and who the individuals were that could be taken for the remedial lessons. This is in line with the demands of the current curriculum (**MoET, 2009**), which motivates that the teacher be fully informed about individual learners' progress and be willing to offer remedial lessons for learners who are left behind to close the gap. Accommodating the different paces of the learners by allowing a group to continue to the next stage of the lesson while still checking the progress of other

learners was also unique for this case. The significance of this finding is the need for teachers to strategize for ICT integration that incorporates all learners in the context of their schools.

Key Finding 4: Unevenness of teachers' patterns of assessing learners in ICT pedagogy lessons

The study lastly found that the participant teachers used the available ICT within their school contexts to assess the learners' 21st-century skills such as collaboration, communication, creativity, technology skills and digital literacy using varying approaches. Key finding 4 continues to answer the research question 2 mentioned in key finding 3 about ICT integration practices of teachers. The teachers' varying approaches could be accredited to the gap in policy and practice observed in this study. The Grade 7 syllabus has gaps in guiding teachers about how they could teach and assess learners using ICT resources while advocating ICT integration. Traces of assessment of the 21st-century skills were observed, even though challenges were experienced in varying contexts.

Existing literature explains why teachers attempted to assess learners' 21st-century skills. The CAP of MoET (2009) stresses teachers' shift of pedagogy to "develop learners' creativity, independent and survival skills: **(See Table 4.1)**. Assessing learners' 21st-century skills, these teachers prepare the learners for survival in the global world and in the higher levels of learning. The Integrated Primary Curriculum Grade 7 syllabus of 2017 lists "communication, problem-solving, scientific, technological, creative skills, collaboration and cooperation …" as competencies learners in Grade 7 are expected to develop (MoET, 2009). These competencies are the 21st-century skills learners across the globe are expected to acquire. Fu (2013:113) found that "using ICT enables students to communicate, share and work collaboratively anywhere, anytime". Several scholars share the same sentiments. Findings about assessment in this study are contrary to Ralebese's (2018) study, which reveals teachers' isolation of instruction and assessment. Teachers assessed learners at the end of the lesson, while in this study, teachers used affordances of technologies to motivate assessment within the instruction. The significance of this finding is to draw attention to the need to empower teachers with emerging strategies

of teaching and assessment that could use ICT resources within the context of their schools.

The following section discusses the model proposed in this study that could contribute to effective ICT integration in primary schools in Lesotho informed by the findings of this study.

5.4 THE PROPOSED BASIC ICT INTEGRATION MODEL (BIIM) FOR PRIMARY SCHOOLS

The proposed basic ICT Integration Model (BIIM) for primary schools developed in this study is informed by the key findings of the present study and existing literature that call for research to focus on classroom practices of ICT integration to improve practice. The key findings seem to highlight that teachers require support on ICT pedagogy and the provision of ICT resources, including data. The teachers struggled with some of the challenges within the context of their respective schools, partly because of the lack of productive discourses in the relevant policy documents informing ICT integration in the country. The teachers are not exposed to the Ministry's lead Continuous Professional Development training on ICT pedagogy. The syllabus specifically guiding teachers do not have adequate guidelines; every teacher decides independently on how to use the ICT resources in classroom practices. Teachers seem to cope in varying degrees within the context of their schools, due to strategies at school levels developed to sustain ICT integration. Collective responsibility for ICT integration by all relevant stakeholders seems to contribute to the success of individual schools' practices of ICT integration. The Basic ICT Integration Model (Figure 5.1) developed by the present study starts with indication of the key role for effective ICT integration in primary schools; the Government/MoET support, School ICT integration preparations, Continuous Teacher In-servicing on ICT pedagogy, Parents/Community and Learners' roles. The model then indicates the activities for each identified key role and the output that promotes effective ICT integration classroom practices. The outputs are then linked to the final outcome, which reflects what is entailed in ideal ICT integration classroom practices. Figure 5.1 presents the proposed model:

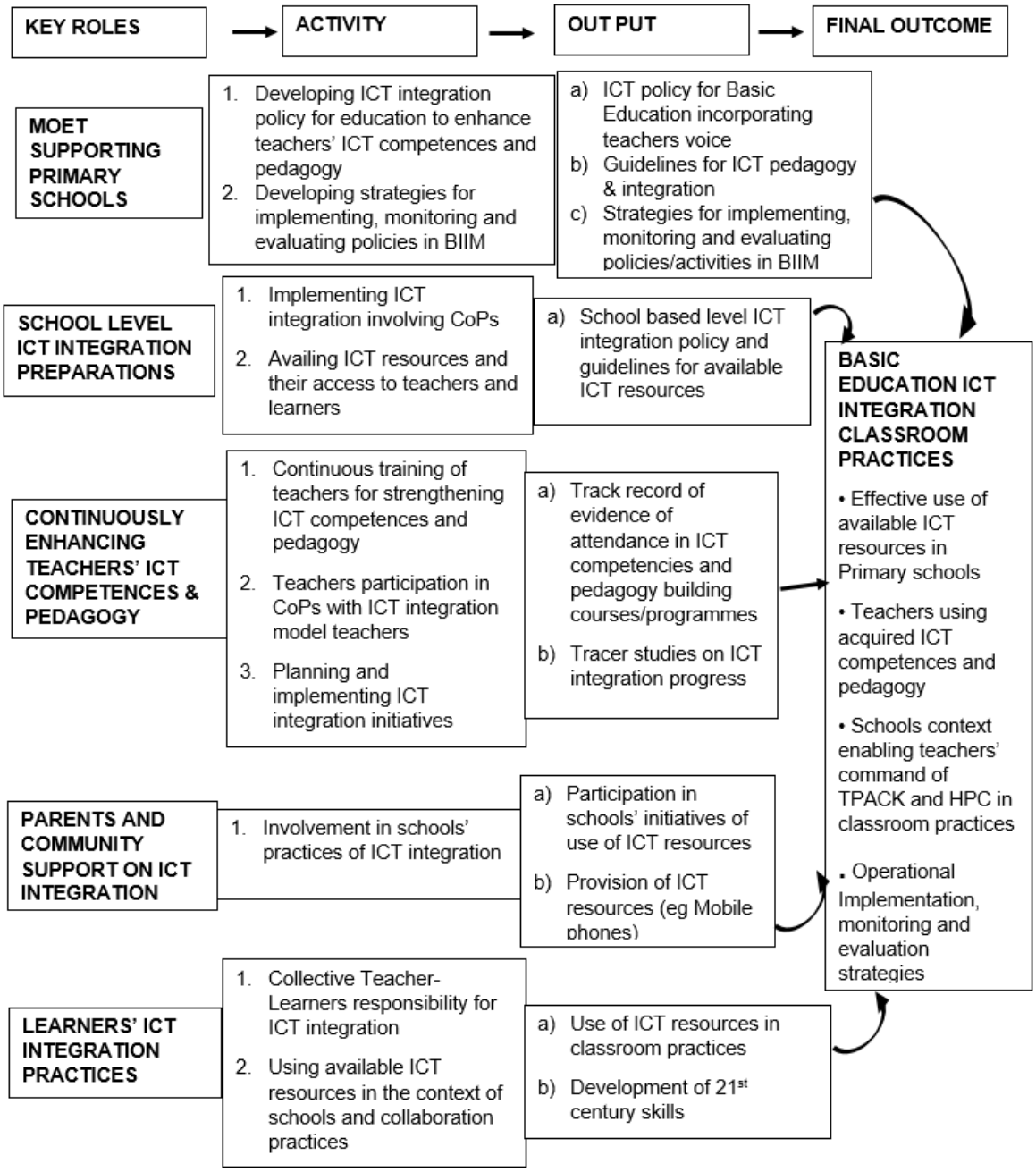


FIGURE 5.1: THE PROPOSED BASIC ICT INTEGRATION MODEL (BIIM) FOR PRIMARY SCHOOLS

Figure 5.1 shows the proposed model for ICT integration in Basic Education, starting with the Ministry of Education and Training (MoET) so that a policy for ICT integration in Education is developed with detailed guidelines for teachers at primary schools. The policy would enable ideal support for in-service teachers' practices of ICT integration and close the identified gap between policy and practice on ICT integration at this level of education. The school-level ICT integration preparations are mainly to assist teachers in establishing a working environment for ICT integration within the context

of schools, which vary, depending on the available ICT resources. The school administration also has the responsibility to making ICT pedagogy training opportunities and ICT resources available to teachers and learners through the support of MoET and parents/community. The current study established the important role of communities of practices and collaborative practices that promoted ICT integration in the selected schools.

The study also established the shortcomings of lack of CPD for some teachers in the study. Exposure of teachers to CPD which focusses on enhancing ICT competences and pedagogy as well as collaboration practices with teachers from other schools would improve the practices of ICT integration in schools. This Basic ICT Integration Model (BIIM) requires of teachers to use what is available in the school environments to sustain ICT integration supported by relevant stakeholders. The BIIM also emphasises the need for evidence of support of teachers on ICT pedagogy training and collaborative practices. The BIIM model in Figure 5.1 shows that the effectiveness of ICT integration depends largely on the developed teachers' TPACK and suitable conditions for applying the HPC constructs in ICT-oriented classroom practices. When all key role-players fulfil their functions, the BIIM model suggests that teachers at primary schools shall effectively use available ICT resources within the context of the schools for teaching and learning, and teachers shall display a good command of acquired TPACK and HPC in classroom practices.

Literature also emphasises the need for teachers' exposure to ICT pedagogy for effective ICT integration. Ederm (2019) stresses that teachers usually struggle and integrate ICT inadequately if they lack training on ICT pedagogy. Agyei and Voogt (2011:92) further articulate that teachers require the "will, skill and tool" which recognise the teachers' acquired ICT competences, positive attitude, and ability to access ICT resources as key constituents for effective ICT integration in a study in Ghana. Almerich *et al.* (2016) highlight that the ICT competences comprise the technological competences and the pedagogic competences both emphasising use of ICTs in classroom practices. The BIIM model stresses CPD for teachers on ICT pedagogy and collaborative practices with experienced ICT integration model teachers. Literature also emphasises the value of communities of practice in teachers' use of ICT in instruction. Padayachee's (2017:55) study about South Africa teachers found that "teachers are calling for communities of practice to share knowledge and

resources". However, not all the teachers in the present study participated effectively in collaborative practices of ICT integration. The teachers, school authorities, parents, community, learners and the Ministry have critical roles to play to ensure effective ICT integration in primary schools.

The three cases of the selected teachers in this study suggest that there is improvement in teachers' use of ICT in classroom practices, as argued by Lisene and Jita (2018: 123) who stress,

> many physical science teachers in selected high schools of Lesotho use ICTs … their use of ICTs for non-teaching activities is slightly higher than their use of ICTs for teaching.

Some teachers in the present study had limited access to either ideal ICT tools or data for adequate use of the internet for browsing effectively for the required educational information. Chigona (2018) and Agyei and Voogt (2011) argue that access to ICT resources contributes to teachers' ability of using ICT in instruction. The study suggests that MoET could provide direction to teachers about how they could use ICT in instruction through policies and guidelines in curriculum. The BIIM attempts to draw the attention of the relevant stakeholders, including parents and community to requirements for effective ICT integration in primary schools, which forms the foundation for Basic Education. If learners could be equipped successfully with suitable technology competencies at this level, they will apply the acquired knowledge and skills successfully in higher levels of education and fit into the global world.

The BIIM is my contribution to scholarship on ICT integration classroom practices of teachers at Basic Education level. This proposed model can also be applicable to secondary schools in Lesotho whose curriculum also requires that learners acquire digital literacy and technology skills. The BIIM is open to contributions for improvement from all relevant stakeholders for facilitating effective ICT integration in Basic Education. Drawing from emerging themes in the study, it can be argued that Lesotho is in the ongoing process of establishing ICT integration in Basic Education. The country, like other developing countries, is trapped in contextual challenges at the respective schools requiring urgent attention.

5.5 CONCLUSIONS

The purpose of the study was to explore the teachers' classroom practices of ICT integration informed by discourses from guiding policy documents and the curriculum from CAP (2009) by:

1. Documenting the discourses that drive ICT integration of science and technology teachers at primary schools in Lesotho using data from document analysis of relevant policy framework.
2. Documenting the ICT integration classroom practices of the selected experienced science and technology teachers at primary schools in Lesotho based on interviews and classroom observations.
3. Accounting for the way teachers integrate ICT in teaching of science and technology in Grades 6 - 7 in Lesotho by interpreting data from interviews, classroom observations and document analysis.

With the indicated purpose of the study, it was important to consider teachers who use the available ICT resources within their school contexts to establish how they cope, and to establish the productive discourses that support the teachers. Current discourses on ICT integration continue to emphasise that effective ICT integration depends on the availability and access of resources, and training of teachers on ICT pedagogy (Jita & Munje, 2020; Margolin *et al*., 2019). The discourses continue to emphasize the underutilisation of ICT resources available at some schools (Erdem, 2019; Kalanda, 2013; Lisene & Jita, 2018; Walan, 2020).

A conclusion drawn from the three cases of the study is that there are discourses that contribute to the success or failure of ICT integration in primary schools in Lesotho. These discourses shape the way teachers at the selected schools cope or struggle with the use of available ICTs in the context of their schools. Some discourses are informed by the guiding policy documents, which have a gap on guiding teachers in classroom practices (Section 5.5.4). Some discourses show that not all primary school teachers have benefited from ICT pedagogy initiatives implemented in Lesotho since the time when the country embarked on integrating ICT into learning and teaching. One teacher in the study benefited from ICT pedagogy from the STIC project during pre-service training. The other teacher currently benefits from ICT resources and ICT pedagogy from the 5 Hub School project supporting a group of five schools in one

region of the country, while the third teacher learnt how to use ICT in instruction from colleagues. This leads to the conclusion that there is inequality in teachers' acquisition of ICT pedagogy, which could disadvantage some learners at this level of education.

The other conclusion drawn from this study is that there are model teachers for ICT integration in Lesotho who have learnt to cope with their contextual challenges. The selected teachers in this study experienced a variety of challenges; however, they sustained ICT integration. The three teachers struggled with different challenges to varying degrees of complexity. This also suggests the inequalities regarding how teachers strategize to ensure that all learners manage to use the ICT resources. This further addresses the lack of guidance in the policy documents such as the Grade 7 syllabus, which leads to teachers or schools taking their own decisions about how they can implement effective ICT integration.

Another conclusion drawn from this study is that teachers use ICT in instruction for teaching and for formative assessment as required by the curriculum informed by CAP (MoET, 2009) and other policy documents. However, it can be concluded that the minimal guidance in the syllabus compromises the teachers' decision on the use of ICT in instruction. This minimal guidance also contributed to schools' decision on how to use ICT in classroom practices. This observation leads to the conclusion that teachers in primary schools require more support on ICT pedagogy to cope with the syllabus. In the context of Lesotho, they could be assisted by the model teachers who already sustain ICT integration at their schools.

The study further concludes that there is a growing digital divide among the primary schools' teachers and learners, as some primary schools have ICT resources, while others do not; yet learners at this level are expected to acquire similar ICT literacy and competencies. The study concludes that use of mobile phones in primary schools could be an accessible mode for most primary schools. The intervention across challenged primary schools from the MoET and the community could also help all learners to acquire ICT literacy and skills as required by the curriculum and for learners' survival in the ever-evolving digital world. It was evident in the case where the school had adequate donated ICT resources that learners benefited more than learners at the other two schools.

It was interesting to find that teachers in this study are willing to share educational information through social media, especially WhatsApp, which most teachers can access. These teachers are willing to assist other teachers to get started with ICT integration. The study reveals that there are opportunities for getting assistance from other teachers using readily available ICT tools such as mobile phones that many teachers and learners have in order to make a difference in teaching and learning practices. It can be concluded that evidence in this study indicates that there are some teachers who can be used as model teachers for the effective diffusion of ICT integration strategies to assist other teachers to cope with the use of ICT in instruction. Mobile phones are readily available in most families and have the potential to overcome the first barrier of availability of ICT infrastructure to facilitate ICT integration.

In line with the existing literature, the study concludes that teachers need support on ICT-based pedagogy in order to use ICT in classroom instruction. Lesotho is lucky to have teachers who volunteer to diffuse ICT within the education system on a voluntary basis. They only require support on basic requirements such as data and devices. The teachers can be used to confront the insignificant use of ICT which has been a challenge in the country for over a decade. Furthermore, the study suggests that teachers could be encouraged to collaborate locally and globally for effective, successful ICT integration. In this study, the teacher from the most challenged school regarding the availability of devices, electricity and internet benefited from being connected to other teachers locally and globally. It appears that ICT integration benefits learners in connecting with other learners globally and this can benefit learners in Lesotho in general.

The study is therefore a foundation, taking research into a new direction in terms of investigating teaching and assessment at Basic Education level in ICT pedagogical lessons. The study provides explanations of patterns of teachers' practices of ICT integration and how the teachers are coping within the context of Lesotho. Since this was a case of three teachers in one district of Lesotho, it does not make a conclusive claim for all teachers on discourses and ICT integration practices and the explanations provided. Thus, this study's findings can't be generalised to all schools. However, there are lessons learnt which could be applicable to other schools in Lesotho.

5.6 RECOMMENDATIONS FOR POLICY, PRACTICE AND FUTURE RESEARCH

This section discusses the recommendations on how the gap pertaining to productive discourses that inform ICT integration can be reduced in guiding policy framework and how teachers' classroom practices of ICT integration could be improved in primary schools in Lesotho.

The evidence shows that there are gaps or silences in the policy framework about ICT integration discourses. Teachers who had exposure to ICT pedagogy are able to establish how they could use the ICT in instruction, whereas those who had been exposed to short-term training courses seemed to struggle to sustain ICT integration. The study therefore recommends Continuous Professional Development (CPD) training programmes for primary school teachers on ICT-based pedagogy to motivate them to sustain ICT integration. There could be formal CPD programmes in which pre-service and in-service teachers are frequently capacitated on enhancement of ICT competences and pedagogy and be afforded access to ICT resources as advocated by the will, skill and tool model and the proposed BIIM model in this study.

There could also be informal CPDs in which teachers engage with CoPs to capacitate one another in ICT pedagogy and maintenance of acquired ICT competences. This could be practical if they include establishing CoPs and other teacher-related seminars, meetings or workshops organised at school level. Some teachers voluntarily engage in CPD, but to some limited extent, due to lack of supporting funds, using their own resources. Some teachers observed had some limitations resulting from a lack of exposure to CPD. More support especially from principals at school level on access to available ICT resources could benefit other teachers as they collaborate and share experiences. The schools with experienced teachers on ICT integration could be used as model schools to educate other teachers on ICT integration in Basic Education across the country.

The study also recommends a review of the current Science and Technology curriculum so that it could provide detailed guidance to teachers pertaining to effective ICT integration strategies. It could therefore be necessary to engage teachers who are experienced in the use of ICTs in instruction in review of the curriculum. Moreover, the study suggests that it could be beneficial if the Ministry and independent sponsors support teachers with ICT infrastructure and data for the use of ICT in classroom

instruction. This could be considered as one of the basic requirements for effective teaching and learning across all levels of education, including the Basic Education level. Teachers and curriculum developers should also be supported to benchmark with other countries to explore how they integrate technology in education and how such countries support the integration of ICT at Basic Education level to inform our ICT policy for education currently at draft stage and the Curriculum and Assessment Policy currently at review stage in 2022.

The study further recommends intensive qualitative research to explore the ICT integration practices of teachers across all ten districts of Lesotho to inform teachers and the education system about how teachers cope with the use of ICT in Basic Education responding to the demands of the current curriculum. The present study focused on three teachers in one district of the country. The study across all ten districts could probably reveal a variety of patterns of use of ICT in the varying contexts of the country. This could provide a broader spectrum of lessons to be learnt for diffusing ICT integration in the country. It would be interesting also to undertake a study tracking the performance and sustainability of all schools that benefited from ICT devices and pedagogy from different initiatives in the country. This could provide the education system a picture of the extent to which ICT integration initiatives have been responsive and to plan a way forward to improve the use of ICTs in instruction.

5.7 SIGNIFICANCE OF THE STUDY

The study contributes to the growing body of literature about ICT integration in schools and to the scholarship about how teachers cope with use of ICT in instruction in varying school contexts (Koh *et al.*, 2014). The study therefore contributes the scenario of the three schools in the context of Lesotho. The work of this study has implications for future studies. It lays a foundation for similar case studies or other approaches of research on ICT integration in primary schools that could extend the study by a wider sample of schools, teachers or varying subjects.

The limited but growing existing literature about technology in education in Lesotho has documented studies revealing teachers' ICT integration practices in classroom instruction using a quantitative or mixed-method approach (Jita & Akintunde, 2021). The studies of the qualitative approach mainly used interviews, which could be

considered as self-reporting instruments. The present study used the qualitative approach, which triangulated data by using multiple instruments inclusive of classroom observations to fill the methodological gap of limited qualitative studies using observations on ICT integration.

One other significance of this study is focusing on ICT integration in the new curriculum subject called Science and Technology, which adds new knowledge on the implementation of the new curriculum in general. To my knowledge, this is the first study in the country that sought to unpack the implementation of ICTs in the new science and technology curriculum at this level, as most previous studies focused on ICT integration in the old version of the Lesotho National Curriculum at primary schools or the sciences at LGCSE level.

The study also showed the importance of CoPs for teaching and learning, especially for promoting teachers' learning ICT integration amongst one another in the country. The study reveals teachers' voluntary actions of supporting other teachers regarding the professional development on ICT-based pedagogy. It is evident in this study that the CoPs benefited the participant teachers and has the potential to benefit other teachers if they could participate in such CoPs or establish their own in the vicinity of their schools.

Additionally, the study displays the varying patterns of teacher's ways of sustaining ICT integration across different schools' contexts in Lesotho. This applies especially to strategies of improvising and grouping learners to enable access by all to the digital devices through a qualitative study. Over and above, the study reveals teachers' independent initiatives of diffusing ICT integration among colleagues without being engaged in a project by the Ministry of Education and Training or NGOs interested in improving the Lesotho Education System. It is evident that such initiatives need to be revealed to inform other teachers about how to cope with ICT integration independently, confronting the various schools' challenging contexts.

The study proposed a conceptual model for effective ICT integration at primary schools. The study therefore points to a direction of focus for future studies to follow up on the impact of the proposed contributing factors to effective ICT integration. The study should therefore have a significant impact on decision making for policy makers and the wider society suggested as role-players for ICT integration. Findings on the

discourses about ICT integration and the patterns of classroom practices of the three teachers are useful pointers for making informed decisions about how to improve policies that drive ICT integration in primary schools to achieve the desired educational goals.

5.8 LIMITATIONS OF THE STUDY

The study covers three cases of teachers' practices of ICT integration in Basic Education in Lesotho. The findings can therefore not be generalized to all teachers of the Basic Education system. Moreover, the data collection stage was interrupted by the teachers' strike and the Covid-19 pandemic lockdowns. This reduced the anticipated number of classroom observations. The classroom observations could therefore not be done in consecutive weeks, as was the original plan. However, triangulation of data collection instruments using document analysis of relevant ICT-related policy framework documents, multiple interviews and frequent classroom observations, as well as member checking and thick description of data ensured trustworthiness of the data informing this study. Additionally, there was a second round of data collection in 2022 to close some gaps from the first data collection period. Not all TPACK and HPC constructs were explicit; the study discussed the ones that emerged within the Lesotho context from the three participants' actions of ICT integration into instruction and from their points of view as recommended in qualitative studies. However, a thick description of how the three teachers used the available ICT resources and the challenges experienced were indicated to give a clear picture of what transpired I each school.

5.9 THE RESEARCHER'S FINAL REFLECTIONS

Personally, in my past years of teaching, I taught LGCSE Physical science, which also encouraged ICT integration. Learners sit for LGCSE examinations upon their exit from secondary school in order to transit to tertiary education in Lesotho. Physical science comprises physics and chemistry and is compulsory for all learners in the country. This is one of the subjects considered a foundation for learners for pursuing Science, Technology, Engineering and Mathematics (STEM)-oriented careers. I worked at a school with an advanced computer laboratory with internet, but which was used mostly for Computer Education literacy lessons by the ICT teachers. The school did not

engage in any project piloting ICT integration in Lesotho secondary schools. I did not have the competence to use ICT in instruction, since during my teacher training I was not exposed to ICT pedagogy. There were no guidelines in the Physical Science syllabus about how ICT should be used. The syllabus just recommended learners' acquisition of technological knowledge and skills to fit into the global world and to contribute to the economic development of the country. It was only after I had trained on ICT pedagogy at Master's degree level that I managed to use ICT in classroom practices.

The study was an opportunity to experience and explore how teachers who were successful in integrating ICT into their teaching practice after capacitation from teacher training institutions or from in-service training, formal or informal, cope with a syllabus that endorses the use of ICT in instruction and how they are supported. Doing this study has opened my eyes to realise the key role of teachers in the implementation of an evolving curriculum in basic education. It is critical to capacitate teachers continuously as key players for implementing educational reforms in teaching practices in the context of schools. Enriched reforms meeting the requirements of the country could be developed, but translation into classroom instructions depends on the acquired competences and interpretation of teachers during implementation. I developed an understanding that teachers sustain ICT integration when they cultivate a positive attitude towards ICT integration, ICT competences and pedagogy. Working collaboratively with other people, including the community, is also a necessary ingredient.

I realised that teachers and principals' involvement in communities of practice contributes positively to the success of ICT integration. I also developed an understanding that teachers who do not use ICT in classroom practices deny learners an opportunity to excel in creativity, higher-order thinking skills and independence in learning that are triggered by using ICT. In other words, they limit learners' development of 21st-century skills critical for their survival in higher levels of education and in fitting in the demands of the currently technology driven economy. I also realised that teachers taking responsibility for facilitating ICT integration in their schools and realising that teachers' pedagogical competences include the ability to use ICT resources in teaching practice contribute positively to the success of ICT integration. Moreover, they should voluntarily engage in continuous professional development on

ICT pedagogy, some of which are freely available on the internet. Teachers should also be willing to share experiences with other teachers so that they are not left behind as technology evolves. The Ministry of Education and Training should strategize on effective means of supporting and tracking ICT integration teachers to inform the education system about current practices of ICT integration in the country.

5.10 SUMMARY OF THE CHAPTER

This chapter highlighted the summary of the key findings of this study on how teachers integrate ICT within a Lesotho context, aligned with the interpretations and conclusions drawn from the study. Recommendations are also indicated and the proposed extension of the contexts in the TPACK model are informed by a synthesis of the findings of the study. The significance of the study is also justified and the limitations of the study are indicated. The cross-case analysis reveals that there are teachers on the ground using ICT in their classroom instruction.

The three teachers acquired ICT-based pedagogy through different modes. Thupa acquired knowledge through STIC as part of pre-service teacher training at the LCE teacher training institution. Thupa further enhances his technological content knowledge and skills by voluntarily engaging persistently in CPD and in volunteering to diffuse ICT pedagogy among other teachers, most of the time using his own resources. On the contrary, Lethu, by means of the professional development programme, attended in-service training that exposed him to ICT pedagogy. Unlike Thupa, Lethu has had limited exposure to CPD since his arrival at the present school. However, skills acquired from the school in South Africa and the variety of ICT devices in the school assisted him to sustain ICT integration. On the other hand, Nasi developed ICT pedagogy during on-the-job training. He studied other teachers doing it and read computer education books, eventually succeeding in being recognised as the potential teacher for ICT integration.

The following were highlighted in this study as discourses informing ICT integration in the selected schools' contexts:

- Teachers' benefits of using ICTs in instruction;
- Learners collaborate and benefit when using ICTs;

- ICT as an affordance for remedial sessions;
- Building Communities of practice (CoP);
- Gaps in the current discourses as framed by policy and practice;
- Warning about ICT integration hassles;
- The digital divide and lastly mixed thoughts about mobile phones at schools.

Establishing a working internal school collaboration atmosphere is also key to sustaining ICT integration. Teachers require CPD for sustaining ICT integration, moving with the evolving technologies. There are also distractors in ICT-integrated classroom practices. Teachers should frequently warn learners to avoid them and to collaborate in resolving some of the distractions.

In summary, the three cases led to the development of the proposed conceptual model for effective ICT integration in primary schools. It is believed that the framework will contribute to the future improvement of Education policy motivating the use of ICT in instruction and in teachers' approaches for effective ICT integration.

REFERENCES

Agyei, D.D. & Voogt, J.M. 2011. Exploring the potential of the will, skill, tool model in Ghana: Predicting prospective and practicing teachers' use of technology. *Computers & Education*, *56*(1): 91-100.

Aikins, M.V. & Arthur-Nyarko, E. 2019. Challenges facing information and communication technology implementation at the primary schools. *Educational Research and Reviews*, 14(13):484–492.

Almerich, G., Orellana, N., Suárez-Rodríguez, J. & Díaz-García, I. 2016. Teachers' information and communication technology competences: A structural approach. *Computers & Education*, *100*: 110-125.

Asabere, N., Togo, G., Acakpovi, A., Torgby, W. & Ampadu, K. 2017. AIDS: An ICT model for integrating teaching, learning and research in Technical University Education in Ghana. *International Journal of Education and Development using ICT*, 13(3).

Baller, S., Dutta, S. & Lanvin, B. 2016. *Global information technology report 2016*. Geneva: Ouranos.

Baydas, O., Kucuk, S., Yilmaz, R.M., Aydemir, M. & Goktas, Y. 2015. Educational technology research trends from 2002 to 2014. *Scientometrics*, 105(1):709–725.

Beglar, D. & Murray, N.L. 2009. *Inside track: writing dissertations and theses.* England: Pearson Education Limited.

Bell, J. & Waters, S. 2014. *Doing your research project: A guide for first-time researchers.* McGraw-Hill Education (UK).

Bielefeldt, T. 2012. Guidance for technology decisions from classroom observation. *Journal of Research on Technology in Education*, 44(3):205–223.

Bingimlas, K.A. 2009. Barriers to the successful integration of ICT in teaching and learning environments: A review of the literature. *Eurasia Journal of Mathematics, Science & Technology Education*, 5(3).

Bladergroen, M., Chigona, W., Bytheway, A., Cox, S., Dumas, C. & Van Zyl, I. 2012. Educator discourses on ICT in education: A critical analysis. *International Journal of Education and Development using ICT*, 8(2).

Bohloko, M., Makatjane, T.J., Mokuku, T. & George, M.J. 2019. Assessing the effectiveness of using YouTube videos in teaching the chemistry of group i and vii elements in a high school in Lesotho. *African Journal of Research in Mathematics, Science and Technology Education*, 23(1):75–85.

Bowen, G.A. 2009. Document analysis as a qualitative research method. *Qualitative Research Journal*, 9(2):27–40.

Brinkerhoff, J. 2006. Effects of a long-duration, professional development academy on technology skills, computer self-efficacy, and technology integration beliefs and practices. *Journal of Research on Technology in Education*, 39(1):22–43.

Bryman, A. 2016. *Social research methods*. Oxford University Press.

Buabeng-Andoh, C. 2012. An exploration of teachers' skills, perceptions and practices of ICT in teaching and learning in the Ghanaian second-cycle schools. *Contemporary Educational Technology*, 3(1):36–49.

Capuk, S. 2015. ICT Integration models into middle and high school curriculum in the USA. *Procedia-Social and Behavioural Sciences*, 191:1218–1224.

Chai, C.S., Koh, J.H.L., Tsai, C.-C. & Tan, L.L.W. 2011. Modelling primary school pre-service teachers' Technological Pedagogical Content Knowledge (TPACK) for meaningful learning with information and communication technology (ICT). *Computer Education,* 57:1184–1193.

Chere-Masopha, J.M. 2018. Personal landscapes of teacher professional identities versus digital technology adoption and integration in Lesotho schools. *International Journal of Learning, Teaching and Educational Research*, 17(3):28-42.

Chigona, A. 2015. Pedagogical shift in the twenty-first century: Preparing teachers to teach with new Technology. *Africa Education Review*, 12(3):478–492.

Chigona, A. 2018. Digital fluency: necessary competence for teaching and learning in Connected classrooms. *The African Journal of Information Systems*, 10(4):7.

Chigona, A. & Chigona, W. 2010. An Investigation of Factors affecting the Use of ICT for Teaching in the Western Cape Schools. In T Alexander, M Turpin & J. P van Deventer (eds). *ECIS 2010 Proceedings*. Pretoria: University of Pretoria.

Claro, M., Nussbaum, M., López, X. & Contardo, V. 2017. Differences in views of school principals and teachers regarding technology integration. *Journal of Educational Technology & Society*, 20(3):42–53.

Cohen, D.K. 1990. A revolution in one classroom: The case of Mrs Oublier. *Education Evaluation Policy Anal.,* 12:311–329.

Cohen, L., Manion, L. & Morrison, K. 2018. *Research methods in education*. New York: Routledge.

Creswell, J.W. & Creswell, J.D. 2018. *Research design: Qualitative, quantitative and mixed methods approaches*. Thousand Oaks, Ca: Sage Publications.

Davies, R.S. & West, R.E. 2014. Technology integration in schools, in: *Handbook of research on educational communications and technology*. New York: Springer, pp. 841–853. Available from: https://doi.org/10.1007/978-1-4614-3185-5_68 [Accessed on 28/12/2017].

Dlamini, R. & Mbatha, K. 2018. The discourse on ICT teacher professional development needs: The case of a South African teachers' union. *International Journal of Education and Development using ICT*, 14(2):17–37.

Donnelly, D., McGarr, O. & O'Reilly, J. 2011. A framework for teachers' integration of ICT into their classroom practice. *Computer Education,* 57:1469–1483. Available from: https://doi.org/10.1016/j. compedu.2011.02.014 [Accessed on 20/04/2018].

Drew, C., Joubert, L., Nyenye, M., Roebert, M., & Turley, C. 2016. *Hands-on Scientific and Technological Grade 6 Learner's book.* Cape Town SA: Oxford University Press

Engida, T. 2014. Chemistry teacher professional development using the technological pedagogical content knowledge (TPACK) framework. *African Journal of Chemical Education*, 4(3):2–21.

Erdem, A. 2019. A Study on Teachers' Views on the Use of Technology to Improve Physics Education in High Schools. *Journal of Education and Training Studies*, 7(4):142-153.

Erduran, A. & Ince, B. 2018. Identifying Mathematics Teachers' Difficulties in Technology Integration in Terms of Technological Pedagogical Content Knowledge (TPCK). *International Journal of Research in Education and Science*, 4(2):555-576.

Finger, G. & Finger, P. 2013. Understanding TPACK in practice: Praxis through technological pedagogical reasoning. *International Association for Development of the Information Society*.

Flick, U. 2014. *An introduction to qualitative research*. London: Sage Publications.

Fu, J. 2013. Complexity of ICT in education: A critical literature review and its implications. *International Journal of Education and Development using ICT*, 9(1):112–125.

Gaible, E. & Burns, M. 2005. *Using technology to train teachers. Appropriate uses of ICT for teacher professional development in developing countries*. Washington, DC: infoDev/*World Bank*. Available from: http://www.infodev.org/en/Publication.13html [Accessed on 15/05/2018].

George, F. & Ogunniyi, M. 2016. Teachers' perceptions on the use of ICT in a CAL environment to enhance the conception of science concepts. *Universal Journal of Educational Research*, 4(1):151–156.

Ghavifekr, S., Razak, A.Z.A., Ghani, M.F.A., Ran, N.Y., Meixi, Y. & Tengyue, Z., 2014. ICT integration in education: Incorporation for teaching & learning improvement. *Malaysian Online Journal of Educational Technology*, *2*(2): 24-45.

Ghavifekr, S. & Rosdy, W. 2015. Teaching and learning with technology: Effectiveness of ICT integration in schools. *International Journal of Research in Education and Science,* 1(2):175–191.

Gillwald, A., Mothobi, O. & Deen-Swarray, M. 2017. The state of ICT in Lesotho (2016). *Africaportal.org.* [Accessed on 20/07/2019].

Gillwald, A. & Mothobi, O. 2019. A demand-side view of mobile internet from 10 African countries. Available from: https://researchictafrica.net/2019_after-access_africa-comparative-report/ [Accessed 25/03/2023]

Government of Lesotho. 2017. *Country analysis working document.* Available from: https://www.undp.org/content/dam/unct/lesotho/docs/202017_rev.pdf [Accessed on 29/05/2018].

Graham, R.C., Burgoyne, N., Cantrell, P., Smith, L., St Clair, L. & Harris, R. 2009. Measuring the TPACK confidence of in-service science teachers. *Tech Trends*, 53(5):70–79.

Gudmundsdóttir, G.B. 2010. When does ICT support education in South Africa? The importance of teachers' capabilities and the relevance of language. *Information Technology for Development*, 16(3):174–190.

Guillén-Gámez, F.D. & Mayorga-Fernández, M.J. 2020. Quantitative-comparative research on digital competence in students, graduates and professors of faculty education: An analysis with ANOVA. *Education and Information Technologies*, 25(5):4157–4174.

Günes, E. & Bahçivan, E. 2016. A multiple case study of preservice science teachers' *TPACK*: Embedded in a comprehensive belief system. *International Journal of Environmental and Science Education,* 11(15):8040–8054.

Guzey, S.S. & Roehrig, G.H. 2009. Teaching science with technology: Case studies of science teachers' development of technology, pedagogy and content knowledge. *Contemporary Issues in Technology and Teacher Education,* 9(1):25–45.

Hayes, D.N. 2007. ICT and learning: Lessons from Australian classrooms. *Computer & Education,* 49(2):385–395.

Hennessy, S., Onguko, B., Harrison, D., Ang'ondi, E.K., Namalefe, S., Naseem, A. & Wamakote, L. 2010. Developing the use of information and communication technology to enhance teaching and learning in East African schools: Review of the literature. *Centre for Commonwealth Education & Aga Khan University Institute for Educational Development – Eastern Africa Research Report, 1.*

Hinostroza, J.E., Labbé, C., Brun, M. & Matamala, C. 2011. Teaching and learning activities in Chilean classrooms: is ICT making a difference? *Computers & Education*, 57(1):1358–1367.

Howard, S.K., Chan, A. & Caputi, P. 2015. More than beliefs: Subject areas and teachers' integration of laptops in secondary teaching: Subject area beliefs and technology integration. *Br. J. Educ. Technol*., 46:360–369. Available from: https://doi.org/10.1111/bjet.12139 [Accessed on 18/05/2018].

Hunter, J. 2015. *Technology integration and high possibility classrooms: Building from TPACK*. New York: Routledge.

Hunter, J. 2017. High Possibility Classrooms as a pedagogical framework for technology integration in classrooms: an inquiry in two Australian secondary schools. *Technology, Pedagogy and Education*, 26(5):559–571.

Hsu, P.S., Mukhopadhyay, S. & Al-Ararah, R. 2020. Exploring current practice of using technology to support collaborative argumentation in science classrooms. *Middle Grades Review*, 6(1):6.

Isaacs, S. 2007. *Survey of ICT and education in Africa.* Lesotho Country Report.

Jaipal-Jamani, K. & Figg, C. 2015. A case study of a TPACK-based approach to teacher professional development: Teaching science with blogs. *Contemporary issues in technology and teacher education*, 15(2):161–200.

Jepkemei, E., Kwayumba, D., Kibukho, K. & Piper, B. 2015. Kenya's ICT policy in practice: The effectiveness of tablets and e-readers in improving student outcomes. In *FIRE: Forum for International Research in Education* 2(1):2.

Jita, T. 2016. Pre-service teachers' competence to teach science through information and communication technologies in South Africa. *Perspectives in Education*, 34(3):15–26.

Jita, T. & Akintunde, M. A. 2021. Pre-Service Teachers' Competence to Teach Science through ICTs: A Case Study of Lesotho. *The International Journal of Science, Mathematics and Technology Learning, 28*(1):27–40. doi:10.18848/2327-7971/CGP/v28i01/27-40.

Jita, T., & Munje, P. N. 2020. Teaching science through Information and Communication Technologies: ‘Enablers’ and ‘constraints’ on beginning teachers. *The Independent Journal of Teaching and Learning,* 15(2):107–120.

Johnson, B. & Christensen, L. 2014. *Educational research: quantitative, qualitative, and mixed approaches,* 5th edition. Thousand Oaks, Ca: Sage Publications.

Juanda, A., Shidiq, A.S. & Nasrudin, D. 2021. Teacher learning management: Investigating biology teachersâ€™ tpack to conduct learning during the covid-19 outbreak. Jurnal Pendidikan IPA Indonesia, 10(1):48-59.

Kalanda, K. & De Villiers, M. 2013. E-Learning in the Science curriculum: A study in selected high schools in Lesotho. Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications in Victoria, Canada. Association for the Advancement of Computing in Education (AACE). EdMedia.

Kalaš, I., Laval, E., Laurillard, D., Lim, C.P., Meyer, F., Musgrave, S., Senteni, A., Tokareva, N. & Turcsányi-Szabó, Márt, A. 2014. ICT in primary education: Analytical survey volume 2: Policy, practices, and recommendations. *UNESCO Institute for Information Technologies in Education.*

Kareem, A.A., & Olafare, F.O. 2018. Comparative study of the effects of computer assisted instruction on students’ academic achievement in science subjects in high schools in Osun State, Nigeria. *International Journal for Innovative Technology Integration in Education*, 1(1):15–22.

Ke, F. & Hsu, Y.C. 2015. Mobile augmented-reality artefact creation as a component of mobile computer- supported collaborative learning. *The Internet and Higher Education,* 26:33–41.

Kihoza, P., Zlotnikova, I., Bada, J. & Kalegele, K. 2016. Classroom ICT integration in Tanzania: Opportunities and challenges from the perspectives of TPACK and SAMR models. *International Journal of Education and Development using ICT*, 12(1):107–128.

Koehler, M.J., Mishra, P. & Cain, W. 2013. What is technological pedagogical content knowledge (TPACK)? *Journal of Education*, 193(3):13–19.

Koh, J.H.L. & Divaharan, S. 2013. Towards a TPACK-fostering ICT instructional process for teachers: Lessons from the implementation of interactive whiteboard instruction. *Australasian Journal of Educational Technology*, *29*(2):233–247.

Koh, J.H.L., Chai, C.S. & Tay, L.Y. 2014. TPACK-in-Action: Unpacking the contextual influences of teachers' construction of technological pedagogical content knowledge (TPACK). *Computers & Education*, 78:20–29.

Koh, J.H.L., Chai, C.S., Benjamin, W. & Hong, H.Y. 2015. Technological Pedagogical Content Knowledge (TPACK) and design thinking: A framework to support ICT lesson design for 21st-century learning. *The Asia-Pacific Education Researcher*, *24*(3):535–543.

Laws, S., Harper, C. & Marcus, R. 2003. Seven Key Research Techniques. *Laws, S., Research for Development: A Practical Guide. Sage Publications: London*.

Lesotho Ministry of Information, Science and Technology (MICST). 2005. Available from: http://unesdoc.unesco.org/images/0015/001585/158512eo.pdf [Accessed on 11/06/2017].

Lesotho Ministry of Education and Training (MoET). 2005. *Education sector strategic plan* 2005–2015. Maseru, Government Printing.

Lesotho Ministry of Education and Training (MoET). 2016. *Education sector plan* 2016–2026. Maseru, Government Printing.

Lesotho Ministry of Education and Training(MoET). 2009. *Curriculum and Assessment Policy (CAP)*. Maseru, Government Printing.

Lewis, J., Ritchie, J., Ormston, R. & Morrell, G. 2003. Generalising from qualitative research. *Qualitative research practice: A guide for social science students and researchers*, 2:347–362.

Light, D. 2010. Multiple factors supporting the transition to ICT-rich learning environments: The Intel® Teach Essentials Course and changing teacher practice in India, Turkey, and Chile. *International Journal of Education and Development using ICT*, 6(4):39–51.

Lisene, N. & Jita, T. 2018. Exploring the integration of modern technologies in the teaching of physical science in Lesotho. *Perspectives in Education*, 36(1):111–127.

Liu, P. 2016. Technology integration in elementary classrooms: Teaching practices of student teachers. *Australian Journal of Teacher Education*, 41(3):6.

Mack, L. 2010. The philosophical underpinnings of educational research. *Polyglossia,* 19:5–11**.**

Makuru, B. & Jita, T. 2022. Information and Communication Technology Practices Biology Teaching in Lesotho High Schools. *International Journal of Information Technology,* 12(7):668–677.

Margolin, J., Pan, J. & Yang, R. 2019. Technology Use in Instruction and Teacher Perceptions of School Support for Technology Use in Iowa High Schools. REL 2019-004. *Regional Educational Laboratory Midwest*. Retrieved from https://ies.ed.gov/ncee/edlabs. [Accessed 30 July 2021]

McCormick, R. & Scrimshaw, P. 2001. Information and communications technology, knowledge and pedagogy. *Education, Communication & Information*, 1(1):37–57.

McMillan, J.H. & Schumacher, S. 2010. *Research in education: evidence-based inquiry, MyEducationLab Series.* New Jersey: Pearson.

Mishra, P. & Koehler, M.J. 2006. Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record,* 108(6):1017-1054.

Moffitt, S.L., O'Neill, M.K. & Cohen, D.K., 2023. *Reforming the reform: Problems of public schooling in the American Welfare State*. University of Chicago Press.

Mokuku, T., Nteso, L., Mphunyane, M., Nyabanyaba, T., Liphoto, N., Mabejane, M., Khaahloe, M., Khanyane, M. & Nthathakane, M. 2013. *Investigating training needs of primary and secondary school teachers, heads and principals in lesotho with respect to the teaching and learning of mathematics, science and technology*. Ministry of Education and Training, Lesotho.

Morrell, P.D. & Carroll, J.B. 2010. *Conducting educational research: A primer for teachers and administrators*. Rotterdam: Sense Publishers.

Moursund, D. G. 2006. Developing A Philosophy of Computers in Education. In *Northwest Council for Computer Education annual conference*. February 2006 Conference

Moursund, D.G., 2005. *Introduction to information and communication technology in education*. D. Moursund. scholarsbank.uoregon.edu

Msila, V. 2015. Teacher readiness and information and communications technology (ICT) use in classrooms: A South African case study. Creative Education, 6:1973–1981.

Ngwane, K.S. 2017 Information and Communication Technology as Agents of Change for Teaching and Teacher Development: A Case Study of a Secondary School, KwaZulu-Natal. *Researchgate.net.*

Nsolly, N.B. & Charlotte, N.M. 2016. Integration of ICTs into the curriculum of Cameroon primary and secondary schools: A review of current status, barriers and proposed strategies for effective integration. *International Journal of Education and Development using ICT*, 12(1).

Nyvang, T. 2006. Implementation of ICT in higher education as interacting activity systems. Retrieved from https://citeseerx.ist.psu.edu. [Accessed 15 May 2019]

Oyier, C.R., Odundo, P.A., Lilian, G.K. & Wangui, K.R. 2015. Effects of ICT Integration in Management of Private Secondary Schools in Nairobi County, Kenya: Policy Options and Practices. *world Journal of education*, *5*(6):14–22.

Padayachee, K. 2017. A snapshot survey of ICT integration in South African schools. South African Computer Journal, 29(2):36–65.

Pombo, L., Carlos, V. & Loureiro, M.J. 2017. Edulabs AGIRE project – evaluation of ICT integration in teaching strategies. *Educational Media International*, 54(3):215–230.

Prestridge, S. 2012. The beliefs behind the teacher that influence their ICT practices. *Computers & Education*, 58(1):449–458.

Ralebese, L.M. 2018. Integrated curriculum in Lesotho: exploring primary school teachers' instructional and assessment practices. Unpublished Doctoral dissertation, University of the Free State.

Ritchie, J., Lewis, J., Nicholls, C.M. & Ormston, R. (eds). 2013. *Qualitative research practice: A guide for social sciences students and researchers.* London: Sage Publications.

Rosenberg, J.M. & Koehler, M.J. 2015. Context and technological pedagogical content knowledge (TPACK): A systematic review. *Journal of Research on Technology in Education*, 47(3):186–210.

Saldana, J. 2011. *Fundamentals of qualitative research*. OUP USA.

Sang, G., Valcke, M., Van Braak, J. & Tondeur, J. 2010. Student teachers' thinking processes and ICT integration: Predictors of prospective teaching behaviours with educational technology. *Computers & Education*, 54(1):103–112.

Santos, J.M. & Castro, R.D. 2021. Technological Pedagogical content knowledge (TPACK) in action: Application of learning in the classroom by pre-service teachers (PST). *Social Sciences & Humanities Open*, 3(1):100-110.

Sasseville, B. 2004. Integrating information and communication technology in the classroom: A comparative discourse analysis. *Canadian Journal of Learning and Technology*, 30(2):2.

Serin, O. 2011. The effects of the computer-based instruction on the achievement and problem-solving skills of the science and technology students. *Turkish Online Journal of Educational Technology-TOJET*, 10(1):183–201.

Shenton, A.K. 2004. Strategies for ensuring trustworthiness in qualitative research projects. *Education for Information*, 22(2):63–75.

Shulman, L.S. 1986. Those who understand: Knowledge growth in teaching. *Educational researcher*, 15(2):4–14.

Starkey, L., 2010. Teachers' pedagogical reasoning and action in the digital age. *Teachers and Teaching: theory and practice*, 16(2):233–244.

Stewart, H., Gapp, R. & Harwood, I. 2017. Exploring the alchemy of qualitative management research: Seeking trustworthiness, credibility and rigor through crystallization. *The Qualitative Report*, 22(1):1–19.

Swallow, M.J. & Olofson, M.W. 2017. Contextual understandings in the TPACK framework. *Journal of Research on Technology in Education*, 49(3-4):228–244.

Tondeur, J., Van Keer, H., Van Braak, J. & Valcke, M. 2008. ICT integration in the classroom: Challenging the potential of a school policy. *Computers & Education*, 51(1):212–223.

Trust, T. 2018. 2017 ISTE standards for educators: from teaching with technology to using technology to empower learners. Journal of Digital Learning in Teacher Education, 34(1):1–3. doi:10.1080/21532974.2017.1398980 Available from: *Iste.org/standards* [Accessed 31/07/2019]

Tsai, H.C. 2015. A Senior Teacher's Implementation of Technology Integration. *International Education Studies*, 8(6):151–161.

Tsakeni, M. & Jita, T. 2019. Classroom Information and Communications Technology Integration by Pre-Service and In-Service Teachers in Rural Ecologies. In MM Dichaba and MAO Sotayo (Eds), *Proceedings of the South Africa International Conference on Education* (SAICEd): September 2019 conference.

United Nations Educational, Scientific and Cultural Organization (UNESCO), 2011. UNESCO ICT competency framework for teacher. Available from: http://hdl.voced.edu.au/10707/217813. [Accessed 16 June 2021].

Vallance, M. 2008. Beyond policy: Strategic actions to support ICT integration in Japanese schools. *Australasian Journal of Educational Technology*, 24(3):275–293.

Walan, S. 2020. Embracing digital technology in science classrooms—secondary school teachers' enacted teaching and reflections on practice. *Journal of Science Education and Technology*, 29(3):431–441.

Wang, Q. 2008. A generic model for guiding the integration of ICT into teaching and learning. *Innovations in education and teaching international*, 45(4):411–419.

Wang, Q. & Woo, H.L. 2007. Systematic planning for ICT integration in topic learning. *Journal of Educational Technology & Society*, 10(1):148–156.

Webb, M.E. 2005. Affordances of ICT in science learning: implications for an integrated pedagogy. *International journal of science education*, 27(6):705–735.

Webster, M.D. 2017. Philosophy of technology assumptions in educational technology leadership. *Journal of Educational Technology & Society*, 20(1):25–36.

Welsh, E. 2002. Dealing with data: Using NVivo in the qualitative data analysis process. In *Forum qualitative sozialforschung/Forum: Qualitative Social Research*, 3(2):1–6.

Williams, P.J. & Otrel-Cass, K. 2017. Teacher and student reflections on ICT-rich science inquiry. *Research in Science & Technological Education*, 35(1):88–107.

Yucel, C., Acun, I., Tarman, B. & Mete, T. 2010. A Model to Explore Turkish Teachers' ICT Integration Stages. *Turkish Online Journal of Educational Technology-TOJET*, 9(4):1-9.

Zain, I.M., Muniandy, B. & Hashim, W. 2016. An Integral ASIE ID Model: The 21st-century instructional design model for teachers. *Universal Journal of Educational Research*, 4(3):547–554.

APPENDICES

A. ETHICAL CLEARANCE

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA
UFS UV

GENERAL/HUMAN RESEARCH ETHICS COMMITTEE (GHREC)

01-Jun-2019

Dear Mrs Taolane, Bonnqe BM

Application Approved

Research Project Title:
Integrating Information and Communication Technologies into the teaching and learning of science in Lesotho

Ethical Clearance number:
UFS-HSD2019/0512/0106

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. Petrus Nel
Chairperson: General/Human Research Ethics Committee

205 Nelson Mandela Drive/Rylaan
Park West,Parkwes
Bloemfontein 9301
South Africa/Suid-Afrika

P.O. Box / Posbus 339
Bloemfontein 9300
South Africa / Suid-Afrika
T:+27(0)51 401 2116
F:+27(0)51 401 3752
WithuhFG@ufs.ac.za
www.ufs.ac.za

B. INTERVIEW PROTOCOL FOR TEACHERS

The interview will mainly be utilised to collect data for the first and second research questions: 1. What are the discourses that inform ICT integration practices of teachers of science and technology in Lesotho? 2. How do teachers across different school contexts in Lesotho practise the integration of ICTs into the teaching of science and technology in Grades 6 - 7?

Introduction

Greetings. I am Bonnqe Taolane, a PhD student at the UFS. The purpose of this interview is to understand how you go about integrating ICT in your classroom practices. This is for the thesis for my PhD study. Relax and please introduce yourself, indicate your name, the subjects you are teaching, the grades and the name of the school. However, remember that you and your school will remain anonymous in the report for this study. The information you are going to provide will remain confidential and will be used particularly for this study, unless agreed upon with you to use it otherwise.

Demographic Information – warmup questions

The questions in this section will focus on teachers' background of gaining knowledge about ICT integration into teaching and learning of science, and how the teacher developed TPACK professionally.

1. Can you indicate your education background, especially from Grade 12/Form E onwards?
2. For how long have you been the science teacher?
3. For how long have you been utilising ICT tools in teaching and learning in your science classroom practices?
4. Describe how you acquired science teaching skills
5. Describe how you were exposed to ICT tools professionally or otherwise.
6. Let's move to how you acquired ICT skills.
7. What informs you to utilise ICT tools in your classroom instruction?

General Questions: The questions in this section focus on how teachers utilise ICT tools in classroom practices and the challenges and resolutions they always come across.

8. Describe the ICT tools available at your school.
9. Explain the extent to which they are readily available for use in teaching and learning.
10. Describe how you use the available ICT tools in teaching and learning in your classroom practices.
11. How do you incorporate ICT in your planning for instruction in science?
12. How do your learners utilise ICT tools in their daily learning of science?
13. How do you collaborate with teachers from your school on teaching of science using ICT?
14. How about collaboration with teachers from other schools?
15. Describe the kind of support you get when teaching science using ICT.
16. What do you consider to be benefits of integrating ICT into teaching science?
17. What challenges do you experience when teaching science using ICT?
18. How do you resolve the mentioned challenges?
19. How have the change to integration of ICT in your instruction impacted on your teaching of science?
20. What do you consider to be the main challenges that hinder the ICT integration process at other schools?
21. What is your point of view about whether teaching and learning is made easier or complicated by incorporation of ICTs into teaching and learning culture?
22. Suggest how the challenges can be mitigated.
23. What advice can you give to science teachers who do not use ICT in their classroom practices?

Concluding questions/wrap-up questions: These are questions allowing the interviewee to exit the session. The main purpose for this section is to thank the participant for taking part in this study through the interview.

24. Is there anything else that you would like to share with me about your classroom practices of ICT integration?
25. Thank you very much for sparing your time for this interview. Till next time. Goodbye.

C. INTERVIEW PROTOCOL FOR PRINCIPALS

The purpose of this interview is to triangulate information obtained from the teachers. This is a **once-off session**

Greetings. Could you please introduce yourself, indicate your name, the majors for your first degree and the name of the school? However, remember that you and your school will remain anonymous in the report for this study. The information you are going to provide me with will remain confidential and will be used particularly for this study, unless agreed upon with you to use it otherwise.

Demographic Information – warmup questions

The questions in this section will focus on principals' background of knowledge about ICT integration into teaching and learning at school, especially of science, and how the teachers developed TPACK professionally.

1. Describe how your schoolteachers acquired science teaching skills.
2. Describe how they were exposed to ICT tools.
3. Let's move to how TEACHER X acquired ICT skills.
4. Describe how policies and policy framework informs ICT integration at your school.
5. What informs the TEACHERS in this school to utilise ICT tools in their classroom instruction?

General Questions: The questions in this section focus on the principals' ideas about how teachers utilise ICT tools in classroom practices and the challenges and resolutions they always come across.

6. Describe the ICT tools available at your school.
7. Explain the extent to which they are readily available for use in teaching and learning by teachers and learners.
8. Describe how you use the available ICT tools in teaching and learning in your classroom practices.
9. How do you incorporate ICT in the planning for science instruction?
10. How do the learners utilise ICT tools in their daily learning of science?

11. How do the teachers from your school collaborate on teaching of science using ICT?
12. How about collaboration with teachers from other schools?
13. Describe the kind of support the school offers to science teachers for using ICT in teaching and learning.
14. What challenges the teachers experience when teaching science using ICT?
15. How are the challenges resolved?
16. What do you consider to be benefits of integrating ICT into the teaching of science at your school?
17. What do you consider to be the main challenges that hinder the ICT integration process in your school?
18. Suggest how the challenges can be overcome.
19. What kind of support do the school administration offer to teachers who are passionate about using ICT in their classroom practices?
20. What advice can you give to principals whose science teachers do not use ICT in their classroom practices?
21. **Concluding questions/wrap-up questions**: These are questions allowing the interviewee to exit the session. The main purpose for this section is to thank the participant for taking part in this study through the interview.
22. Is there anything else that you would like to share with me about teachers' practices of ICT integration?
23. Thank you very much for sparing your time for this interview. The information you provided will highly benefit this study. Goodbye.

Consecutive Interviews

The questions will be follow-ups, depending on what was observed in the classroom practices of ICT integration.

The questions could be developed during observation session.

D. OBSERVATION PROTOCOL/SCHEDULE

This guideline will be utilised to maintain consistency in recording observations about ICT integration practices of all participating teachers across all school contexts. This will mainly be to collect data for the second research question: How do teachers across different school contexts in Lesotho practise the integration of ICTs into the teaching of science and technology in Grades 6 - 7?

<table>
<tr><td colspan="2">Teacher A: Date: Time:

Subject:</td><td colspan="2">Grade 6/7

Topic:</td></tr>
<tr><td colspan="2">Objectives of the Lesson</td><td colspan="2">Available ICT Tools & Classroom setup</td></tr>
<tr><td rowspan="2">ICT Tools used by the teacher and the students</td><td>Technology use period within the lesson</td><td rowspan="2">ICT Integration Activities (Teacher)</td><td rowspan="2">ICT Integration Activities (Learners)</td></tr>
<tr><td>Percent of students engaged</td></tr>
<tr><td colspan="2">How the ICTs were Engaged in Classroom Practices</td><td colspan="2" rowspan="3">Successes/innovative ICT Integration Practices in This Lesson</td></tr>
<tr><td>Teaching & Learning</td><td>Assessment of learners</td></tr>
<tr><td></td><td></td></tr>
<tr><td colspan="2">Challenges</td><td colspan="2">Resolutions</td></tr>
</table>

Classroom Observation Tool adopted from Bielefeldt, 2012 ISTE Classroom Observation Tool (ICOT) and Technology Standards for Teachers (NETS)

E. CONTENT ANALYSIS PROTOCOL

This guideline will be utilised to maintain consistency in content analysis of relevant documents about ICT integration of all participating teachers across all school contexts.

The documents will be analysed investigating how they support the science teachers in integration of ICTs into classroom practices. It will mainly be in response to the research question: What are the discourses that inform teachers ICT integration practices in science and technology in Lesotho?

ICT-related Policy Documents, Date & Publisher	**General data emerging about Technology plans for Education sector**	**Emerging Technology Plans for Basic Education/ Primary Schools**	**General data emerging about ICT Integration in schools**	**Key Plans related to Teachers and ICT Integration**	**Emerging data guiding teachers on ICT integration in instruction**
1. The Lesotho Vision 2020, 2004, Government of Lesotho.					
2. The National ICT policy (2006–2011), Government of Lesotho					
3. Lesotho Education Sector Strategic plan (ESSP, 2005–2015) by Government of Lesotho, MoET					
4. Curriculum and Assessment Policy (CAP, 2009), MOET – NCDC					
5. The Lesotho National Strategic Development Plan (2013 – 2017), 2013 by Government of Lesotho, Ministry of Development Planning.					
6. Lesotho Country Analysis Working Document final draft, 2017, Government of Lesotho					
7. Integrated Primary Curriculum Grade 7 Syllabus, 2017, MoET – NCDC					
8. Education Sector plan (2016–2026), **Ministry** of Education and Training.					
9. Science & Technology Textbooks: **Grade 6** *Hands-on Scientific and Technological Learners Book.* Oxford, 2016 **Grade 7** *Hands-on Science and Technology Learners Book*. Oxford, 2020					

F: MINISTRY OF EDUCATION & TRAINING PERMISSION LETTER TO PRIMARY SCHOOLS

THE GOVERNMENT OF THE KINGDOM OF LESOTHO
MINISTRY OF EDUCATION AND TRAINING – MASERU
P.O.BOX 47 MASERU 100 TEL:22322816 FAX: 00266-

Dear Sir/Madam

RE: PERMISSION TO CARRY OUT RESEARCH STUDY

Permission is hereby granted to Ms Bonnqe Mamothibeli Taolane to undertake a study whose Topic is – ***"Integrating Information Technologies into the Teaching and Learning of Science in Lesotho.*** It is the hope of the Ministry of Education and Training that the findings of this study will help a great deal in the advancement of the Ministry's efforts to provide quality education.

I hope this will reach your favourable considerations

Yours Sincerely

Teboho Moneri (Mr) - Regional Inspector Central
Cell +266 6300 3734
E-mail – tebohomoneri@yahoo.com

MINISTRY OF EDUCATION
AND TRAINING
REGIONAL INSPECTOR - CENTRAL
27 MAR 2019
TEL: 22322816, P.O. BOX 47
MASERU 100 LESOTHO

G. LETTER FROM THE EDITOR

CORNELIA GELDENHUYS

083 2877088
corrieg@mweb.co.za

26 March 2023

TO WHOM IT MAY CONCERN

Herewith I, **Cornelia Geldenhuys (ID 521114 0083 088)** declare that I am a qualified, accredited language practitioner and that I have edited the final copy of the following PhD thesis:

INTEGRATING INFORMATION AND COMMUNICATION TECHNOLOGIES INTO THE TEACHING AND LEARNING OF SCIENCE IN LESOTHO

by

BONNQE TAOLANE

All changes were indicated by track changes and comments **for the author to verify, clarify aspects that are unclear, make the necessary adjustments and finalise.** The editor takes no responsibility in the instance of this not being done. The document remains the final responsibility of the author.

.....
C GELDENHUYS
MA (Lin) cum laude, MA (Mus), BA Hons (French), HED, HDL, UELM

Accredited member/Geakkrediteerde lid, SATI, Membership/Lidmaatskap: 1001474 (A/E-E/A)
Full member/Volle lid, Professional Editors Guild (PEG, Membership GEL001)
Mediterranean Editors and Translators (MET: Membership 02393)
European Association of Scientific Editors (EASE: Membership 5523)

H. PLAGIARISM REPORT

turnitin

Digital Receipt

This receipt acknowledges that Turnitin received your paper. Below you will find the receipt information regarding your submission.

The first page of your submissions is displayed below.

Submission author:	Bonnqe Taolane
Assignment title:	ILCIS plagiarism check
Submission title:	Thesis_Final_Submission_Taolane_13 April 2023-Revised @ O...
File name:	Thesis_Final_Submission_Taolane_13_April_2023-Revised_Oct...
File size:	10.29M
Page count:	277
Word count:	86,500
Character count:	476,487
Submission date:	09-Oct-2023 01:02AM (UTC+0200)
Submission ID:	2018934233

INTEGRATING INFORMATION AND COMMUNICATION TECHNOLOGIES INTO THE TEACHING AND LEARNING OF SCIENCE IN LESOTHO

By

BONNQE 'MAMOLIBELI TAOLANE

Thesis submitted in fulfilment of the requirements for the Degree

Doctor of Philosophy
with Specialisation in Subject Education in Science & Technology

Faculty of Education
at the
UNIVERSITY OF THE FREE STATE (UFS)

Supervisor: Prof T. Jita
Co-supervisor: Prof L. Jita

DATE: April 2023