

**Incorporating PICRAT Model to develop Geospatial
technological skills in Geography learners: A case of one
secondary school in Maseru district, Lesotho**

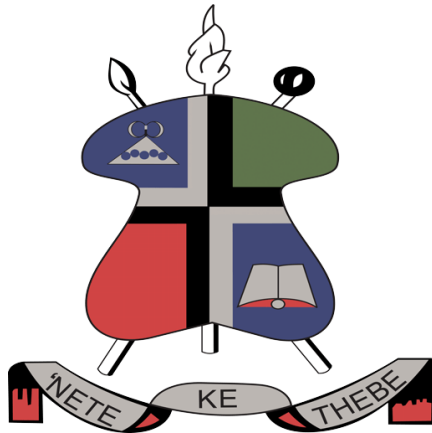
By

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Education, Faculty of Education at the

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Declaration

I, 'Mafane Rants'o (Student ID:201401473), confirm that this dissertation entitled **Incorporating PICRAT model to develop Geospatial technological skills in Geography learners: a case of one secondary school in Maseru district, Lesotho** submitted at the National University of Lesotho is a product of my personal effort. Also, this study has not been submitted to any academic institution at either undergraduate or honours level.

In cases where the content and images are inspired by the work of others, appropriate acknowledgement is provided. Likewise, the extracts taken from other scholars are paraphrased and cited properly. I also ensured adherence to ethical considerations in research.

Researcher: 'Mafane Rants'o, Signature _____ Date _____

Supervisor's statement

This thesis has been submitted through my endorsement

Supervisor's signature _____ Date _____

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I would like to unreservedly show gratitude to my God for His unmerited favour. Thank you, God, for making all this possible, and for constantly giving me hope, discipline, courage, and strength to persevere in this strenuous journey. God I am filled with gratitude for the wisdom you have granted me, and demonstrating mightily in all my weaknesses that indeed, you never let down those who trust in you.

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Dedication

This dissertation is dedicated to my deceased friend, my father, who would have been extremely proud of me. Equally, it is dedicated to my mother, Liemiso Rants'o, who also serves as a father figure and friend. I respect your bravery and strength and maintain that, with God's assistance, if I could become twice the woman you are I could become anything I want to be. Your support has been invaluable during my most lonely journey. The work is also dedicated to my two younger brothers, Thabang and Lehlohonolo, whose inspiration for me is unfathomably divine. You are my closest friends and the most incredible and best gifts from my parents.

Abstract

In the wake of technology affecting all facets of our lives, development of learners' technological skills has become more crucial in different countries' education systems. This study employed passive, interactive, creative, replacement, amplifying and transformative model (PICRAT) to geospatial technological skills of geography students. Purposively, pre and post-tests, interviews, observations were used to generate data from 28 Grade 10 Geography students in one school in Maseru. The data was thematically analysed, and the findings reveal that PICRAT has a positive influence on the development of geospatial skills of learners. The reason being that PICRAT allow learners to passively and actively interact with the technology. The study has discovered that PICRAT enhances students' motivation, participation and productivity. It is recommended that the Ministry of Education and Training, through the National Curriculum Development Centre (NCDC), should consider including technology models such as PICRAT in the Lesotho Education Policy as one the approaches that can be used to promote the development of technological skills. In addition, teachers should consider using PICRAT to guide their technology integration practices in classrooms. This may be possible by varying classroom activities when integrating technology in their teaching. Again, as a way of introducing learners to GIS, it is recommended that Geography teachers use google earth and google map in their teaching.

Keywords: *Geography, Geospatial technological skills, passive, interactive, creative replacement amplification transformation (PICRAT)*

Abbreviations and Acronyms

CAP	-	Curriculum Assessment Policy
CPAR	-	Critical Participatory Action Research
CR	-	Critical realism
GSTs	-	Geospatial technologies
GTCM	-	Geospatial Technology Competency Model
ICT	-	Information and Communication Technology
LBECP	-	Lesotho Basic Education Curriculum Policy
LGCSE	-	Lesotho General Certificate of Secondary Education
MoET	-	Ministry of Education and Training
NCDC	-	National Curriculum Development Centre
PICRAT	-	Passive, interactive, creative replacement, amplifying transformation

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Chapter 1

Introduction and background to the study

1.0 Introduction

The current chapter serves as an introduction to this study. It commences by providing a general overview about technology in other countries and moves on to the study's contextual background in Lesotho. This is followed by the presentation of the problem statement, the objectives of the research, research questions, significance of the study and its delimitations, the organisational structure of the study and a concluding section.

1.1 Background

The influence of technology on all facets of our lives has been profound. As a result, advancement of learners' technological skills has become more central in different countries' education (Rodrigues et al., 2021). For instance, in Eswatini, the target of the Swaziland National Curriculum Framework for General Education Document is for learners to become capable in using new information and communication technologies (Ministry of Education & Training, 2018). Along similar lines, South Africa's Government (2020) also has developed the National Digital and Future Skills Strategy as well as the implementation programme that guides it. Based on these policies, universities are required to hasten their contribution to advanced digital skills by producing digital bilinguals in every degree programme and short course. Grounded on these frameworks and policy guidelines, it is apparent that technological skills are mandatory.

Technological skills which are denoted as digital skills refer to the abilities that assist an individual to interact with the digital world around them and one's capacity to use computer-based technology for various tasks involving accessing and managing information, enabling digital content generation and sharing, communication, collaboration, and problem-solving (UNESCO, 2018; Stebbins, 2023). In my view these skills can be designated as ideological ware since according to Zuma et al. (2023) ideological ware resources help users manipulate both software (the internet and Google Earth) and hardware (computers and laptops).

The utilisation of technology and acquisition of technological skills is of interest because of its potential to prepare students for the after-school life since it provides them with a series of aptitudes like creativity, solving problem and collaboration (Henriksen et al., 2016). These wide-ranging skills are necessitated at work and the marketplace as they could capacitate students to respond to industrial and societal needs. Hence, in South Africa, it has been

established that early digital technology adoption could increase South African employment by 1.2 million by 2030 (Magwentshu et al., 2019). Again, several studies underscore the importance of integrating technology into classroom practice, suggesting that it facilitates the learning process not only for students but also for teachers (Salam, 2019).

In the context of Lesotho, like in other nations, the government and Ministry of Education and Training have developed technology and innovation policies to assist the development of digital skills to meet the needs of contemporary practices. To begin with, through the help of technology integrated into school curricula, the Lesotho 2005 Information and Communication Technologies (ICT) policy sought to equip citizens with competitive skills and competencies pertinent to the demands of society and turn the country into a hub of ICT literacy (Lesotho Government (GoL), 2005). Complementary to this, UNESCO (n.d.) postulates that educational establishments play an important role in enhancing the methods of instruction and learning that create a technologically proficient society, thus creating robust economies.

In line with the ICT policy, the Lesotho Curriculum Assessment Policy (CAP) places a high value on technological proficiency because these proficiencies are viewed as some of the fundamental knowledges and abilities secondary students should be equipped with to address socio-economic issues (MoET, 2009). Additionally, in the improved Lesotho Basic Education Curriculum Policy (LBECP), it has been stipulated that to improve teaching and learning, multimedia instruction including ICTs should be used (MoET, 2021). It is essential to note that Geography is one of the subjects that may contribute to the development of technological skills (MoET, 2009). This is evident in the National Curriculum Development Centre (NCDC) Geography syllabus where the internet, videos and the National Geographic channel are suggested as teaching materials (MoET, 2020). In support, UNESCO (2019) submits that the rapid innovations in new modern technologies influence how knowledge is established, learnt and shared.

Moreover, the 2020 Lesotho General Certificate of Secondary Education (LGCSE) Geography syllabus indicates that there is a variety of careers related to Geography and, among those, being a teacher, climatologist and air photo and satellite image interpreter requires technological skills (MoET, 2020). It appears that careers lately require acquisition of technological skills. Along similar lines, Costley (2014) points out that modern jobs that did not require technology in the past do so now. For example, in the old days Geography teachers

used to teach using flat maps from the atlas rather than digital maps which can now be accessed through smartphones (three-dimensional maps: globes).

Geography, as a subject, is defined by the Kenya Institute of Curriculum Development (2016) as one practical social science course offered by Competency Based Curriculum (CBC). It calls for the application of core competencies that help students relate to their surroundings more effectively through real-world experiences. According to Osvaldo et al. (2015), geospatial technologies (GST) make Geography distinct as it competes with other subjects for its survival in the curriculum. This is because the acquisition of geospatial competencies has the potential to augment the employability of Geography graduates by making them more marketable to employers in the geospatial industries. Demirci and Van der (2015) expound geospatial technologies as all the technologies that are used to acquire, manipulate, and store geographical data. These include remote sensing, virtual globes, global positioning system and geographical information systems.

Raselimo (2016) adds that Geography has a high potential to promote geospatial technologies, which assist students to respond to technological challenges and prepare them for geospatial technology-based courses at the university level. In addition, Besele and Molatseli (2022) indicate that students should be introduced to modern technologies to learn Geography at secondary level so that they graduate from high school with technological competencies as it prepares them for 21st-century life. Therefore, Geography instructors should adopt the use GST in geography education in order to produce young competent labourers for the future who can solve geographical problems as well. Students' ability to use google earth and maps – for example – may help them solve the locational problems.

Further, since it has been said earlier that Geography should provide students with hands-on experience, the integration of geospatial technologies in a classroom will be through the PICRAT model to advance technological competences of Geography students. PICRAT denotes that learners can interact passively, interactively, and creatively with technology, and technological influence on teachers pedagogies may be to replace, amplify, and transform (Kimmons, Graham & West, 2020). PICRAT distinctively focuses on the students' relationship with technology in the classroom. Thus, it appears to be appropriate because it offers students the platform to relate with technology with the aim to develop geospatial technological skills.

In support, Wang (2023) indicates that the model encourages reflection and can transform inactive learners into engaged, innovative ones, which improves performance and yields

acceptable learning results. Moreover, the education system through its policies does not only emphasise these technological skills but goes on to call for a pedagogy that is learner-centred and develops the creativity, independence, and survival skills of learners (MoET, 2009). As per Aristotle (2009), “for the things we must learn before we can do them, we learn by doing them.” This implies that Geography students will have to be exposed to geospatial technologies to develop geospatial technological skills.

1.2 Statement of the problem

It is stated that Lesotho suffers from a skills mismatch and that the budget allocated for technical and vocational education and training is very low at 0.86% in 2021 (United Nations et al., 2022). It could therefore be concluded that the low budget impacts the availability of technological resources that assist in developing geospatial technological skills. Also, the research findings by Besele and Molatseli (2022) indicate that the Grade 10 Geography syllabus inadequately develops the technological skills of students. The syllabus has no guidelines on how technologies and geospatial technologies should be integrated in the teaching space to empower students with scientific and technological skills. To substantiate, Chere (2018) highlights that lack of clear policy guidelines on how to integrate technology hinders technology usage in education. In harmony, Gonzalez and Donert (2014) confirm that there is a need to have clear guidelines on strategies through which teachers should teach geographic information system.

Nevertheless, there are no studies I am aware of that use PICRAT to guide technology integration in secondary Geography education and that seek to advance the development of students’ geospatial technological skills. Yet it is worth noting that there is a slightly similar study at tertiary level by Wang (2023) which adopted the PICRAT model as an intervention strategy to guide technology integration in teaching linguistics courses. In the area of geospatial technologies, Mohashole (2018) investigated the prospects and challenges of incorporating GIS into Geography instruction and found both. She suggested that GIS be included into the Geography curriculum to give teachers the foundation for incorporating GIS, as one of the difficulties was the GSTs’ limited proficiency with the tool and the absence of software.

Similarly, Selialia and Kurata (2023) carried out a conceptual analysis of the real-world difficulties associated with incorporating technology into secondary Geography instruction in Lesotho. They concluded that tools like GPS and GIS improve Geography instruction and learning, making it easier for students to understand spatial relationships and linear networks.

The study revealed insufficient professional development, resource limitations and unclear policies to be one of the challenges in integrating technology. This suggests that it takes the teacher's ability to integrate technology to replace traditional methods and resources in teaching for transformational purposes and to change students from passive citizens into engaged and innovative ones using technology. Against this background, this study incorporated the PICRAT model in the teaching and learning of Geography to develop the geospatial technological skills of Grade 10 Geography students in Lesotho secondary schools.

1.3 Purpose of the study

This study was conducted with the purpose to incorporate PICRAT in the teaching and learning of Geography to enhance the geospatial technological skills of Geography students in Lesotho.

1.4 Objectives of the study

The main objective of the study was to investigate the impact of the PICRAT model on the development of geospatial technological skills of Geography learners in Lesotho.

Specific research objectives:

- To examine the current level of technological knowledge among Geography students.
- To investigate the factors contributing to the current technological level among Geography students.
- To explore how PICRAT influences the development of geospatial technological skills of Geography students.
- To investigate why Geography students whose intervention is informed by the PICRAT model behave the way they do when geospatial technology is used.

1.5 Research questions

Main Research question: What impact does the PICRAT model have on the development of geospatial technological skills of Geography learners in Lesotho?

Specific research questions:

- What is the current level of technological knowledge among Geography students?
- What factors contribute to the current technological level among students?
- How does PICRAT influence the development of geospatial technological skills of Geography students?
- Why do learners whose learning is informed by PICRAT behave the way they do when geospatial technology is used?

1.6 Significance of the study

The study is a critical action research aiming to transform students into technologically competent citizens. Therefore, Geography students need to be empowered in using geospatial technologies. The study places a strong emphasis on using technology transformatively and in an active and creative manner. Hence, this study may significantly contribute to Lesotho's education system whose goal is to equip learners with technological skills for future use (MoET, 2009).

Furthermore, the effective application of the PICRAT model, which serves as the study's intervention, could be instrumental in motivating students to utilise technology in daily life and address technological problems in society. Examples of such problems include using Google Earth and Maps to find one's location and enrolling in post-secondary courses related to geospatial technologies. This study is anchored in the belief that students must develop their technological skills to successfully further their studies, especially in the 21st century where such skills are indispensable. Also important is that once students reach tertiary level, all their school activities will necessitate the use of technology to access information, type assignments, and submit their work. It is therefore important that students be exposed to technology in an interactive and transformative manner as early as possible.

Furthermore, policymakers may include the PICRAT model in curriculum as one of the strategies that may be used to guide integration of technology with the purpose of ensuring that students acquire technological skills.

Moreover, the results of this study may encourage teachers to reflect on their classroom practices and activities when integrating technology in the classroom through the support of PICRAT. Teachers may recognise that the effective way to integrate technology in their teaching is not only by using technology to replace old classroom practices and promoting passive students' relationship with technology but allowing them to create and interact with technology as this can be equally beneficial. Lastly, it may contribute to the existing knowledge that can be useful to the research community.

1.7 Delimitation of the study

According to Miles and Scott (2017), and Bhosale (2024), delimitation refers to the restrictions of the study. This is a concept scholars use to indicate the components upon which their studies are focused. These may include the research site selected, the participants, the methodology used, or even the phenomenon under investigation; all of which have a bearing on the results

(Terrell, 2016). In light of this, a single high school in Maseru that offers Geography at Grade 10 was the sole focus of my investigation. Moreover, due to the purpose of my study, I chose a school which has a computer lab to allow me to do action research successfully. In addition, the study is delimited to the population sample of Grade 10 Geography students from a least developed country.

1.8 Operational definition of terms

The study is premised on certain operational terms, and these are explained below in relation to how they are used in the study.

PICRAT Model refers to the intervention that has been used to guide technology interaction in my classroom, where learners interact passively with the video, interact about the technology and create with the technology by accessing information. In other words, I used technology to replace old classroom practices to amplify and transform pedagogical activities.

Geography is a multi-disciplinary science that describes and explains the earth, atmospheric processes, and fauna and flora. This subject provides learners with basic geographic skills and practices they could use to address environmental challenges. It is one of the subjects that contribute to the development of learners' technological skills (MoET, 2009; MoET, 2020).

Technological level refers to students' knowledge of technological devices, how and where they can be used, and lastly, the students' ability to use these technological devices to access information.

Geospatial technological skills in the context of this study – which is informed by GTCM – include both basic computer skills and geography skills, being learners' ability to use Google Earth and Google map to access Geography information.

Learners / participants refers to all Grade 10 Geography learners who were taught through the guidance of PICRAT.

1.9 Organisation of the dissertation

This dissertation is comprised of six chapters, and underneath is a summation of each chapter.

The preliminary chapter gives the introduction and context to the research. The background of the study, statement of the problem, objectives of the study, research questions, significance of the study and its limitations and delimitations are outlined.

Chapter Two is divided into three sections, being the theoretical framework, which entails the conceptual framework that delves into the PICRAT model and GTCM and its relevance to this study. It reviews the existing literature which is informed by the research questions. Moreover, it addresses empirical research gaps, which the study identified.

Chapter Three explains the research methodology employed for generation of data and analysis. It discusses the qualitative approach, critical realism paradigm, critical participatory action research design, and sampling methods. Data collection tools, such as student tests and semi-structured interviews and observations are delineated. Data analysis techniques and ethical considerations are also elaborated upon.

Chapter Four entails the presentation and analysis of data. The analysis was guided by the research questions. Charts, tables and direct quotations are used for to ensure a clearer presentation.

Chapter Five discusses the findings presented in Chapter Four. The discussion is backed by the reviewed literature in Chapter Two. The findings are judged against the PICRAT model and GTCM that underpinned the students and the empirical literature to establish where the results agree or diverge. The chapter also summarises the entire study and draws conclusions and recommendations in light of the findings.

1.10 Summary of the chapter

This chapter presented the background to the study, statement of problem, aims, and importance of the study. The key terms were defined, and a summary of how the study is organised was presented. The chapter underscored the purpose of fostering the development of the geospatial technological skills of Geography students. The subsequent chapter reviews literature based on the research questions and concepts from the models underpinning the study and the adopted theoretical framework.

Chapter 2

Literature Review

2.0 Introduction

This chapter consists of two sections. The first section forms the theoretical and conceptual frameworks, which are derived from concepts of models. The second section is on the literature review.

2.1 Section One: Theoretical framework

A theoretical framework denotes the “blueprint” of the whole research process, which guides and supports a scholar in building their own study. The theoretical framework provides the structure that indicates how the scholar will approach the whole dissertation, epistemologically, philosophically, methodologically and analytically (Grant & Osanloo, n.d.). The current study is underpinned by the Geospatial Technology Competency Model (GTCM) and the Passive, Interactive, Creative Replacement Amplifying and Transformation Model (PICRAT), which is the intervention strategy in this study. This is because Cohen et al. (2018) claims that two or more theories in a study contribute to a thorough understanding of the inquiry under review. These models are fit for this study since they support integration of technology in education and this research aims to capacitate learners to be technologically skilled. For instance, the PICRAT model emphasises that integrating technology into the classroom can lead to more dynamic, innovative, and interactive learning for the students (Kimmons et al., 2020).

PICRAT is a newly developed model by Kimmons in 2020 and is meant to be a tool for introspection not a directive tool on how to incorporate technology in the classroom (Kimmons et al., 2020). In other words, it could serve as an appropriate framework that helps both teachers and students to reflect on their skills, and guides teachers on how well they could utilise technology in varied and effective ways to promote the development of geospatial technological skills. Most importantly, the framework for integrating technology should emphasise higher-quality pedagogy and learning by going beyond integration (Kimmons & Hall, 2016).

Equally important, Kimmons et al. (2020) highlight the benefits of the PICRAT model as compatibility; ability to complement other teaching strategies such as collaborative learning. This leads to the conceptual framework based on the concepts of the PICRAT model and Geospatial Technology Competency Model (GTCM). The PICRAT concepts explored are

passive, interactive, creative learning, and replacement, amplifying and transformative pedagogy practices and Geography and basic computer skills from GTCM.

2.1.1 Conceptual Framework

The section discusses the concepts in this study. These are passive learning, interactive learning, creative learning, replacement, amplifying and transformative use of technology. The section also discusses the basic computer skills and Geography skills.

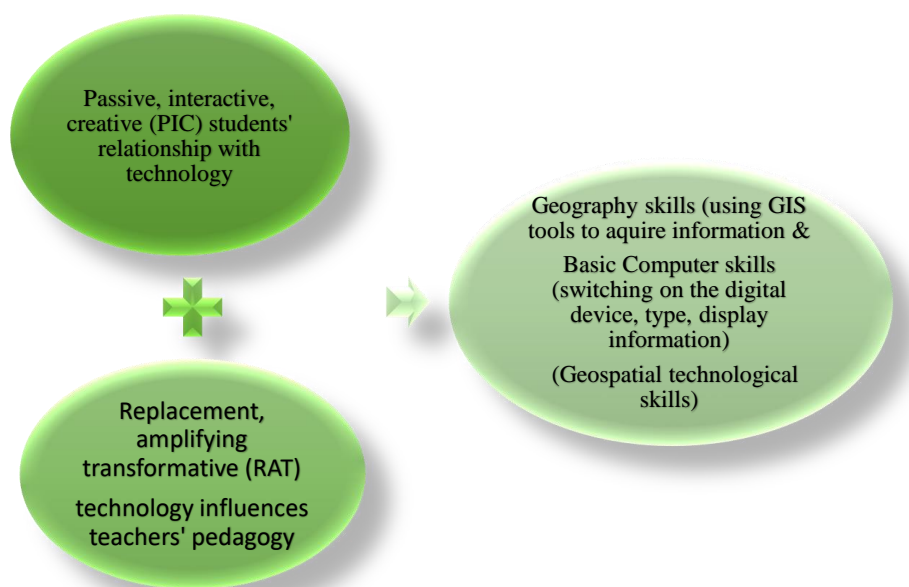


Figure 1: Conceptual framework

The conceptual framework of the current thesis is grounded on Kimmons (2020), who argued that students can passively, interactively and creatively relate with technology and that technology can influence teachers' pedagogy by replacement, amplifying and transformation. GTCM by DOLETA (2010) specifies the competencies that are required at geospatial industries. These concepts help the teachers to reflect on their classroom activities when using technology. Figure 1 illustrates that technology influences teachers' pedagogy and, consequently, students' relationship with technology, which in turn influences the development

of geospatial technological skills. Stated differently, one could maintain that students will adopt a passive attitude towards technology if teachers replace outdated teaching methods with digital ones. This means there is a chance that students will not acquire technological competencies.

2.1.1.1 Students' interaction with technology (Passive, Interactive, Creative (PIC))

Firstly, students can relate passively with technology. Passive learning is where students passively just read and listen to the content presented through technology. Thus, the concept leads to teachers, or the digital device used, being knowledge transmitter (Kimmons & West, 2020). Moreover, passive integration of technology implies its incorporation in the teaching and learning setting without disturbing a student and the classroom context (Laine & Nygren, 2014).

Passive learning is relevant to my study since the study adopts unfamiliar technologies that require students to be shown how they operate. In support, the research conducted by MacDonald and Frank (2016) examined when the efficacy of active learning is enhanced by passive learning and revealed that the “passive first” learners outperformed “active first” learners thus, experiencing passive learning first can enhance functional learning.

In contrast, Araújo (2019) contends that real changes will not result from altering the format only where the content material is presented without proper consideration of the students' relationships and roles in the content knowledge production. Similarly, the findings by Diepreye and Odukoya (2019) showed that active teaching approaches significantly influence students' learning more than passive approaches. Therefore, this appears to be one of the primary downsides of passive learning due to its failure to wholly involve students in the educational process.

Moreover, concerns also exist regarding the effect of passive learning on the acquisition of skills. Because passive learning entails absence of hands-on activities and collaborative work, students may not have as many opportunities to practise critical thinking, problem solving, and other crucial skills (Strobel Education, 2023). Against this background, passive learning cannot solely benefit this study. The discussion will transition to the second concept of this literature review: interactive learning and/or interactive relationship with technology.

According to Pawar (2023), innovative and interactive learning strategies are increasingly being used in addition to traditional teaching methods, encouraging students to participate, collaborate, and think critically. In collaborative learning (interactive), also referred to as active learning, students are directly involved in every process of their learning. It is my firm belief

that students interact with technology so that they develop skills; in this regard, interactive learning appears to be suitable for this study. According to Kimmons, et al. (2020), interactive learning refers to a classroom setting where students interact with the information taught and with one another.

The PICRAT model in interactive learning maintains that students have the opportunity to respond to the information they have received from technology. By manipulating information, they can begin to scaffold it into existing knowledge (Kimmons & West, 2020). Additionally, Mbuti (2022) discovered that the interactive teaching approach is characterised by several doings, problem-solving opportunities, creativity and sensitiveness that encourage students to participate, addressing their needs where they are, thus giving them the chance to ask questions through demonstration.

Additionally, Abykanova et al. (2016) attest to the efficacy of using interactive learning technology. In their experimental research, they discovered that combining interactive and conventional learning technologies could enhance instruction and accelerate student development. Senthamarai (2018) argues that interactive teaching engages learners. For instance, in a Geography class, a student may be given a task where they interpret 3D photographs of river process landforms using google earth. This way, students will have a platform to actively interact with technology to promote the development of geospatial skills.

Another concept is creative interaction with technology. PICRAT emphasises the use of technology as a knowledge artefacts tool rather than conflating creativity with artistic expression (Kimmons & West, 2020). For example, a student in a Geography class might be assigned to download a video on the marine process, rather than watching the teacher's download, and explain the concepts they have learned. This will aid students' independence in information-accessing skills.

A systematic literature review by Jindal-Snape (2013) and a study by Miller (2018) found that creative learning environments positively impact learners' achievement, self-assurance, fortitude, drive, problem-solving abilities, social skills, and attendance at school. Creative coursework also predicts confidence in essential skills for adapting to work settings. Presenting a different view, technology may influence teachers' pedagogy.

2.1.1.2 Technology influence on teachers' pedagogy (Replacement, Amplify, Transformation)

Kimmons and West (2020) used the Hughes, Thomas and Scharber (2006) RAT model which is – like (Graham & Robison, 2007) – an enabling, enhancing, and transforming model, that responds to how influential the use of technology is on teachers' pedagogy. Based on Kimmons and West (2020), three probable outcomes of technology use in the classroom are replacement, amplification, or transformation on the teacher's pedagogical approach.

Replacement, as defined by Kimmons and West (2020), is the adoption of an established educational approach into a more modern media without resulting in functional improvement in that approach. This may be evident where the Geography teacher uses video to show learners how the google app operates. Secondly, amplification is when a teacher uses technology to enhance instruction or student results. For example, if a Geography instructor uses videos to enhance students' understanding of foreign topics and Geography concepts, after which they are given the platform to discuss and ask questions.

Lastly, the transformative level makes use of technology to support the pedagogical practices implemented, not just supplement them (Kimmon & West, 2020). This suggests that eliminating the technology would mean doing away with the instructional technique. For instance, students could use GPS searches on mobile devices to learn about their local communities. Alternatively, low-tech approaches could not have given any of these experiences. Arbeiter and Bucar (2020) indicate that transformative teaching and learning prepares students to accept and appreciate change, control the uncertainty and be critical thinkers, blend in as the values change and cherish diversity. Transformative education promotes fundamental alterations of attitudes, beliefs, as well as behaviours and provides learners with the needed information, abilities and dispositions to enhance sustainable development. According to Balsinger et al. (2017), critical reflection on one's own experiences, predispositions, assumptions and behaviours is necessary for transformative learning.

Against this background, this model will benefit this study in guiding the researcher on how students should relate with technology and for what purpose, and the kind of influence the teacher's use of technology may have on their pedagogy. Notwithstanding the benefits of PICRAT, the theory has several limitations. The model does not specifically direct teachers to link technology integration practices to quantifiable student outcomes, as asserted by Kimmons et al. (2020). Hence, the GTCM was chosen as an alternative to complement PICRAT as it

offers a framework for assessing the combination of Knowledge, Skills and Abilities (KSAs) that experts in geospatial intelligence ought to possess (Jackson & Kerski, 2023). One point of view is that understanding the skills that students should be able to perform is essential, so that the instructor can design lessons that align with the skills.

As opposed to PICRAT, GTCM explicitly mentions the geospatial technology skills and knowledge related to Geography and are needed by geospatial industries. This model assisted me in analysing the skills Geography students had acquired. However, it is essential to note that GTCM could not stand on its own to inform this study since it does not account for the complex and dynamic nature of classroom environments. For that reason, it does not have guidelines on how the skills are obtained.

GTCM is the 2010 framework, which was developed in partnership with the Employment and Training Administration, the GeoTech Center, and specialists in the industry. It was updated in 2014 and 2018 incorporating the latest competencies and knowledge needed by modern geospatial technology workers, with subject matter experts on board as well (DiBiase, 2018). Based on the Department of Labour Geospatial Technology Competency Model [DOLETA] (2010), the competency pyramid is composed of nine layers called tiers. The current study drew its insights from two basic proficiencies: personal effectiveness competencies and academic competencies, which focus on intellectual abilities that are largely acquired in a school context (DOLETA, 2010). This is illustrated in Figure 2 below.

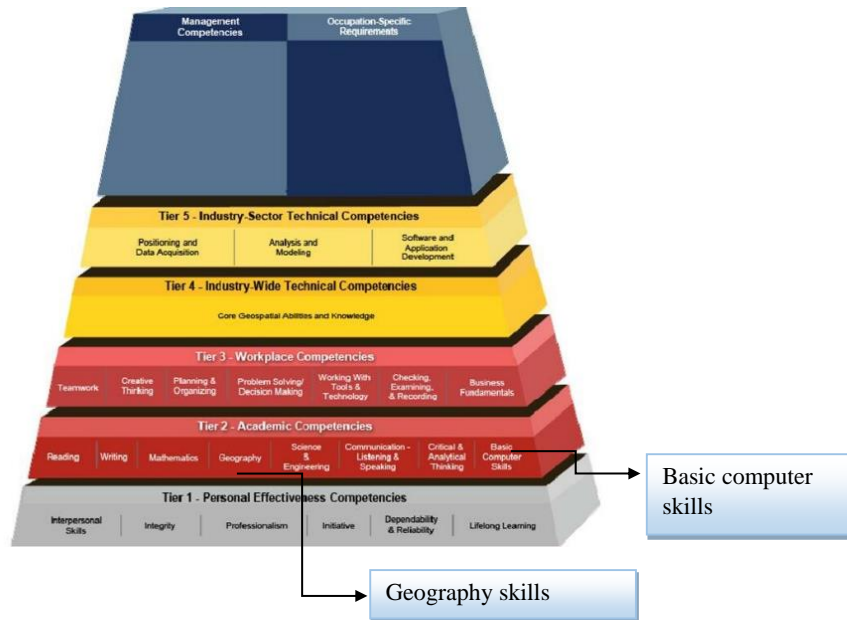


Figure 2: GTCM by DOLETA (2010)

Academic competencies in relation to this study refer to Geography skills, the students’ ability to use Geographic Information Systems (GIS); google earth to attain, manage, present, and analyse spatial data digitally (DOLETA, 2010). As elucidated by Utami et al. (2018), an individual with a strong understanding of geography can identify solutions that minimise harm to the environment and reduce unfavourable consequences. Geography skills aid in comprehending relationships between natural processes, river patterns, human activities, city patterns, and local events in local communities and distant global locations (Utami et al., 2018).

In the current study, the skills are portrayed in a Geography classroom where a teacher’s lesson on tourism is simplified and made more interactive through students and the teacher’s ability to operate using digital devices to access and see a tourism attraction. These devices enable virtual field trips to various geographical locations, providing students with immersive learning experiences beyond the confines of the classroom. In support, as will be seen in the latter chapters, the findings highlight that blended learning has considerable influence in the development of Geography skills (Alajmi, 2021). This implies that the incorporation of technology with conventional teaching methods fosters competency in using technology.

Moreover, Geography skills and information will be gathered and shown with computers and smartphones running Google Earth and Google Maps applications. Thus, one of the competences that students should demonstrate during and after intervention is their ability to operate concurrently with several computer tools and google earth to navigate information. Additionally, Hwang et al. (2014) point out that learning new skills via conventional means like lectures and knowledge presentations is challenging. This implies that students should be actively involved in the acquisition of skills.

As a result, GCTM will be used to determine if the goal of acquiring geographic technology abilities has been accomplished and what information students have learned that might help them strengthen their study of geospatial technology abilities (DOLETA, 2010). Furthermore, personal skills in this study refers to students' ability to work and collaborate with one another, positive attitude towards use of technology and willingness to learn and apply new knowledge and skills (DOLETA, 2010). The next section presents the literature review based on the research questions.

2.2 Section Two

For researchers, practising managers, and students alike, determining what is known and, by extension, what is unknown about a subject is a critical skill. This process is known as reviewing scholarly work in order to understand the current knowledge in the field with the aim to relate it with ongoing investigation and identify gaps in the existing literature (Arshed & Danson, 2015). The literature reviewed is based on technological knowledge, geospatial technologies, benefits of technology and geospatial technologies, challenges of integrating GSTs, ways to promote skills development and, lastly, empirical literature on the PICRAT model.

2.2.1 Technological knowledge

According to Volti (2009), technology is a man-made system that can produce objects and techniques in order to achieve a specific goal through knowledge and organisation. Carrol (2017) argues that Television and computers qualify as technology. In relation to education, Samantha (2021) defines educational technology, as an umbrella term for a range of digital tools and techniques that can advance learning. Spector (2013); Tu (2022); Oliveira (2019) expound that technology application in the classroom includes the use of computers, internet, educational software such as Microsoft Office (for example, PowerPoint and Word) SMAS,

electronic books which students can access through their mobile devices, and digital photographs.

Further, Miriam (2024) considers technological knowledge to be a general knowledge about technology tools and application. In the same way, Koehler and Mishra (2006, 2009) elucidate technological proficiency as the ability to use ICT hardware and software resources and associated peripherals knowledge. As expounded by EU DigComp (2022), digital competences entail knowledge about the technologies, usage (skills), and attitudes towards technology in five areas namely, data and information mastery; collaboration and communication; digital content creation; security; as well as solving problems. In light of these definitions, technology and technological knowledge entail technological resources and their usage.

Similarly, Carretero (2017) asserts that the ability use technologies in a critically collaborative way implies being technologically skilled. Additionally, Moore (2011) expounds that technological literacy identifies the relevant technologies for a task and comprehending it, including how its interface is navigated, and understanding the internal-working or structure of the technology. This suggests that one has to have some knowledge of the technology they are using, where it relevant and its usage. Since this study was carried out in rural Maseru, below I discuss the current use of technology in Lesotho.

2.2.2 The current use of technology in Lesotho

Lesotho Communications Authority (2017) reports that 80.3% of people have never used a computer and that 93.7% of people in rural settlements have never used a computer. Moreover, Lesotho Communications Authority's (2017) report indicates that social networking accounts for 86.3% of internet activity, followed by instant messaging at 74.8% and music and video downloads at 54.0%. According to the report, 88.9% of secondary students said they spend the majority of their time on social media. Accordingly, the benefits of technology as well as GSTs are discussed below.

2.2.3 Technological benefits in Education

Most importantly, technology-supported learning significantly aids in creating self-sufficient, lifelong learners with the proficiencies and information required to prosper in the rapidly revolving world of today (Costley, 2014; Domalewska, 2014). The reason for this is that incorporating technology into problem-based learning fosters students' development as problem-solvers in the twenty-first century (Green, 2018). Therefore, when new technologies are used properly in the classroom, Lesotho students stand to gain a great deal from them. For

instance, in the context of Geography lessons where learners are made familiar with google maps, they can access places and landforms even when they are outside of the classroom.

Furthermore, it is crucial to remember that learners' perspectives change when they are constantly exposed to technological possibilities. Students are more likely to advance their technological skills and become motivated to engage in deeper learning if they become more positive about using technology (Barakabitze, 2019; Costley, 2014). This therefore indicates that the use of digital devices in learning can motivate students to enjoy learning through technology, and consequently develop their digital skills. Similarly, Alsadrani et al. (2020) argue that teachers who use ICT more frequently can inspire students to aspire to develop technological access and skills.

Another essential benefit of technology is that it offers prospects to transform course content and pedagogy for students to easily access knowledge and other teaching resources (UNESCO, 2019; Batra, 2022). Schindler et al. (2017) discovered that according to students, technology helps in comprehending course material better, which raises their academic performance and considerably equips them for a workforce that depends heavily on technology. For instance, videos could be used to teach foreign topics like marine processes in a Geography class. The disadvantaged students who have never been at a sea or an ocean to see marine landforms may access information, knowledge and be able to observe coastal processes. In the same way, studies reveal that increased access to laptops – whether shared between children (Bet et al., 2014) or via provision at home (Fairlie, 2012; Beuermann et al., 2015) – lead to increased computer skills and fluency in operating relevant hardware and software.

Again, research by Carstens et al. (2021) highlights that students are more comfortable and engaged when they are taught with technology. Another benefit, according to Inegbedion (2024), is that technology usage stimulates peer-learning outcomes extensively due to the inspiration it generates among students. Since the aim of this study is to enhance learners' geospatial technology skills, some literature on the geospatial technologies is reviewed in the next section.

2.2.4 Geospatial technologies (GSTs)

Geographic information system (GIS) is one of the geospatial technologies, and Aladağ (2015) defines it as a system of information-based computer combining map elements (geographically) and attributes of data (the data on the map) which is intended to store, process, analyse as well as spatially display the data. GIS is premeditated to operate with the use of

information data about a space. For instance, in Geography, this may include location of places on the map.

Another GST is Google Earth, which is one of the GIS tools for learning that is based on GIS. Google Earth permits students to engage in learning by exploring the earth and evaluating the photographs and information they are learning (Ratinen & Keinonen, 2011). Again, global positioning system (GPS) is a satellite-based navigation system made up of a network of 24 satellites placed into orbit by the U.S. Department of Defense. GPS was initially envisioned for military applications, however, in the 1980s, the authorities made the system accessible for civilian use (Wall & Harvey, 2022).

Lastly, remote sensing is defined as the science in which the information about places and objects is obtained from a distance, mostly through aircraft or satellites (Maetensson, 2011). Understanding geographical landscapes, from mountainous terrains to desert expanses, has become more accessible with remote sensing. Students can delve into topographic maps and 3D imagery, which offer a comprehensive understanding of earth's physical features. In light of this, it is equally crucial to understand the advantages of GSTs in Geography education.

2.2.5 Benefits of Geospatial technologies

Studies by Britz and Webb (2016) and Ma et al. (2023) demonstrate that the use of geospatial technologies has improved student and teacher outcomes and assisted in addressing the challenge that teachers face when trying to explain concepts that are applicable at several spatial scales. In agreement, Goldstein and Alibrandi (2013) concur that high school students' performance in science and social studies is positively impacted when using geospatial technologies in the classroom. This suggests that the ability to use these technologies in the classroom can positively affect the students' performance in Geography.

Further, Kulo and Bodzin (2013) and Metoyer (2014) discovered that all the participants in their studies had significantly higher levels of content knowledge and retention. Students who used Google Earth performed better than their peers who did not in terms of pattern recognition and spatial relationship understanding, according to a study by Westgard (2010). This is because satellite images, as sources, provide very visual up-to-date information that is easy to understand. For example, through satellite imagery, students can visualise weather patterns, storm developments, and other atmospheric phenomena (Martínez-Vega et al., 2015). This suggests that geospatial technologies improve students' comprehension of geographical content, such as location data.

Adopting Google Earth to teach Geography, according to Patterson (2007), enhances students' geographic awareness, critical thinking and analytical and questioning abilities. This data makes it clear that using GST has the potential to encourage skill development. Similarly, Mašterová (2023) states that GST develops students' digital competencies and skills as well as their knowledge. Moreover, Thankachan and Franklin (2013) indicates that Google Earth enhances user experience, increases interactivity, and supports student learning. Thus, it can be argued that Google Earth gives students the opportunity to explore the planet dynamically and interactively, assisting them in learning the spatial context of their location in relation to the global context in a way that is meaningful, entertaining and educational.

Additionally, learning can be more engaging for unwilling learners, and their motivation to learn could significantly be improved by using GSTs in regular secondary school classrooms (Demirci, 2015). In the same manner, Bikar (2022) indicates that, when compared to traditional teaching techniques, GIS-integrated instruction greatly improves participants' innate motivation. It appears that geospatial technologies are one of the key influences in sustaining student-centredness in the classroom. Against this background, it is essential to understand how learners' skills may be developed hence the subsequent section delves into the ways of promoting skills development among learners.

2.2.6 Ways to promote learner skills development

Wing and Sessions (2007) indicate that the proficiency in using geospatial technologies grows with practice just like many skills. In support, as mentioned earlier in the background, Aristotle (2009) expounds that to know how to do something we must do it. The changes include varying teaching practices to fulfil different students' learning styles (Abulhul, 2021). The learning strategies and materials may include incorporating technology. According to Qu (2023), EdTech offers more facilities and techniques that assist students to actively explore and solve problems. For example, students can access rich information resources through the Internet and electronic libraries to better understand and solve problems.

Another way may be sharing of digital gargets (Bet et al., 2014; Beuermann et al., 2015). These authors revealed that access to computers (laptops) – whether shared by students or through provision at home – results into enhanced computer proficiency and ease in using technological resources such as hardware and software resources. This demonstrates the value of sharing.

Additionally, Zuma and Mthembu (2023) believe that availability of hardware resources is of no use if the ideological ware and software resources are not there because all three of them

are equally important for efficient utilisation of technology in education. Ideological-ware resources, according to Khoza (2018), are concepts, theories, and ways of thinking that go into using technology in the classroom. Hardware resources, on the other hand, are elucidated by Mpungose (2020) as the visible and touchable devices like computers, laptops, tablets, and cell phones, among other devices, that provide internet access, whereas software resources are those created specifically for hardware to make information display easier, such as application software packages.

Along similar lines, Van Dijk (2017) emphasises that in order to use technology effectively, people need to understand why, when, and how to use it. They also need to have the skills and opportunities to use technology creatively on a regular basis. Therefore, in relation to the current study, students should at least know the hardware and software resources they can use in their learning of geography and have the skills to use them. Additionally, new research in this field indicates that greater exposure to and access to technology can positively impact the development of technological skills, particularly familiarity with technology and basic computer skills (Rodriguez-Segura, 2021).

Notwithstanding the aforementioned information, Zuma and Mthembu (2023) discovered that the majority of researchers indicate that a productive and fruitful integration of technology fully depends on the accessibility of technological resources (hardware and software) and nothing is said about ideological ware resources as an important aspect when using information and communication technology. However, as discussed below there are difficulties in integrating GSTs in the teaching and learning of Geography.

2.2.7 Challenges of integrating technology and geospatial technologies in teaching and learning

Literature in Lesotho and India indicates that low integration of ICT in schools is due to lack of skills and confidence because of insufficient professional development on the use of technology by teachers (Siamisang, et al., 2018; Selialia & Kurata 2023). In a similar vein, an Indonesian study and one in Lesotho found that challenges to using geospatial technologies and technology include absence of GIS software, inadequate facilities for learning them and inadequate teacher expertise (Mohashole, 2018; Ridha & Kamil, 2021). These challenges may signify a digital divide which Van Dijk (2013) defines as the disparity in the distribution of resources, technological knowledge and efficiency of use.

Moreover, due to the digital divide, students struggle to use e-learning resources (Makumane & Mpungose, 2022). This suggests that unequal access to technological resources and teachers'

lack of skills lead to inadequate technological use in the education process. In harmony, Van Dijk (2017) emphasises that in order to use technology effectively, people need to understand why, when and how to use it. They also need to have the skills and opportunities to use technology creatively on a regular basis.

The lack of GSTs in the national curriculum could be another restrictive factor to using them (Kerski et al., 2013). In the same way, Chere (2018) confirms that unclear policy guidelines on how to integrate technology in the classroom setting is another challenge. The evidence shows that for efficient integration of GSTs in teaching and training, it is essential that policy guidelines on strategies are developed.

Additionally, the findings of Awanda and Diab (2018) highlight that there are some disadvantages of using Google Earth. These include the fact that some areas are not depicted correctly, some images are out of date, and anyone can access and contribute images. Additionally, Google Earth occasionally has trouble with location, so one might end up in South Africa accidentally while searching for landforms in Lesotho. On the other hand, Patterson (2007) expresses that Google Earth spells some places differently, contrary to the familiar spelling, thus making it more difficult to find the location. It is apparent, therefore, that the educational value of lessons could be affected if the teacher is not aware of the disadvantages of Google Earth.

Furthermore, failure to understand the appropriate use of technology appears to be one of the challenges. For instance, it has been found that despite students owning smartphones they use them only for social media not for learning purposes (Byungura et al., 2018). Lastly, the findings of Carstens et al. (2021) indicate that classroom management becomes an issue when technology is used in the learning process.

2.2.8 Empirical literature

Some empirical literature has been reviewed on how PICRAT has been incorporated into the realm of teaching and learning. As identified by Writer's king (2022), this is an analysis of prior empirical studies, sometimes referred to as a systematic literature review, to address a particular research topic and help identify any gaps.

Donald and Heberer (2021) investigated teachers' views regarding technology integration both before and after the professional development of the PICRAT matrix. The participants were secondary school teachers from different school districts of Long Island, New York. Pre- and post-surveys were adopted to gather data on teacher insights. The results showed that following

the professional development session, participants' perceptions and methods of teaching changed right away. After merely one professional development session, they managed to integrate technology at higher levels. Moreover, stakeholders are advised to prioritise professional development on educational technology integration models, specifically PICRAT, as a crucial component of providing support to educators (Donald & Heberer, 2021).

Further, using the PICRAT and 4E Frameworks, Borup et al. (2022) investigated the incremental developments on instructional changes and justifications of K–12 virtual teachers. This was a qualitative case study which analysed the modifications that instructors who teach online make to their curriculum and the reasons behind them. The reported changes concentrated on amplifying learning activities or increasing their level of interaction. Additionally, changes tended to prioritise student-teacher and student-content interactions over student-to-student. Notwithstanding, the present study employs a qualitative approach, where the focus of the investigation is on the pedagogy of teachers rather than students. Furthermore, by making sure that Geography students engage actively and creatively with technology in the classroom, I hope to use this research to promote the development of their geospatial technology skills.

To provide direction for the incorporation of cutting-edge technologies into university-level linguistics instruction, Wang (2023) used the PICRAT model. The total number of students registered for the course was 105. Surveys as well as interviews were used to find out how they felt about the PICRAT model. Using the model managed to transform students from passive to interactive and creative classroom participants. Consequently, their performance became satisfactory. These results align with Lesotho's Curriculum and Assessment Policy (CAP), which advocates learner-centred pedagogies.

In addition, technology integration in K–12 public schools was examined based on the PICRAT (Passive, Interactive, Creative, Replace, Amplify, Transformative) matrix classification by Sung et al. (2024). The study performed an online survey and asked 76 K-12 teachers about their grade-level teaching, implementation frequency of various technology-integrated activities, and support. The findings demonstrated differences in technology-integrated activities between K-6 and 7-12 grades. Additionally, a PICRAT matrix-based analysis revealed lower frequencies for Creative and Transformative use for all grades and higher frequencies for Passive and Replace levels.

2.2.9 Research Gap

Considering the preceding literature review and empirical literature, a research gap was identified. The reviewed studies focus more on teachers except the one that was conducted at tertiary level on the teaching of linguistics. Additionally, there is a contextual gap since the studies were mostly conducted in developed countries like the United States of America and China. It would therefore be necessary to see if the model may be useful in Lesotho's context as a developing country.

The goal of the current investigation is to encourage the enhancement of geospatial technology competencies of Geography students. As a result, this study differs from those that have been reviewed. The current study will bridge the gap in secondary education in Lesotho, particularly in Geography. Given the model's capacity to transform passive learners into proactive and imaginative thinkers, it is plausible that learners' proficiency with geospatial technologies will advance in the current critical action study.

Chapter 3 Methodology

3.0 Introduction

The preceding chapter explored the models upon which this study is anchored. A review of literature was also done. This chapter presents the research paradigm, research approach, design and procedure adopted in this study. In addition, the chapter highlights the data generation tools that were used to conduct the study. The sample and sampling techniques are also presented along with the method of data analysis. Lastly, the elements of trustworthiness and ethical considerations adhered to in the study are discussed.

3.1 Paradigm

A research paradigm comprises of epistemology, ontology, methodology, and axiology as its elements. These components explain how knowledge can be understood and what one considers to be reality (Lincoln & Guba, 1985). Stated differently, it is a method of studying and comprehending the world as it really is (Rehma & Alharthi, 2016). The current study is based on the critical realism (CR) paradigm's philosophical lenses because it has emancipatory implications. Price and Martin (2018) highlight that the goal of CR investigation is to make the earth a better place. On the other hand, the study incorporated the PICRAT model to transform learners into technologically competent citizens by improving their geospatial technological skills so that they can respond to some societal challenges that require these skills.

CR was thought to be appropriate for this study because it aims to understand the underlying causal relationship between events with the aim to comprehend the issues at hand better and, as a result, provide tactical recommendations to solve societal matters (Fletcher, 2017). Therefore, the CR paradigm assisted in comprehending the influence of students' technological interactions on the development of geospatial skills and suggest appropriate interactions with technology. In support, Clark et al. (2012) highlight that the realist approach acknowledges the interconnectedness of context, setting elements, mechanisms, unseen forces, and outcomes in promoting transformation, rather than assuming interventions have innate change capacity. Consequently, the paradigm was appropriate for addressing the how and why questions in this study.

Furthermore, to explain three domains (empirical, the actual and the real) of reality in connection to how they can be known, critical realism proposes a depth ontology (Bhaskar, 1975). The empirical domain, which is the first domain of reality, constitutes observation and

first-hand experience of phenomena. That is, the students' behaviour towards the use of geospatial technologies whereas actual includes all things that exist whether understood or observed by human beings and can be examined easily through qualitative research techniques. This may include students' feelings and experiences towards the use of technologies (Stutchbury, 2022).

On one hand, the real domain adds a deeper, causal level of reality to the empirical and actual domains. This entails the ability to identify the causal mechanism behind the students' level of geospatial technological skills. Based on the epistemological idea, it is implied that our understanding of the outside world is based on subjective interpretations, which are prone to error because of the researcher's operating conceptual framework (Bhaskar, 1998). Some would contend that passive technology interaction is useless in light of this study, but as a critical realist, I considered passive interaction essential because some students may not be familiar with geospatial technologies as well as some technological devices.

3.2 Research approach

Researchers often adopt three approaches namely, qualitative, quantitative, and mixed methods research approaches. The current study aimed to promote the development of geospatial technological skills of Geography students using qualitative approach. The rationale for this was that according to Yin (2018), this approach allows comprehensive investigation into an existing phenomenon, while maintaining holistic and lived experiences of the participants. Therefore, the approach allowed the researcher to explore students' experiences, level of geospatial technological skills, how their relationship with technology impacts the development of these skills and why students behave the way they do towards the use of technology.

3.3 Research design and procedure

Research design includes a plan or framework that directs an investigation and allows capturing of information by the researcher on 'how,' 'what,' and 'why,' of something (Jansen & Warren, 2023). The purpose of this study aligns with action research designs. As expressed by Cohen et al. (2018), action research is the methodical process teachers use to collect data and with the aim to make improvements to their teaching, student learning, and the way their educational environment functions.

Moreover, the progress of this study is structured specifically through critical participatory action research (CPAR) defined by Kemmis et al. (2014) as engaging in continuous and circular

preparations, acting, observations, and reflecting in order to solve the problematic consequences of social practices, often entrenched in global concerns collaboratively and with commitment. Additionally, the study adheres to a cyclical procedure with distinct phases being diagnostic, transformative and, lastly, reflective phase (Ivankova, 2015). For the purpose of this study I was continuously planning, acting, observing, and reflecting in each phase to guarantee transformation and these steps helped me to capture data to answer the what, how, and why questions. It is worth noting that I acknowledged the difficulties in incorporating GSTs while also considering the opportunities, and thereafter made use of the available options, which made the critical part obvious. Therefore, I argue that in addition to serving practical purposes, this research also satisfies the emancipatory elements.

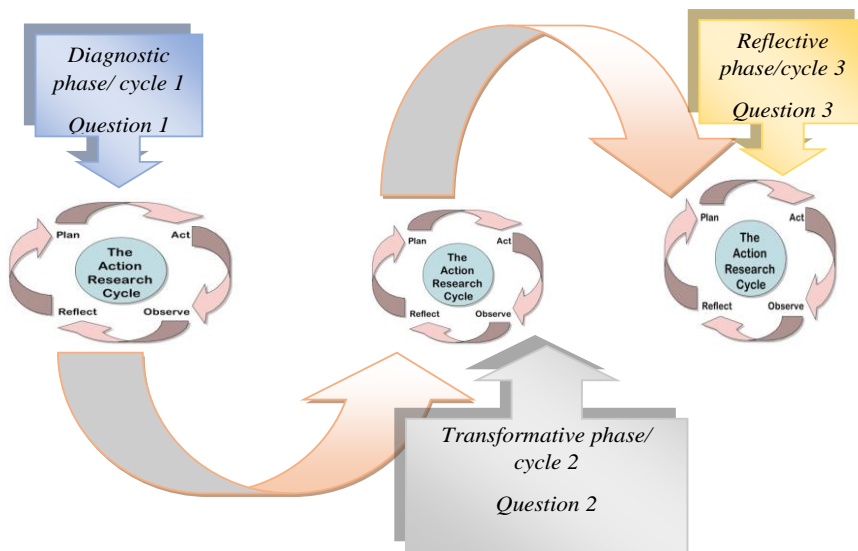


Figure 3: Action Research Cycle Inspired by (Nelson, 2014)

The study employed action research phases or cycles as depicted in the above figure. The key phases are the diagnostic, transformative and reflective phases as the figure demonstrates.

3.3.1 Diagnostic phase

As an initial step in my study, the preliminary study was conducted as part of the diagnostic phase. This included me observing the school context to establish if there were opportunities for developing students' geospatial technological skills. The observation part of the study focused on availability of working computers and computer labs, electricity, network, and internet. Furthermore, both Computer and Geography teachers were interviewed in order to understand the possible knowledge and skills their students had. The piloting proved to be instrumental in discovering and addressing issues with my data generation tools. Pre-tests were prepared informed by teachers' responses. Then the students were given a practical test, which then allowed room for observations. I was individually monitoring them during the test. These tests contributed in that they assisted me to identify the strengths and weaknesses of the students. Following the test, a reflection was done through one-on-one semi-structured interviews.

3.3.2 Transformative phase

Drawing from Thamae (2023), the transformative phase includes change of mindset and behaviour. Concerning the present study, the transformative phase encompassed giving students more information about technologies and gadgets, as well as preparing them with the fundamentals of geography and computer usage. Initially, the researcher prepared lesson plans based on the foundational findings from phase 1 and intervened in the classroom using hardware resources like laptop and smartphones. Also considered were software resources such as videos, google earth, google map technologies through the guidance of the PICRAT model as my ideological ware resource. Principles like passive, interactive, creative learning, as well as replacement, amplifying, and transformative influence of technology guided how students relate with the technologies used in their learning. In some lessons, students had to relate passively with technology, whereas in others they were interactively and creatively involved.

For example, students watched the video on google earth usage and observed the teacher while demonstrating varieties of geography-related tasks to them, which they could perform through google earth. After the observation and watching of the video, the students used the hardware and software resources to access and interpret the geographical information (tourism attraction and direction to such places). After each lesson, the observed students' behaviour and other classroom practices were recorded in a reflective journal. Lastly, in completion of the intervention – learners took a practical post-test to see if there was a difference on their

students' abilities as compared to the pre-test stage. The test was informed by transformative the activities that were done in the classroom.

3.3.3 Reflective phase

Finally, at the reflective phase – follow-up semi-structured interviews were employed to evaluate the possible effect of the intervention and the potential contributions to the achievement or failure of the main objective of this research. The participants were expected to share their experiences during passive, interactive and creative learning through technology. Through reflection, participants were aware of their skills and their newly acquired information, as a result, allowed them to improve and to aspire to learn more about the GSTs.

3.4 Population, sample and sampling techniques

The target population for my study was Geography students from secondary schools in Maseru. As defined by Privitera (2014), population represents all members of a group of interest to a researcher, which is typically exceptionally large. Given this, not every member of the population is accessible to the researcher (Privitera, 2014). Complementary to this, it is argued by Sedgwick (2016) that the population size is naturally finite, thus making it impossible to include every participant in a study. The same applies to this study, which represents 28 Grade 10 Geography students whom I taught.

Consequently, I had to gather a sample for my research, which was the accessible subset that embodies the traits of the target population (Kabir, 2016). The study population comprised Computer and Geography teachers, as well as Grade 10 geography students. Against this background, purposive sampling was deemed suitable. De Carlo (2018) explains purposive sampling as a non-probability sampling technique enabling scholars to fully comprehend the phenomenon they are studying by purposefully choosing participants based on their traits, backgrounds, and experiences.

This sampling strategy was appropriate for the study since it made it possible to generate rich data and conduct an in-depth analysis from Grade 10 teachers and students. The Grade 10 students were considered more knowledgeable and experienced in Geography than their Grade 8 and 9 counterparts. Drawing from the conversation I had with Mrs. Libenyane on June 02, 2024, I discovered that teachers at School X choose to bring their students to the computer lab on a voluntary basis rather than teaching computers as a subject. The principal, the Geography teacher, and the English Language teacher were specifically chosen to go against this trend

because, from what I had heard, they were the ones who typically accompanied the students to the computer lab.

Furthermore, the school was chosen conveniently since as the researcher I went for the nearest and easily accessible school offering Geography. As elucidated by Cohen et al. (2018), selecting the closest people to act as research participants and the location of the study is known as convenience sampling. In harmony, Kibir (2016) concurs that convenience sampling is a type of non-probability sampling in which a sample is taken because it is readily accessible and convenient.

3.5 Time and site of data generation

The process of data generation lasted two months. Phase one started from the time I went to school to inquire about it and somewhat form a relationship with the participants. The transformative phase was followed by the reflective phase as demonstrated in the cycles portrayed in a previous section. The study was conducted in one rural secondary school in Maseru.

3.6 Data generation tools

The data generation tools employed in this study were informed by the research objectives, questions, the model used to inform the study and the research context. Hence, to answer the research questions presented in this study, four methods of data generation were used to promote the credibility of the study through triangulation. These were diagnostic pre-tests, observation and reflective journaling, post-tests, semi-structured interviews as data generating tools.

3.6.1 Tests (Pre-test (diagnostic) and post-test)

This tool was chosen because of its ability to allow the researcher to diagnose and assess factors such as achievement, aptitude, proficiency and performance (Cohen et al., 2018). Pre-testing entails administering tests prior to the study of material to be learnt whereas post-testing involves taking a test after information is studied (Pan & Sana, 2021). In light of my observation and the teachers' responses through pre-test, I only assessed students' knowledge on basic computer skills practically. However, the post-test included assessing both the computer and Geography skills.

In the same vein, pre-tests helped me to identify strengths (skills students had mastered), weaknesses and needs of students in geospatial technological skills. This, according to Cohen et al. (2018), serves as a diagnostic test, which was used as a basis for formative planning,

providing guidance on necessary actions. On one hand, for transformative phase, the post-test helped me to see how the PICRAT model may have influenced the students' use of geospatial technologies. The responses and performance of the pre-test were compared with that of the post-tests. Nonetheless, due to the test being practical, the information obtained was limited to skills hence the interviews were used to gather more information on the technological knowledge; technological devices, how and where they could be used. Behl (2022) adds that tests may pose limits due to their limited scope as they are intended to measure particular skills or attributes.

3.6.2 Interviews

Interviews are a primary method for generating qualitative and quantitative data, and they allow the researcher and the interviewee to establish a line of communication. The communication can either be in person, over the phone, or online, and the researcher attempts to comprehend and investigate respondents' beliefs and actions regarding a particular topic (Taherdoost, 2022; Creswell, 2012). It is evident that there must be a dialogue between the researcher and interviewee. To validate and confirm the results of the pre-test, this study specifically employed face-to-face in-depth semi-structured interviews. Cohen et al. (2018) assert that in-depth semi-structured interview is where the researcher can ask probing questions to elicit meaningful information from participants about their experiences, knowledge of the issues, and what they know about the issues. Students' perspectives on learning, based on the PICRAT model and the value of technology in skill development, were included in this, with the aim to help to dispel myths regarding PICRAT and the skills that are learned.

In the same manner, semi-structured interviews were used to authenticate the post-test results and the observation results in the transformative phase. This method allowed the participants to share their different experiences in using technology in learning and acquiring their skills. In addition, they shared experiences on how their relationship with technology had an impact on their geospatial technological skills. The aim was to understand the causal relationship between student skills and the PICRAT model. This indicates that researchers have the chance to probe more deeply into participants' answers and investigate the fascinating insights they raise during the interview (Cohen et al., 2018).

3.6.3 Observations and reflective journaling

The study employed participant observation as one of the data generation tools in qualitative research (Kawulich, 2005). This type of observation was deemed suitable for this study

because, as DeWALT and DeWALT (2002) elucidated, it enables the researcher to learn about participants' behaviours in the natural setting while on the other hand participating in the classroom activities. This tool was applicable for this study because of its ability to offer an investigative chance to collect first-hand, real-time data in-person from social situations that naturally arise (Cohen et al., 2018). Also, observations gave me the chance to see students' behaviours, the classroom environment, and other classroom procedures more closely and in their natural environment (Volpe et al., 2023). Therefore, observations helped me observe students' abilities and struggles in a natural setting and the behaviours were observed and recorded in the reflective journal.

During observations and the ensuing evaluation process, I was able to document personal experiences on the issue, including the observed behaviours, abilities and weaknesses. For that reason, keeping a reflective journal stimulated me to note down my thoughts and considerations. Hayman et al. (2012) indicate that in phenomenological research studies, journaling is used to document participant experiences in their natural environments.

3.7 Data analysis

Data analysis is one of the research procedures of turning the generated data into informative knowledge (Taherdoost, 2020). The process of organising, deriving meaning from, and presenting findings from gathered data is known as qualitative data analysis (Jnanathapaswi, 2021). The data was analysed through thematic analysis, which refers to a technique for analysing qualitative data, which entails reading through a generation of data and searching for patterns in the meaning of the data to identify themes (Maguire & Delahunt, 2017). In addition, coding significant themes, identifying trends, classifying recurring codes and themes, conceptualising the inner meaning, developing the underlying theory, and reporting the findings are characteristic of thematic analysis (Jnanathapaswi, 2021). This method assisted me to understand the data codes and categorise them into themes. The qualitative research tool ATLAS.ti software version 24 assisted with coding and theme generation, making network diagrams, and data visualisation (NYU Libraries, 2024).

Furthermore, there are two approaches of qualitative data analysis namely, deductive and inductive approach (Bingham, 2022). The deductive approach was considered appropriate since the themes were developed based on the research questions and concepts from the PICRAT model. This method provided me with a chance to categorise data and to keep it consistent with my research question by applying pre-set codes to the data to identify and

analyse themes or patterns in a set of data (Bingham, 2023). However, I was open to new themes that may emerge during data generation process therefore inductive approach, which entails codes that emerge during the investigation, was fitting for the study (Bingham, 2023).

Moreover, content analysis was a useful method of analysis since I used my classroom lesson plan reflections to authenticate the findings. In addition, content analysis was appropriate in this study since it allowed me to quantify some of my qualitative data. Gbrich (2007) corroborates the fact that it is possible to qualitatively analyse data and quantify it as the same when using content analysis. According to Vaismoradi et al. (2013), it is possible to measure frequency when using content analysis hence this approach appeared to be suitable for this study when I was measuring students' scores and their frequencies. Microsoft excel became handy when quantifying the qualitative data since it assisted me in creating the bar chart and pie chart.

3.8 Trustworthiness

3.8.0 Introduction

As stated by Cope (2014) and Ahmed (2024), guaranteeing trustworthiness is essential to proving the validity and dependability of qualitative findings. As outlined by Amankwaa (2016), rigour involves the researchers' capacity to adhere to the required process and guidelines. The principal standards for guaranteeing the value of qualitative research, as proposed by Lincoln and Guba (1985), are confirmability, dependability, transferability and credibility.

3.8.1 Credibility

Credibility is guaranteed through long-term participation where the researcher spends enough time in the field, interacting with participants, and closely observing their actions so that the researcher can gain thorough understanding (Dodgson, 2019). To establish credibility, I built a relationship with the students to gain their trust before giving them a pre-test. I also assured the participants that they would have access to the analysed data and the interview transcripts, and that if they wanted to have a soft copy of my research, they would have access to it.

4.8.2 Confirmability

Confirmability entails ensuring that the researcher's personal morals or theoretical predispositions have not visibly affected the findings to be biased. This is attained through member checking, peer questioning, and reflexive journaling (Ahmed, 2024). As Polit and Beck (2014) explained, confirmability entails the possibility of the findings producing the same

results if they were to be repeated. Triangulation of data generation tools was useful to prevent bias for confirmability purposes. Finding out if all the tools would produce the same results was one of the reasons for triangulating them. Therefore, the interview results were used in this study to cross-examine bias in journaling, while the observation findings ensured that personal inclination had not influenced the data hence strengthening the reliability of this research. Furthermore, to maintain uniformity, I ensured that the pre-test, post-test, and interview questions required the same understanding of geographic technologies, including where, how, and by whom they could be used.

3.8.3 Dependability

Dependability, according to Lincoln and Guba (1985), is concerned with whether the same results would be yielded if the study were to be replicated. In other words, dependability infers reliability and consistency attained through documentation and creation of an audit trail (Janis, 2022). I maintained dependability by keeping all research process records secure and easily accessible. To verify and authenticate the data, I used direct quotes from the participants.

3.8.4 Transferability

As elucidated by Drisko (2024), transferability is an abstract process that allows knowledge from particular people, places, and times to be applied to unstudied subjects. It is attained through thorough and detailed explanations and clear articulation of the sampling process. Thus, to ensure transferability, I explained the sampling process and how the PICRAT model works.

3.9 Ethical considerations

According to Privitera (2014), research ethics are crucial for responsible and moral research, as they protect participants' rights, enhance validity, and maintain academic integrity (Bhandari, 2021). In this study, my research proposal was assessed by the internal examiner and approved by the Department of Languages and Social Education (LASED). I was then offered an informed consent letter to submit to the principal of the school where I conducted the study. I thoroughly explained the purpose and theories of my study as well as the expected duration to the principal and the Geography teachers.

Participants were made aware that they were voluntarily participating in the research and could withdraw whenever they wished to stop their participation. Again, confidentiality was ensured by not disclosing the information provided by the participants to other people. To demonstrate adherence to proper ethics, the participants were not comfortable with being recorded hence no

recording happened. I made sure not to break the participants' trust. Anonymity was ensured since I only attached scripts of the participants who did not mind when I used their real names. In addition, I used pseudonyms such as Participant 1 and Learner 1. Anonymity, as expressed by Privitera (2014), is the more stringent requirement where participants' identities are kept secret from the public through the entire study, whereas confidentiality is the protection of the individual identity of participants who remain unknown to anyone who is not directly involved in the study.

Chapter 4

Data analysis and Presentation

4.1 Introduction

The forgoing chapter discussed the methodological approach followed in this current study, which include research approach, paradigm, design, population and sampling techniques, data generation tools, data analysis, trustworthiness and ethical considerations. This chapter presents the analysis of the generated data from the tests, learners and teachers' interviews, participants' observations, and reflective journal. To represent the data, tables, bar charts, atlas.ti visuals (figures) are used. The data is presented and analysed according to the themes as reflected by the research questions listed below.

- What is the current level of technological knowledge among Geography learners?
- What are the factors contributing to the current technological level among learners?
- How does PICRAT influence the development of geospatial technological skills of Geography learners?
- Why do learners whose learning is informed by PICRAT behave the way they do when geospatial technology is used?

4.2 Biography of Participants

The table below provides brief biographies of the learners who participated in the study.

Table 1: Learners' biography

Age group	Gender		Total
	Male	Female	
14	2	2	4
15	1	3	4
16	4	8	12
17	2	2	4
18		3	3
19	1		1
Total	10	18	28

The table shows the biography of the learners who comprised a total of 28 participants: 10 males and 18 females. Their ages ranged from 14 to 19.

4.3 The current level of technological knowledge and skills

Phase one aimed to investigate the current technological proficiency level of Grade 10 Geography learners. In order to achieve this, I observed the school context to establish if the development of geospatial technological skills was possible before giving learners the pre-test. I wanted to know whether the school had a computer lab with functioning computers (desktop), network and internet connection. Secondly, 28 Geography learners were given a practical pre-test to assess their basic computer skills. Further, for conformability purposes and to obtain rich data on the technological knowledge and skills of participants, triangulation was done by interviewing both the Geography teacher and the learners. The interview questions derived the following sub-themes: learners' definition of technology, learners' knowledge of technological devices, knowledge on the use of technology and knowledge on the advantages of using technology. From the data, another sub-theme – the possible factors behind the current technological knowledge including prospects and challenges – emerged.

4.3.1 Pre-test results

The pre-test findings are presented quantitatively, and this includes the scores learners obtained and how their technology proficiency differs across areas of technology.

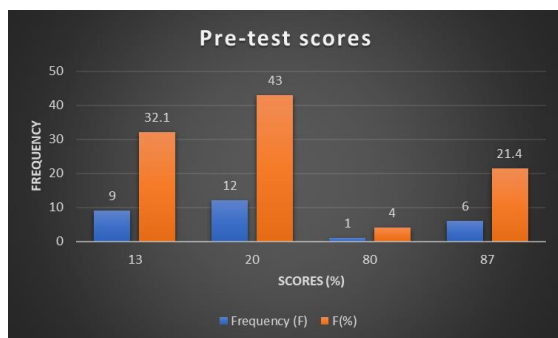


Figure 4: Geography learners' test scores

Figure 4 indicates that of all the 28 Geography learners who wrote the pre-text, 6 (21.4%) scored 87%, 1 (4%) obtained 80%, 12 (43%) scored 20% and, lastly, 9 (32.1%) obtained 13% in the test. Overall, the data shows that only 7% participants passed the test and this percentage points a low-level of technological proficiency. Below is the figure that shows how learners' technology proficiency differs across the different areas of technology.

4.3.1.1 Basic computer skills

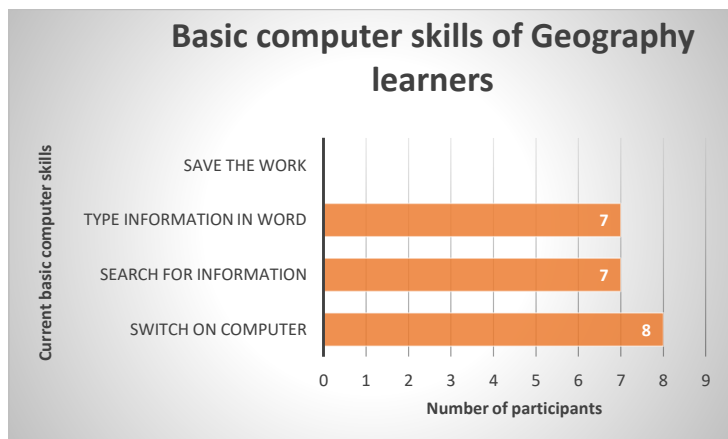


Figure 5: Basic computer skills of Geography learners

Figure 5 depicts that Geography learners' basic computer skills obtained from the pre-test differ, with 8 participants out of 28 displaying the ability to switch on a computer. The figure further shows that 7 managed to search for information and type in a word, even though they were slow in typing. Moreover, none of the participants knew how to save the typed work. From the findings, it is apparent that Geography learners have partial basic computer skills, and this implies that the majority of participants require assistance (*see Appendix 6*). In triangulating data, I conducted semi-structured interviews in order to validate the pretest results and to cover the technological areas that were not covered in the pre-test. The results of the interview are presented below.

4.3.2 Interview results

The interview results are presented qualitatively according to the following sub-themes: participants' definition of technology, knowledge of technological devices, prerequisite in using technology, knowledge on the use of technology and factors behind the current level of technological knowledge and skills of Geography learners. Since all the 28 Grade 10 Geography learners that were interviewed, I gave each of them the interview questions to answer on a paper. I then went through their responses and for those that required follow-up questions, face-to-face interview sessions were held with the learners. Also, during the interviews, the participants were allowed a platform to respond in the language they were comfortable with hence they used both Sesotho and English.

4.3.2.1 Learners' definition of technology

The interview responses reveal learners' varying levels of technology comprehension. Participants 6, 7, 8, 10 and 11 view technology as a means of communication. Additionally, some of the participants believe that technology is a tool that helps with information access (Participants 1,2 and 3). It is further revealed that Participants 7, 9, 1, 4, 12, 15, 18, 25 and 3 define technology as phone, Television, and computer. In other words, to them technology refers to digital devices. In light of the findings, learners have limited knowledge in defining technology. However, Participant 1 seemed to have a deeper understanding of technology than many other participants did. She defines technology as

A tool such as phone and computer that is used for learning by watching video and accessing information and a tool that can be used to have discussions using WhatsApp and to communicate with friends and family.

4.3.2.2 Learners' knowledge of technological devices

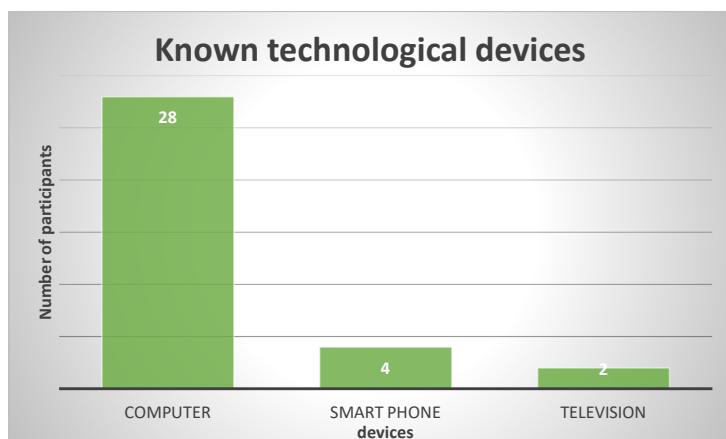


Figure 6: Knowledge of technological devices

The above figure shows that the most known and preferred digital device in learning Geography is the computer which was mentioned by all the learners interviewed. However, they did not know that the type of computer they had seen in their school is called desktop and that the word computer is an umbrella term for other computers like desktop, laptop and tablet. By the term computer, they were referring to desktop. In support, one learner responded: *“Madam I know computer and laptop.”*

The second most known technological device was the smartphones, which was mentioned by four participants. Lastly, two participants knew Television. It appears that the participants' knowledge of digital devices was limited to only those they had seen. To support this, on the 18th of June 2024, I observed that some participants did not know a laptop. One participant asked: *"What is that?"* This happened as the learners saw the laptop.

The observation that the learners were more familiar with a desktop is confirmed by the responses of their computer teacher who said: *"My students are familiar with computer including its parts and smartphone."*

The Geography teacher also concurred: *"The technologies my students are familiar with are phones and computers."*

4.3.2.3 Essential prerequisite knowledge in using technology

The responses indicate that a few learners have knowledge on the essential prerequisite for one to use technology in learning. A number of participants prefer hydropower electricity as opposed to the solar energy-powered electricity. One of the participants said:

Madam I think we need the electricity because this one of solar energy when it is cloudy and rainy there is no electricity.

The interview responses further revealed that Geography learners possess an awareness that being connected to electricity is not enough. They understand that internet, Wi-Fi, and network must be present. Participants 2, 3 and 6 mentioned this. Lastly, some participants mentioned that someone who has knowledge on how to use technology and can teach them is needed. For instance, Participant 3 said: *"Madam I think for us to use technology we need Wi-Fi and a person to teach us."*

Participant 8 agrees: *"Madam, I think for one to use technology there has to electricity, internet, Wi-Fi, and network."*

However, I noted in my reflective journal on 18/06/2024, that one participant believed the computers in the computer lab still had batteries during a discussion I had with the learners (Appendix 9). That was when I realised they were not aware that certain electronics, like desktop, only operate when they are powered on. *"Madam I think some of the computers in the lab still have battery,"* she claimed. The following responses that indicate learners' knowledge on the essential prerequisites in using technology.

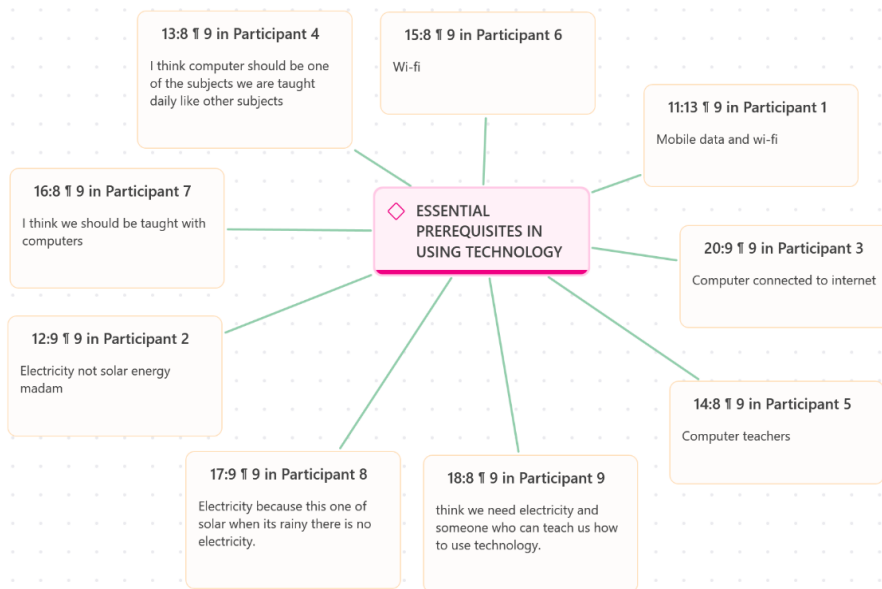


Figure 7: Essential prerequisite in the use of technology

4.3.2.4 Tasks Geography students perform or think technology can perform

The learners were asked to provide the tasks they perform with technology and their thoughts on what technology can be used for in the learning of Geography. The results are presented below.

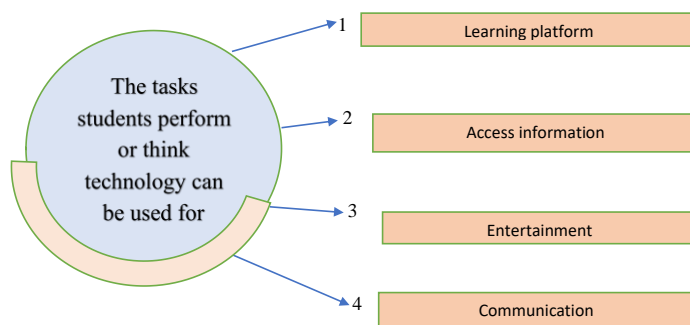


Figure 8: Tasks Geography students perform with technology

The figure above shows four sub-themes that have been derived from participants' responses during the interview. The results reveal that learners use technology for learning, accessing information, entertainment and for communication. For example:

Participant 1 said: *"I have WhatsApp where I discuss schoolwork with my friends."*

Another one said: *"I think technology can be used in learning difficult topics such as marine process and for communication purposes"* (Participant 7).

In the same way, Participant 28 indicated: *"I think technology can be used by showing us maps."*

Again, the participants search for current affairs (information) as specified by Participants 1, 2, 3 and 13. They indicated that their principal advises them to listen to the radio so that they hear current affairs. Moreover, they use technology for entertainment. They watch movies and funny YouTube videos as one of them remarked: *"Madam ke shebella biskop"* (I watch videos) (Participant 11). Others indicated that they watch videos on YouTube. All the students interviewed use their technological devices for communication with friends and family on Facebook and WhatsApp. The subsequent theme will present the data on the factors contributing to the current technological level of knowledge among learners.

4.4 The factors contributing to learners' current technological knowledge (skills)

4.4.1 Interview results

The data generated from interviews with learners and teachers revealed some factors contributing to the current technological skills. The figure below presents those findings.

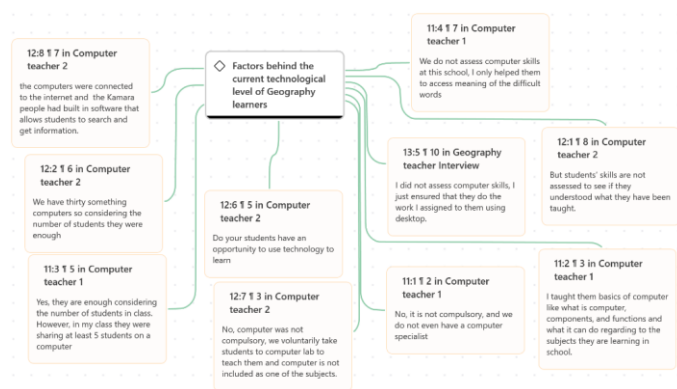


Figure 9: Factors behind the current technological level of learners

The figure shows teachers' responses and, from the results, both the enabling and hindering factors are evident. From the responses, it seems that School X has enough desktops to accommodate all the students, and this is one of the enabling factors to the development of geospatial technological skills. Again, it was discovered that desktops have internet connection and the teachers indicated that the computers have a built-in software that allows remote access even when the internet connection is not there. Nevertheless, there are factors that hinder learners' skills development, and these are presented below.

4.4.1 Learners' limited exposure to computer

The study revealed lack of required resources such as electricity as one of the factors behind the current technological level of Grade 10 geography students. To illustrate the point, use of solar energy appeared to be an issue on cloudy days, and this discouraged teachers from taking their students to the computer lab. It is further revealed that sometimes the battery dies and needs replacement, which is expensive to replace.

Another factor drawn from the teachers' responses regarding students' technological level is the approach used in teaching computer. Both teachers expressed that computer is not taught as a subject. The data indicates that students were voluntarily taken to the computer lab, and were grouped with five sharing one desktop computer. One learner claimed: *"Madam the day we went to the computer lab we were sharing a computer so some of us never had a chance to use desktops."*

4.4.2 Lack of computer skill assessment

Lastly, the additional factor is lack of basic computer skill assessment. It was disclosed earlier in Figure 9 that there is no assessment of students' skills to determine whether they grasped the computer skills. Based on these responses, it could be argued that there is a possibility that some students do not have basic computer skills at all.

4.4.2 Observation results

Below are the findings from the observations that support prospects and challenges on the development of technological skills at School X.

	Availability (Yes / No)	Comment
Computer lab	Yes	
Working on computers	Yes	

Electricity		No	Solar energy
Network	Yes		Econet only
Internet connection		Yes	Also, the computer has a built-in software that allows students to search for information without internet connection Remote access
Another technological device	Yes		Printer

Table 1: Technological infrastructure at School X

Table 1 presents the School X's technology infrastructure based on my observations. It is observed that the school has a computer lab with adequate and working desktop computers for learners. Additionally, there is an Econet network connection. However, there is no hydropower electricity; rather School X uses solar energy, which depends on the energy stored in the batteries, though this seems to pose problems at times, especially on cloudy days when the batteries cannot charge adequately.

In conclusion, the findings from phase one illustrate partial technological level among Geography students. Phase one played an important role in informing my planning, and action in the transformative phase. Hence, the section beneath presents the phase two results.

4.5 Transformative phase: Influence of PICRAT on Geospatial technological skills of students

The primary aim of this study is to use PICRAT to enhance the geospatial technology skills of Geography learners. Therefore, in order to address this objective, observations and post-tests were employed. Moreover, to determine the influence of PICRAT, learners were given a post-test which encompassed questions from pre-test and questions that required students to access Geography content with google earth as one of the geospatial technologies.

4.5.1 The observation results

I observed and noted my learners' behaviours in a reflective journal meant to demonstrate the influence of the PICRAT model on the geospatial technological skills of Geography learners. This includes their behaviour when technology is used to replace old classroom pedagogies where they are passive and when technology is used to amplify and transform some classroom practices, where learners interact and create with technology. Below I present the sub-themes

that emerged from my observations when Geography learning is informed by PICRAT. The findings include the learners' observed behaviours and their quoted views.

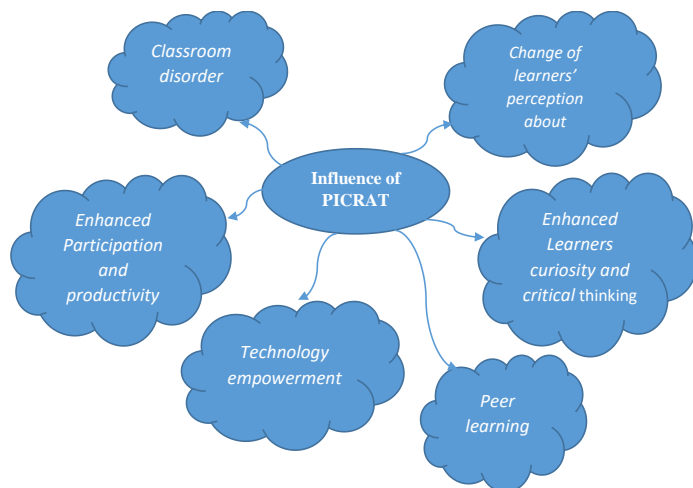


Figure 10: Influence of PICRAT model on Geospatial technology skills

The visual above indicates the themes that emerged during participants' observation when their learning is guided by the PICRAT model. The themes include enhanced participation and productivity, peer learning, enhanced learners' curiosity and critical thinking, technological empowerment, change of learners' perception on the use of technology (motivation) and classroom disorder.

4.5.1.1 Enhanced participation and productivity

The observations reveal that the videos, which learners watched, assisted them to comprehend and have foundational knowledge about google earth and how to use it. Consequently, learners had something to share during discussions because of that video which introduced them to google earth. Not only did they participate in discussions but they were also equally productive during creative interaction with technology. In support, one of the learners said:

Madam I really enjoy being taught with technology and it provided me with information that I can share with others and participate in the classroom freely with my classmates and guess what! I was able to teach my mother how to find direction of a place.

Learner 2:

Madam while observing you and the video I learned a lot of google earth features which I can use, and I understood tourist attraction better.

4.5.1.2 PICRAT encourages peer learning

Regarding my observations, the interactive relationship with technology influenced learners to learn from one another. During discussion, they shared many google earth features they had discovered. They also found many tasks that they could perform with technology and were useful in their learning. One said:

Madam, as we were talking about the features of earth 3D and google earth that we have learned on a video, I was able to take note of other features I had missed when watching a video from my classmate.

Another student indicated:

I did not know that printer, websites, white board and internet are technologies, but the discussion helped me to understand the meaning of technology better.

Again, one participant said:

If it was not because of the discussion, I would not have learned the geospatial technologies and a lot of tourism attractions I learned from my classmate.

Through classroom discussion, learners were able to remind one another the technological devices they had learned, for instance, one whispered:

You should stop saying computer remember this is a desktop and that one is a laptop.

Further, in one of the lessons, I had grouped learners based on the devices they had used in the previous lesson and those who were using the laptop and desktop were able to remind one another the basics of a computer and the features they had used previously, according to the lesson 3 lesson plan evaluation (see Appendix 9.1).

4.5.1.3 Enhanced learners' curiosity and critical thinking

The PICRAT model influences learners' curiosity and critical thinking. An interactive and creative relationship with technology leads to students who are curious about its use as well as how it can be used in other lessons. This was evident when students were asking questions like: "Madam where and how can we use measurement and search feature"? In the form of a discussion, we talked about some of the topics that can be learned with the use of google earth, which entail marine process, map reading and river processes.

Learners were thinking critically about the use of google earth in the learning of Geography. In further curiosity, one asked:

Madam since the name of the software is google earth, does it mean we can find everything that talks about the earth and environment, for example, topics like weather and climate?

Another added:

Madam I think our teachers can download the videos on the topics they teach us so that at the end of the lesson or before we watch it for understanding.

The examples quoted above demonstrate the added curiosity generated by technology amongst the learners. Teachers could then harness this enthusiasm to create captivating Geography lessons.

4.5.1.4 Technological empowerment

The observation further depicts that learners whose learning is informed by PICRAT become technologically empowered. Consequently, during the lessons, I observed that learners comprehend more of google earth functions such as accessing information, calculating area, and finding directions and distance between places. Learners began to demonstrate awareness of the tasks they could do with their smartphones and new technologies they could employ in their learning of Geography. In addition, they were able to correct their peers when referring to a desktop as a computer. On the table below, I have provided some extracts, which affirm the above observations.

Learners	Learners' views indicating technology empowerment
Learner 1	<i>"Madam we got lost on our way from Matsieng Royal Palace to Thaba-Bosiu Cultural Village, but we realised and started the virtual trip again observing one another so that we can help each other, and we managed to find our way."</i>
Learner 2	<i>"I have learned a lot of technologies like, Visit Lesotho website which I use to learn about tourist attractions in Lesotho, and that computer is an umbrella term for desktop and laptop."</i>
Learner 3	<i>"I have developed some skills on laptop use and how to use google earth and map for accessing information for learning purposes. I can even screen shoot using desktop."</i>

Learner 4	<i>“Madam the handout you gave us that had picture and list of different technologies and their importance in learning was really helping and the more we discussed those the more we learned”.</i>
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Table 3: Technology empowerment

On the 27th of June 2024, I had a conversation with some of the learners and one of them said:

Madam some of us come from poor families so when we learn about technology and through it at school that equips us with skills and knowledge, and we become better people.

This denotes that they became empowered on their technological knowledge as well as skills. It also reduces the digital divide as it ensures everyone – irrespective of background – has some access to technology.

4.5.1.5 Change learners’ perception about technology

The findings further reveal that learners who did not know how to use a computer became frustrated and discouraged because they thought it was not necessary to integrate technology in learning. However, when encouraged, motivated and made aware of its importance, their perceptions about technology changed. These extracts exemplify some of the new perceptions of technology:

Learner 1:

Madam you really have a good communication skill you helped us to deal with our fears, when you spoke to me about the importance of technology that changed my mind about technology and even when I struggle, I’m not afraid to ask for help.

Another learner:

Madam I was thinking we use our phones only for social media and calls, but after this experience, my thinking about technology is not the same.

One even said:

Madam this software is interesting we are able to see locations without actually being there. At first I hated it and I was asking myself why you are teaching us with it, but now I have seen it is important and can help me learn a lot of things.

It seems that learners whose learning is informed by PICRAT were able to change their perception about technology and its utilisation in their learning. Notwithstanding the positive influence of the PICRAT model, a drawback was discovered as presented below.

4.5.1.6 Classroom disorder

In my observation, when some learners had a task assigned to them, they were playing games instead of following the lessons or searching for school-related information. I even had an incidence where one learner said: *“Madam some are playing and not doing the work.”* This consequently led to classroom disorder hence one may conclude that despite the many positives of the model, a number of shortcomings still have to be managed.

For trustworthy purposes, learners were given the post-test based on the skills they had acquired when their learning was influenced by PICRAT. The results are shared in the subsequent section.

4.5.2 Post-test results

Further, with the aim of investigating the impact of PICRAT on the development of geospatial technology skills, learners were given a post-test, which intended to establish if they could use google earth to access geography information. The figure below shows their performance.

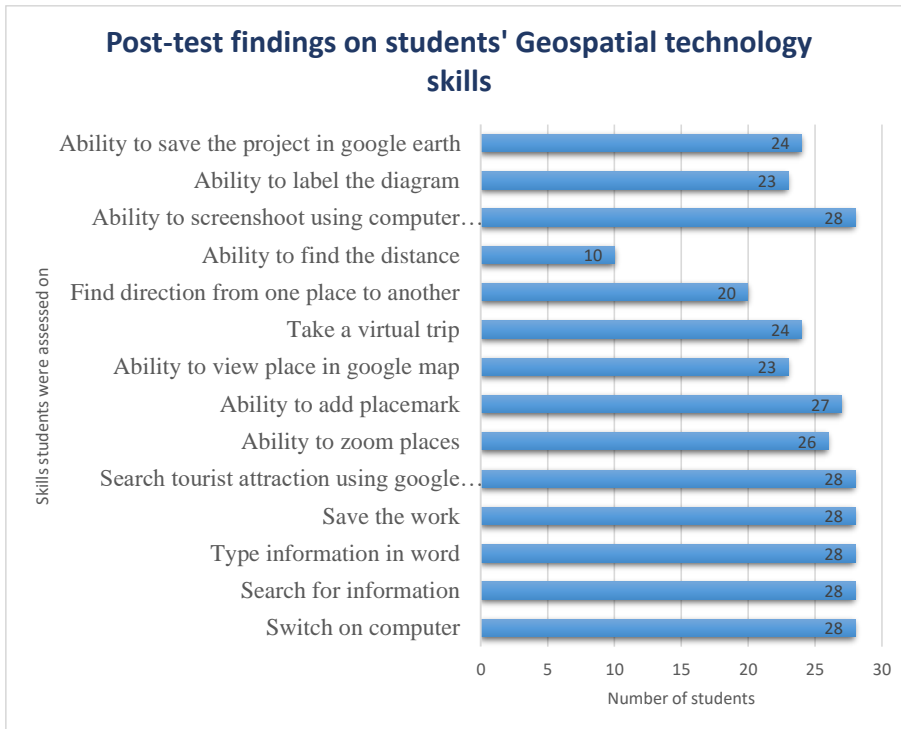


Figure 11: Post-test results: Geospatial technology skills

Figure 11 indicates the results from the post-test administered on learners' geospatial skills when their learning is influenced by the PICRAT model. It is apparent that out of the 28 participants, all managed to switch on the computers, search for information using google chrome, type information, save their work, access tourist attractions using google earth and screen shoot the places they had found. Moreover, 27 participants were able to add place mark on the places, 26 were able to zoom places for a better view, and 24 managed to save the project on google earth under sightseeing. It is evident also that 23 labelled their photographs since they appeared under sightseeing tour on google earth and they had a view of the places on google map. From the figure, 20 participants managed to find the direction of places. Lastly, 10 respondents managed to find the distance between their current location and a place of interest.

In brief, the performance of learners on the use of GSTs seems to have improved after the use of PICRAT as compared to their scores in the pre-test. In addition, from the observations, the PICRAT model influenced learners learning, technological knowledge and skills. Similarly, it

influenced my classroom practices including choice of teaching methods. This implies that PICRAT has a positive impact on enhancement of geospatial skills and improved classroom pedagogical practices. The following section is based on the reflective phase of the study.

4.6 Reflective phase: Reasons for learners' behaviour in relation to use of geospatial technologies when their learning is informed by PICRAT

This stage was essential because it gave the researcher and the Grade 10 Geography learners time to reflect on their experiences. This served to solidify the knowledge and skills acquired during the transformative phase and to see if PICRAT indeed had an influence on participants' skills and knowledge. On my part, it helped me to avoid assumptions about my intervention and this aligns with the paradigm of this study. The semi-structured interviews were employed, and the questions were focused on knowing whether the classroom practices helped students in the acquisition of geospatial technologies, and all the students were interviewed. In this study, passive interaction goes hand in hand with replacement, interactive relationship with amplifying and creative with transformational. The following are the reasons behind learners' behaviour towards the use of geospatial technologies when the PICRAT model guides their learning.

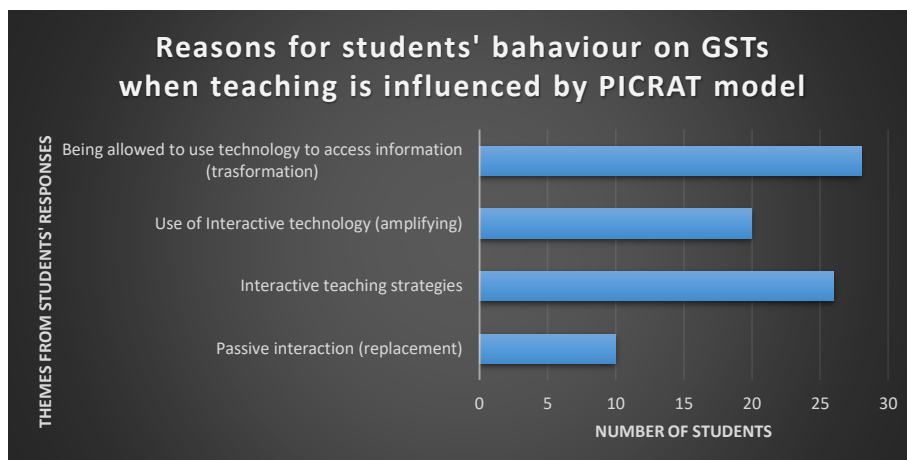


Figure 12: Reasons why students behave the way they do towards use of GSTs

The figure above portrays the reasons behind the Geography students' behaviour towards geospatial technologies when technology integration is informed by PICRAT. As mentioned by 10 of the participants, the use of technology to replace old practices helped them to use

GSTs, while 20 participants indicated that video with explanation was very helpful to them. Furthermore, the responses of 26 participants show that interactive teaching methods like discussion and group works were helpful when using technology. Lastly, 28 of the participants appeared to have gained significantly from creative interaction with technology. Based on the figure, principles of PICRAT had a great influence on the development of geospatial technology. The sub-themes that emerged are creative interaction with technology (transformation), use of interactive technology, interactive teaching strategies and passive interaction with technology (replacement) and they are discussed below.

4.6.1 Passive interaction with technology (use of technology to replace old classroom practices)

The interview responses demonstrate that learners' behaviour regarding use of GST is influenced by the opportunity to watch the teacher in action and to watch a video that explains how to use Google Earth, Google Maps, and other features to create and generate Geography content. This means the passive interaction helps them to creatively interact with technology. The subsequent quotations show some of the participants' responses:

Participant 4: *“Observing you and watching the video madam was one of the ways that helped me in the use of technological devices and google earth to access information.”*

Participant 6: *“Madam the video provided me with a clear explanation on where I can go for a particular purpose. For example, it showed me where I can search for a place or a landform and how to add a place mark on that place.”*

4.6.2 Interactive relationship with technology

Another reason, according to the findings, is interactive teaching strategies. For instance, Participant 4 stated that being given the chance to work together in suggesting different places of interest that they could search for was very helpful. Notably, the use of discussion method in the class assisted the students to learn from both their peers and the teacher. The productive discussions enabled the students to share their discoveries from the videos and helped them to internalise the features and information they had learned from the video. Below are the extracts of participants' responses corroborating the findings:

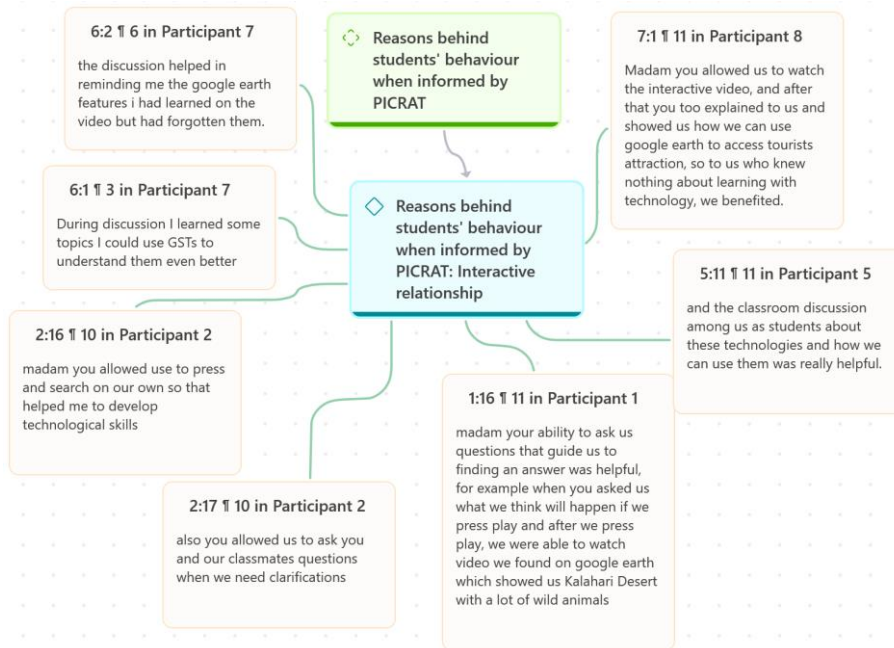


Figure 13: Impact of Interactive relationship with technology

Moreover, it was discovered that the videos with explanations made it easier for students to understand the procedure of using google earth. The participants indicate that the explanation was easy and clear to understand. For instance, Participant 6 specified:

The video clearly showed how I could search for a place and then add place mark, change icon, the colour of the icon, calculate distance as well as area of the places and when given a task it was easy.

4.6.3 Creative interaction with technology

The responses indicate that one of the reasons behind enhanced learner skills on geospatial technology is the creative engagement with technology, which helped the learners to learn how to use technology for learning purposes. For instance, the majority of participants indicated that being allowed to use phone, laptop and desktop computer assisted them to acquire skills on using these devices and google earth to access information. These were some of their responses:

Participant 11: *“Madam you allowed use to press and search for information on our own after showing us how it is done.”*

Participant 16: *“Madam you gave us permission to use many devices to learn and that helped me very much because I no longer know how to use phone only, but I can use desktop and a laptop.”*

Participant 28: *“One of the things that contributed more on my skills was when we were given opportunity to do practical after watching videos, so I was able to search for many tourist attractions.”*

Participant 6: *“I wish I could keep practising and using google earth more to learn Geography because I see that when I use it my skills develop.”*

4.4 Conclusion of the chapter

This chapter shared the results and findings obtained from both quantitative and qualitative data. After the analysis, the results and findings were organised according to the various action research phases namely, the diagnostic phase, transformative phase and reflective phase based on the three research questions and in alignment with the purpose of the study. The impact of PICRAT on geospatial technological skills is the key purpose of the study. In conclusion, based on the findings, it has been established that PICRAT has a positive influence on the development of geospatial technological skills of Geography learners. The next chapter delves into the discussion of the findings.

Chapter 5

Discussion, Conclusion and Recommendations

5.0 Introduction

Data presentation and analysis in the preceding chapter served as the basis for this chapter, which discusses the findings of the study. They are discussed in relation to the literature and the theoretical model which guided the study. The impact of PICRAT on the development of geospatial technological skills was the main research question the study sought to answer, along with the following sub-questions:

- What is the current level of technological knowledge among Geography learners?
- What are the factors contributing to the current technological level among the Geography learners?
- How does PICRAT influence the development of geospatial technological skills of Geography learners?
- Why do learners whose learning is informed by PICRAT behave the way they do when geospatial technology is used?

5.1 Phase one: The current level of technological knowledge and skills among Geography learners

Responses from interviews with teachers and learners, as well as the pre-test results point to a limited understanding of technology. This is because only a few learners defined technology comprehensively and were familiar with technological devices. Furthermore, a small number of learners knew the required technological infrastructure and had limited knowledge on the use of technology. The discussion beneath will elaborate on the sub-themes derived and those that emerged during data generation.

5.1.1 Limited knowledge and understanding of technology

The key objective of this study was to investigate the impact of the PICRAT model on the development of geospatial technological skills of Geography learners in Lesotho. The study diagnosed the current technological level of learners first. Grounded on the learners' responses, technology is a tool humans use to communicate with one another, including social media and phones. Learners described technology as instruments that improve everyday lives by allowing people to access information more easily, watch videos and communicate with one another. This understanding aligns with the findings reported by Carretero (2017) who asserts that being

digitally competent is about being able to use digital technologies in a critical, collaborative and creative way. The competence areas defined are information and data literacy competence, communication and collaboration competence, digital content creation competence, safety competence and problem solving.

Additionally, the discovery shows that learners' definition of technology is limited to a few digital devices, in particular, hardware such as computer (desktop), television, laptop, and a phone. Carrol (2017) reports similar results that television and computers qualify as technology. Drawing from Spector (2013); Tu (2022); and Oliveira (2019), technology application in the classroom includes use of computers, internet educational software such as PowerPoint, social media platforms, electronic books – which learners can access through their mobile devices –, and digital photographs. Some of these of applications were not mentioned in this study, which suggests there is a discrepancy on the learners' knowledge of technological devices. In the same way, Miriam (2024) considers technological knowledge to be general knowledge about technology tools and application. This aligns with Volti (2009) who describes technology as a man-made system that can produce objects and techniques in order to achieve a specific goal through knowledge and organisation. Against this background, it would seem that learners have a limited knowledge on technological devices since the devices they have seen and used are few as they only mentioned computer, phone, television and laptop. It was equally surprising that learners were not aware that computer includes both desktop and laptop.

5.1.2 How Geography learners use technology

The findings further indicate that the Grade 10 Geography learners understand some important uses of technology, which include communication, entertainment and information access. However, it is only a few who claimed to use technology to access information for educational purposes. These results reveal that the majority of learners were not familiar with educational technology and had never had any previous exposure to using technology for learning. The main reason learners are not using technology for learning purposes might be that they do not know the significance and use of the digital device they own apart from using their smartphone for social media to communicate. Another reason might be that their teachers rarely use technology as a teaching resource. The analysis of the data aligns with the conclusions of the Lesotho Communications Authority (2017) which stipulates that 80.3% of people have never used a computer. Moreover, it is reported that 93.7% of people in rural settlements have never used a computer. This implies that indeed learners in School X were not exposed to the use of technology since the school is located in the rural parts of Maseru.

In addition, the findings are in harmony with those of Byungura et al. (2018) which revealed that even though the Rwandan tertiary learners own smartphones they do not use them for learning but rather use them for social media purposes. In the same way, the results concur with the Lesotho Communications Authority's (2017) report, which indicates that social networking accounts for 86.3% of internet activity, followed by instant messaging at 74.8% and music and video downloads at 54.0%. According to the report, 88.9% of secondary school learners said they spent the majority of their time on social media. In light of these findings, it is apparent that learners' knowledge on how to use technology is limited to social media, entertainment and, thus, their knowledge on how to use technology is narrow. In relation to the PICRAT model, learners are not passive; rather they use technology interactively and creatively even though it is not for learning purposes.

5.1.3 Basic computer skills

In order to determine the current technological level of learners, I gave them a practical test in order to test their ability to switch on the desktop, search for information, type and save information. Analysis of the data presented in Chapter Four revealed that a few respondents possess some basic computer skills, including ability to switch on the computer, search for information and type, even though none of them could save a typed document. As literature shows, technological skills go beyond the capacity to use hardware and software; they involve searching for information, communicating and creating content (Van Dijk, 2013). Along similar lines, technological skills refer to the abilities that assist one to interact with the digital world around them and their capacity to use computer-based technology for various tasks involving accessing and managing information, enabling digital content generation and sharing, communication, collaboration and problem solving (UNESCO, 2018).

Moreover, the study has revealed that the majority of the Geography learners, who participated in this study, do not know how to access information using technology. This revelation is in harmony with the findings of Kumar et al. (2014) who revealed that learners in India do not use technology in their learning because they do not know how to use it. In agreement, Fook et al. (2021) reported research findings indicating that university learners in Malaysia use their smartphones for social media not for academic purposes. This then suggests that learners need to be taught how they can use technology (educational devices they own) for educational purposes. Drawing from the Geospatial Technology Competency Model (GTCM), ability to use computers to store, retrieve and manage files is one of the academic competencies an

individual should acquire in the geospatial industry (DOLETA, 2010). Therefore, it is essential that learners know they can use technological devices for learning purposes.

5.1.4 Essential resources required for effective use of technology

Under this sub-theme, the study aimed to establish whether learners knew the essential prerequisite in the use of technology. The findings additionally uncovered that learners have limited knowledge on the essential prerequisite for one to use technology in learning. A few participants indicated that there is a need for electricity, internet, network, computers and a person who can teach them how to use technology. This implies that most participants understand technology as digital devices (hardware resources). A small number of learners have a clue that software resources and ideological ware resources are needed, and this shows discrepancies on the prerequisites in using technology. These findings are consistent with those of Moore (2011) who expounds that technology literacy has three distinct levels, which include identifying technologies relevant to a task, understanding how to use the technology and how to navigate its interface, and understanding the inner-working or structure of the technology. This is not the case in this study because a few learners seem to know that using technology requires an expert who can teach them how to use technology and internet connection. To complement this, Van Dijk (2017) emphasises that in order to use technology effectively, people need to understand why, when, and how to use it and the accompanying skills and opportunities of using technology creatively on a regular basis. In the case of this study, most learners could not mention the essential prerequisites needed to use technology, and a few of them mentioned hydropower electricity and internet.

The findings corroborate Tang and Chaw (2016) who posit that for successful usage of technology in learning, a person should acquire a certain digital knowledge. Tang and Chaw (2016) continue to say that digital knowledge is beyond knowing how to run the technology, rather it includes having critical thinking skills, merit in managing information and appropriate online behaviours. Regarding the current study, the lack of knowledge on the prerequisite limits the learners' thinking on the possible ways by which they could access information through technology, for instance, hotspot in the instances where internet is unavailable in order to access the electronic books or lecture notes. The next section discusses the research findings on the factors behind the current technological level of learners.

5.2 Factors behind the current technological level of learners

This study has revealed a number of factors which might be contributing to the low level of technological skills and usage among learners. These are: lack of appropriate resources, inappropriate approaches used to teach computer and lack of assessment of computer skills.

5.2.1 Lack of required resources

The study found lack of required resources such as electricity as one of the factors behind the current technological level of the Grade 10 Geography learners who participated in this study. For instance, use of solar energy appeared to be an issue on cloudy days, and this discouraged teachers from taking their learners to the computer lab. It was further revealed that sometimes the battery dies and needs replacement, which is expensive to replace. The learners showed that solar energy is not reliable especially on cloudy and rainy days. The results resonate with Kumar et al. (2014) who found that most rural learners have not used computers mainly because of electrical power failure. Similar to these findings, it has been reported that 19.1% of settlements and 6.4% of Maseru's population, respectively, rely on solar energy (Lesotho Communications Authority, 2017).

5.2.2 Learners' limited exposure to computers

Another factor is that generally, learners at School X are occasionally taught Computer. The teachers however, indicated that Computer is not taught as a subject, and they do not even have a computer expert. Consequently, they voluntarily take learners to the computer lab to teach them some computer basics. Additionally, teachers expressed that they are not intentional about which grade they take to the computer lab. Therefore, these prevailing situations lead to learners' limited technological skills. Wing & Sessions (2007) observe that proficiency in using geospatial technologies grows with practice just like many skills. In support, as mentioned earlier in the background, Aristotle (2009) expounds that for the things we must learn before we can do them, we learn by doing them. As a result, I contend that learners who are less exposed to technology-based learning are likely to have little to no technological knowledge and skills.

Similarly, sharing computers hindered them to acquire basic computer skills. The teachers indicated that they used to have five learners per computer and the learners claimed that due to sharing they never had a chance to use desktops. It is important to note that learners were sharing because their teachers preferred group work to individual work, not because desktop computers were scarce. According to UNESCO Institute for Statistics (2016), other

stakeholders suggest that Learner Computer Ratio (LCR) of 2 to 1 and or 3 to 1 is the acceptable ratio that can promote collaborative learning, even though in developing countries there will still be a high number of learners sharing one computer. This suggests that the larger LCR hinders learners' usage of computer, which results in lack of computer skills. The findings dispute some studies which revealed that increased access to laptops – whether shared between children (Bet, Cristia and Ibararán, 2014) or via provision at home (Beuermann et al., 2015) – lead to increased computer skills and fluency in operating relevant hardware and software.

5.2.3 Lack of assessment

Lastly, it was revealed that learners' computer knowledge and skills are not assessed. The responses from the teachers showed that learners are familiar with the basics of desktop computers, however the learners' responses indicated otherwise. Since the teachers further indicated that they do not assess computer skills, this suggests the teachers assume their learners understand computers, how they work, and what they can accomplish with a desktop in relation to the subjects they study in class. It is worth noting that teachers could be right or wrong in their assumptions. In addition, assessment is an essential component in learning since it provides learners and teachers with the needed feedback to improve classroom activities in the learning and teaching process (Stancescu & Draghicescu, 2017). This therefore implies dearth of proper assessment and no feedback for both the teachers and learners. Hence, there appears to be no change in classroom practices and there is a possibility that those whose knowledge about technology and computers is lacking remain like that.

5.3 Phase 2: Influence of PICRAT on the development of Geospatial technological skills

In this section, the results of phase 2 of the study are discussed. Analysis of the data in the previous chapter has revealed several ways in which PICRAT influences development of geospatial skills which include enhanced of learners' motivation and participation, learners' curiosity and critical thinking, technology empowerment, positive learners' perception towards use of technology and peer learning.

5.3.1 Enhanced motivation, participation and productivity

PICRAT proved to have a positive impact on learners' motivation, participation and productivity. Learners' responses and behaviours indicate that passive, interactive and creative relationship with technology motivates them to use and know more about geospatial technologies and other digital devices. Learners find technology interesting as they are inspired to learn more about GST, and they wish to acquire skills to use other GSTs that were not used

in the classroom. As a result, they participate and are productive in classroom activities that require them to use technology. During the lesson review, learners participated and mentioned the appropriate features of google earth. In addition, when they were asked to access a place of tourist attraction, they managed to do so. In agreement, Pawar (2023) indicates that innovative and interactive learning strategies encourage learners to participate, collaborate and think critically. In the same way, Senthamarai (2018) argues that interactive teaching engages learners.

Moreover, these findings are in harmony with Alsadrani et al. (2020) who maintain that teachers who use ICT more frequently can inspire learners to develop technological skills. Correspondingly, learning can be more engaging for unwilling learners and their motivation to learn can be significantly improved by using GSTs in regular secondary school classrooms. There is a general agreement in the literature that learners are comfortable and become actively engaged when they are taught with technology (Demirci, 2015; Hammond et al., 2018; Carstens et al., 2021).

Wang (2023) also uncovered that with the use of the PICRAT model, the teacher managed to turn learners from passive into interactive and creative learners, leading to enhanced learner performances and satisfactory learning outcomes. Therefore, it is argued that passive interaction be used in the classroom but with the activities that allow interaction and creativity with technology. Additionally, the results corroborate the Geospatial Technology Competency Model (GTCM), in particular, category one, which represents the personal effectiveness competencies. The above finding indicates learners' positive attitude towards the work, and willingness to learn and apply new knowledge (DOLETA, 2010).

5.3.2 PICRAT enhances and provokes learners' curiosity and critical thinking

This study has revealed that the use of the PICRAT model leads to learners who are curious about technology. Not only that, but interactive use of technology and amplifying use of technology resulted in learners who can ask relevant questions related to the devices and software they are using and the subject they are learning. Additionally, learners were able to think of the topics they could learn with technology. For instance, they mentioned map reading, marine and river landforms. The discovery is in concord with Arbeiter and Bucar (2020) who ascertain that learners who receive transformative instruction are better equipped to engage in critical thinking. In the same way, the findings are consistent with Kimmons and West (2020) who explain that based on the PICRAT model in interactive learning, learners receive

information and have some means of responding to it. By manipulating information, they can begin to scaffold the information into existing knowledge. Moreover, as per GTCM, one of the geospatial skills learners should possess is communication skills, which include critical thinking (DOLETA, 2010). Therefore, in light of the findings, learners were able to ask appropriate questions hence this concurs with GTCM.

5.3.3 PICRAT promotes technology empowerment

In addition, it has been found that the PICRAT model enhances technology empowerment since learners are able to discover the educational potential technology has on their lives including their education. Complementary to this, learners indicated that they discovered the [Visit Lesotho](#) website, which they can use to learn about tourist attractions in Lesotho. They also learned that computer is an umbrella term for devices such as desktop and laptop. In addition, learners managed to screen shoot places of tourist attraction using the desktop. The research findings align with Foergard (2024) who expound technology empowerment as equipping people with the knowledge and abilities they require to function in the increasingly digitalised world and ensuring universal access to technology and its potential for personal growth irrespective of an individual's socio-economic background. Along similar lines, the finding in this study aligns with Costley (2014) and Domalewska (2014) who discovered that technology-supported learning considerably aids in the growth of self-sufficient, lifelong learners with the skills and knowledge necessary to prosper in the rapidly changing world of today.

Furthermore, the study found that learners whose learning is informed by PICRAT have developed basic computer skills and Geography skills (geospatial skills). According to GTCM, geospatial technology skills include basic computer skills and Geography skills such as using GIS tools to access and store Geography information. These results are consistent with those reported by DOLETA (2010), who established that academic competency refers to basic computer skills, which denotes ability to use computers to compose text, save and retrieve word-processed documents. Moreover, Geography skills denote the learners' ability to use Geographic Information Systems (GIS) like google earth to attain, manage, present, and analyse spatial data digitally. In the current study, learners managed to access information through google earth, acquire basic skills on how to use a computer (laptop, desktop) and smartphone to search for information, type and save that composed text after the intervention. Regarding the PICRAT model, Kimmons et al. (2020) indicate that integrating technology results in an enhanced and transformed learning experience, which – in this study – is evidenced

by the learners' ability to obtain knowledge without utilising textbooks and see locations without physical contact with them.

5.3.4 PICRAT encourages peer learning

The findings revealed that learning that is influenced by PICRAT, especially when interacting with technology, promotes peer learning. The learners indicated that the discussion they had among themselves helped them learn many different technologies and how they can use technology for learning. This coincides with Inegbedion's (2024) results that technology usage stimulates peer learning outcomes extensively and increases learners' appetite to learn. Correspondingly, Kimmons et al. (2020) highlight one of the benefits of the PICRAT model as compatibility; ability to complement other teaching strategies such as collaborative learning. Additionally, drawing from GTCM, learners managed to pick important information in the discussion and this was beneficial to the development of geospatial technological skills.

5.3.5 PICRAT positively influences learners' perception of technology

PICRAT positively influences learners' perception about technology. For instance, they found technology interesting and think it makes life easier since they were able to access places without being in physical contact with them. One of the learners expressed that their attitude towards google earth changed after they realised its importance in learning Geography. Moreover, on 01/07/2024 I recorded in my reflective journal that learners willingly sacrificed their break time so that they could access information using google earth. The results resonate with UNESCO (2019) and Batra (2022) who indicate the benefits of technology as the ability to offer prospects to transform course content and pedagogy for a learner to easily access knowledge and other teaching resources.

In the same way, this result is corroborated by the findings of Donald and Heberer (2022) that following the professional development session which was informed by PICRAT, the participants' perceptions changed. In addition, Alsadrani et al. (2020) argue that the teachers' frequent use of ICT can inspire learners to desire to develop technological access and skills. This suggests that the utilisation of technology in education clearly impacts learners' motivation and perception about technology. Additionally, learners who struggled to use the computer were not shy to ask for help; suggesting that they used their struggle as an opportunity for them to learn. The results align with GTCM that one of the personal proficiencies learners should acquire is ability to treat an unforeseen situation as a prospect to learn (DOLETA, 2010). Therefore, I argue that PICRAT has a positive influence on learners' perception of technology.

5.3.6 Drawback of PICRAT model

Notwithstanding the positive influence of PICRAT, one drawback was discovered when technology integration is guided by PICRAT. With the aim of knowing the impact of the PICRAT model, the learners' behaviour was observed when they were interacting passively and creatively. Based on the classroom observations made, learners' creative use of technology promotes chaos in the learning environment when they are not closely supervised while using desktop and smartphone apps to obtain information. As an example, there was an incidence when some learners chose to play games in class because they had completed their assigned tasks ahead of time. Similar to this finding Mushtaq (2024) disclosed that use of smartphone leads to interruptions while learning. In support, the findings of Carstens et al. (2021) indicated that classroom management becomes an issue when technology is used in the learning process. Thus, the findings of my study, along those of the previous studies, suggest that when engaging in creative interaction with technology, whether on a desktop or smartphone, learners require ongoing supervision and guidance to become proficient in geospatial technologies in order to prevent this behaviour.

5.4 Phase 3: Reasons behind learners behaviour towards use of geospatial technologies

The PICRAT model is considered to be a model of reflection when one is using technology, and the model has been useful when reflecting on the classroom practices and during the reflective phase of this study. This stage allowed the geography learners in Grade 10 to consider what transpired during the intervention phase where they had an opportunity to interact passively, interactively and creatively with technology. The results from the learners' responses indicate that passive interaction, interactive relationship, creative interaction, use of interactive videos, teaching strategies and use of google earth are the reasons that influence learner behaviour.

5.4.1 Passive interaction with technology

The PICRAT model believes that learners interact passively, interactively and creatively with technology. Thus, during my intervention, I had incidences where learners watched videos passively. It is discovered that passive interaction helped learners to comprehend the features of google earth and use of the technological devices such as desktop, laptop, and smartphone. This was evident when it was time for them to interact and create with technology and it became much easier for them. From that behaviour, I realised that they indeed learned from watching a video and my demonstrations. This discovery aligns with MacDonald and Frank (2016) who revealed that the "passive first" learners outperformed "active first" learners, thus, experiencing

passive learning first can enhance functional learning. Additionally, this suggests that replacing conventional teaching methods with technology is not always a bad thing.

5.3.2 Use of an interactive video

The findings in Chapter Four revealed that the interactive video the learners watched helped them to understand how to use google earth. It is apparent that the video provided them with foundational knowledge about google earth and earth 3D. In support, one participant expressed that the explanations from the video simplified the use of google earth for them. This finding is supported by the discoveries of Alber (2019) that one of the purposes of using videos in teaching is to build background knowledge to learners about the topic. Along similar lines, Abykanova et al. (2016) attest to the efficacy of using interactive learning technology. In their experimental research, they discovered that combining interactive and conventional learning technologies can enhance instruction and accelerate learner development.

5.3.3 Creative interaction with technology and Google Earth

The creative engagement was one of the reasons that influenced the development of geospatial technological skills. In other words, hands on activities helped participants to acquire geospatial technological skills. Learners showed ability to use features of google earth, google map and/or earth 3D map without fear of getting it wrong. This finding is in agreement with Aristotle (2009) who wrote that for the things we must learn before we can do them, we learn by doing them. In the same way, Jindal-Snape (2013) and Miller (2018) found that creative learning environments positively impact learners' achievement, self-assurance, fortitude, drive, problem-solving abilities, social skills, and attendance at school. Creative activities also predict confidence in essential skills for adapting to work. It is evident that creative relationship with geospatial technology promotes development of skills to use these technologies. This means the use of GST helps in the development of geospatial technology skills. In support, Mašterová (2023) states that GSTs develop learners' digital abilities and skills, as well as their knowledge. It is evident that creative relationships with technology revolutionises education and fosters transformative learning since learners discover that there are other ways to access information besides textbooks.

In addition, the findings indicate that learners were able to respond to the questions in the classroom and participate because the software (google earth) provided them with visuals of what they were learning: tourist attraction. This discovery reverberates with Thankachan and Franklin (2013) who indicate that Google Earth enhances user experience, increases

interactivity, and supports student learning. Along similar lines, Google Earth helped learners to understand tourist attractions and how to find directions. The results support Patterson (2007) who discovered that adopting google earth to teach Geography, enhanced learners' geographic awareness, critical thinking, analytical and questioning abilities. This is in agreement with Qu (2023) who found that educational technology provides more resources and tools to help learners proactively investigate and resolve challenges. This suggests that teaching pedagogies significantly contribute towards the geospatial technology skills development.

In a similar vein, the learners' geospatial technology skills were influenced by the various learning activities, which included relating passively, interactively and creatively. Some learners had a phobia of using technology because they had never used it before. However, the different technology interactions and how it was used in the classroom (PICRAT) managed to motivate them. These results are in line with Barakabitze (2019) who observed that learners' perspectives change when they are constantly exposed to technological possibilities. Learners are more likely to advance their technological skills and become motivated to engage in deeper learning areas if they become more positive about using technology.

5.3.4 Interactive teaching strategies

Teachers' ability to vary their pedagogical practices resulted in the development of learners' geospatial technology skills. For instance, the discussion allowed room for flexibility and even those who had the phobia of using a laptop became motivated to try. Teaching methods contribute significantly to learners' acquisition of what is being taught. Nonetheless, what is effective in teaching one topic might not be effective in another lesson, and what is effective for a particular learner might not be effective for another. Thus, teachers should vary their teaching practices to fulfil multiple learners' learning styles (Abulhul, 2021). In addition, Finch and Crunkilton (in Torres, 2015) recommend that to accomplish learners' aptitude, the teaching and learning strategies should change in the learning environment. The change entails provision of learning facilities, resources and media that can provide transformative learning experiences to learners.

One of the reasons for learners' acquisition of geospatial technological skills is because of the use of various technologies and being allowed to interact with it. In harmony, Wang (2023) revealed that by methodically employing several technologies to substitute, amplify and transform traditional practices, the educator succeeded in turning learners from being inert

learners into collaborating and inventive learners, resulting in improved learner performances and satisfactory learning results.

In this study, it was revealed by learners that the videos were clear and easy to understand, and therefore this helped them to have a clear picture of how they could use geospatial technologies. This suggests that the content of the video was simple enough for them to understand. Thus, they were able to engage in practical activities without struggling. These findings echo the research findings by Brame (2016) who established that cognitive load, learner engagement and active learning provide a solid base for the development and use of video as an effective educational tool. It is indeed apparent that interactive relationship with technology promotes the development of geospatial technological skills. Drawing from this discussion, the subsequent section delves into the pedagogical implications of the study.

5.5 Pedagogical implications

The findings of this study underline the usefulness of PICRAT in developing the geospatial technological skills of Geography learners. This implies that the teachers can use this model to guide their technology integrations in order to promote the development of learners' technological skills. This entails teachers' ability to vary their pedagogical practices when using technology in order to avoid using technology just for replacement. During creative interaction with technology, teachers should ensure that they have extra activities for those who might finish ahead of others to avoid game playing in the classroom. Another pedagogical implication is that use of technology should be used with interactive teaching strategies to ensure that learners are not just passive receivers of information but are active participants in their own learning.

5.6 Conclusions of the study

The investigation explored the impact of PICRAT on the development of geospatial technology skills. Based on the findings of the study, it can be concluded that PICRAT positively influences learners' technological and geospatial skills, improving their performance and ability to solve locational problems. This was evident because learners had limited technological knowledge and skills before the intervention. However, after the intervention with PICRAT, they were able to access Geography information on google chrome, YouTube, google earth and google map. Additionally, learners took virtual trips, calculated area and distance using google earth. It is therefore concluded that the use of interactive teaching strategies and videos is crucial for advancing learners' geospatial technological skills, as they

need to observe and interact with technology before creating. It is noteworthy that, despite being a model utilised in developed countries, PICRAT is found to be of great value in developing nations as well, both at the secondary and tertiary education levels. Based on these conclusions, several recommendations can be made.

5.7 Recommendations

The findings of this study have triggered a number of recommendations, which have implications for the relevant stakeholders. The recommendations are categorised into two key parts: school-based regulations and education policy.

Revisiting the school regulations

- The school regulations should allow learners to bring their smartphones to school so that learners can use them for learning purposes, and this will raise awareness to learners that they should not only use their smartphones for entertainment and communication; rather, they should watch educative videos and lessons on YouTube and Facebook. In addition, they could use their social media platforms to interact on topics they learn at school.
- The school management should design policies that guide the use of smartphones within the school premises in view of their significance as learning devices.

Reviewing the Lesotho Education Policy

- The Ministry of Education and Training should ensure that Computer Education is offered as one of the school subjects and is assessed so that the aim of equipping learners with technological skills is achieved.
- The Ministry, through the National Curriculum Development Centre (NCDC) should consider including technology models such as PICRAT in the Lesotho Education Policy as one of the approaches that can be used to promote the development of technological skills. In other words, it should be clear in the educational policies how learners should be equipped with technological skills. Hence, workshops must be held on how technology should be integrated in teaching and learning.
- It is recommended that teachers should consider the available opportunities in integrating the technology and make use of those prospects in order to introduce learners to technology.

5.8 Limitations of the research

Based on the number of participants used in this research, the findings cannot be generalised. Nevertheless, considering how the study was conducted, as well as participants' profiles, which were outlined, transferability is possible should interested individuals be willing to replicate the study. Furthermore, in view of the limited number of digital devices used, creative interaction was compromised since learners were allowed to use each smartphone and laptop once. Moreover, a few learners were still reluctant and scared to use a laptop. Another limitation is that only Google Earth was used in this study. Some geospatial technologies like GIS and GPS were not used, therefore, it is highly likely that learners still do not know how to use them.

Within the framework of this research, I wanted to video-record learners' behaviour during the lesson and observe their engagement with Google Earth. I was also interested in their technological usage to enhance their learning and skill development, and how they use digital apps to access and comprehend geographic information. However, I failed since my participants were not comfortable with it, so for ethical purposes, I respected their feelings.

Other aspects such as socio-economic background of learners – which are considered necessary in the usage of technology – were not included in the investigation. Therefore, it is possible that with the use of different theories like material access in resources and appropriation theory, the finding may be different. In light of these limitations, possible areas for further research are suggested below.

5.9 Possible areas of further research

Considering the recommendations outlined above, and in line with the limitation of this study, it is suggested that further research be undertaken on using GIS and GPS in the teaching of Geography through the guidance of TPACK and PICRAT and the use of material access in resources and appropriation theory. In addition, a different learning context can be considered for further research, for instance, in schools which offer computer as a subject with assessment.

5.10 Reflections

The data generation phases were equally thought-provoking and interesting; most importantly it was a learning experience for me. The use of the PICRAT model did not only help in the development of learners' skills, but it also helped me gain experience in using technology appropriately. The model guided and assisted me, for instance, in the choice of appropriate teaching methods and activities. I was able to reflect on my pedagogical practices based on

learners' behaviour and this helped me to advance the transformative pedagogical practices in the teaching and learning of Geography.

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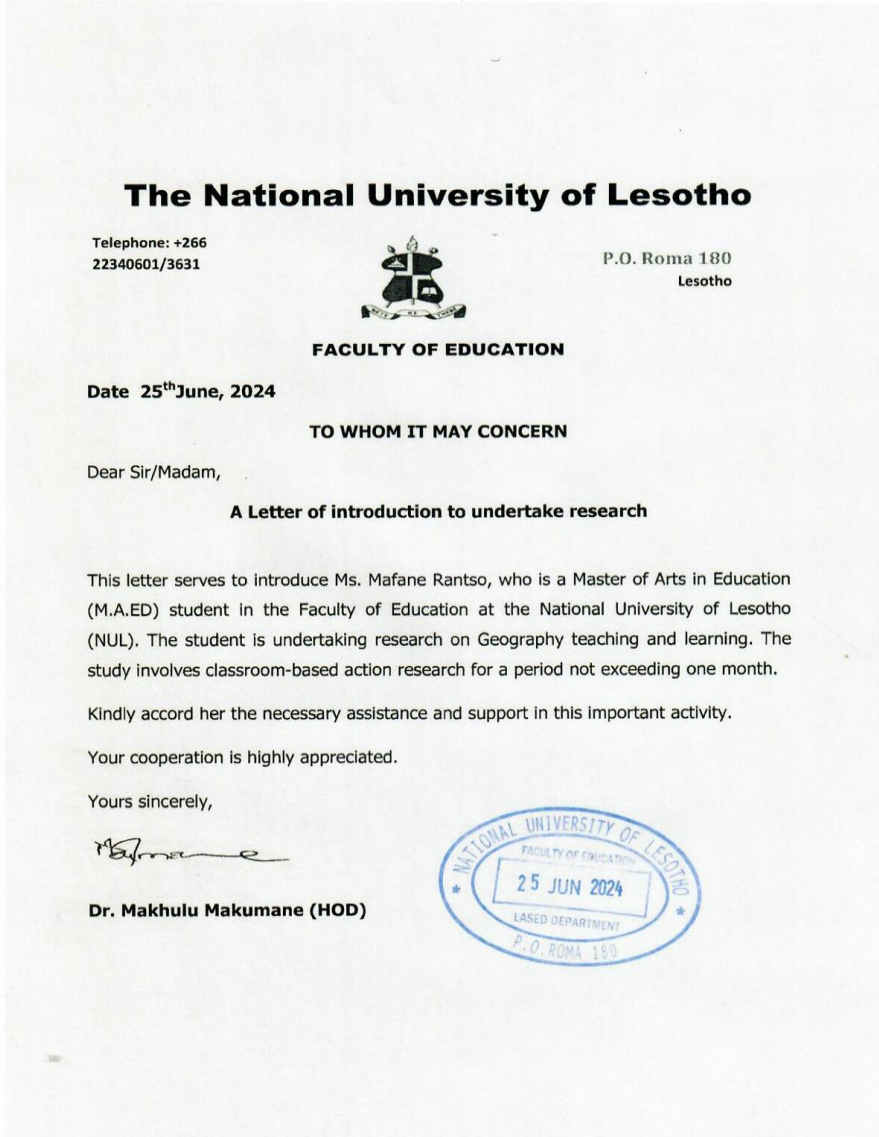
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Appendices

Appendix 1: Introductory letter



Appendix 2: School context observation

	Availability (Yes / No)		Comment
Computer lab			
Working on computers			
Electricity			
Network			
Internet connection			
Other technological infrastructure available			

Appendix 3: Geography teacher's interview

Greetings madam/ sir. I am Mafane Rants'o postgraduate second year student at the National University of Lesotho (NUL), studying Master of Arts in Education (MA Ed), Geography. I am conducting research on the following topic: Incorporating PICRAT model to develop geospatial technological skills of geography learners in one secondary school in Lesotho. I would love to interview you on the following questions. And if you allow me, I will be recording. So, you are free to choose whether I should record you or not. I assure you that your identity will be confidential.

- Do you use technology to teach Geography?
- What technologies do you use in teaching Geography?
- Which topics do you teach using technology?
- Which technologies your learners are familiar with?
- In which ways do you use technology in teaching geography?
- Which computer skills do you think your students have that can assist in the learning of Geography?
- How do you assess students' computer skills and geography skills?

Appendix 4: Computer teacher's interview

Greetings madam/ sir. I am Mafane Rants'o postgraduate second year student at the National University of Lesotho (NUL), studying Master of Arts in Education (MA Ed), Geography. I am conducting research on the following topic: Incorporating PICRAT model to develop geospatial technological skills of geography student in one secondary school in Lesotho. I would love to interview you on the following questions. And if you allow me, I will be recording. So, you are free to choose whether I should record you or not however, I assure you that your identity will be confidential.

1. Is computer compulsory for every student in your school?
2. Are the available computers enough for your students or they have to share?
3. If they share how many students per computer?
4. How do you teach computer (do your learners learn by doing or depend only on theory)?
5. What basic computer skills do you introduce your students to?
6. Do your students have an opportunity to use technology to learn other subjects or they come to computer lab when it is time for computer only?
7. How do you assess the basic skills of your students?

Appendix 5 pre-tests and students' reflections after pre-test

1. Switch on computer
2. Go to google chrome/ search and search for the meaning of tourism
3. Type the definition in Microsoft word
4. Save the work
5. Search for tourist attraction using google earth or earth 3D
6. Zoom the place for clearer view
7. Add place mark
8. View the place in google map
9. Find the direction from Matsieng to one of the tourist attractions you have accessed

Appendix 6: Students' reflection after pre-test results

17/06/2024 Akshat

Participants	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Basic computer skills, knowledge	Students' abilities and reflections									
	X indicate student's inability and lack of knowledge about computer or technological devices									
	✓ Indicates student's ability and knowledge about computer or technological devices									
Student knows that technology includes computer and its components	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Student knows how to put computer on.	✓	✓	✓	✓	X	✓	X	X	X	✓
Student knows how to use google chrome/camera to search for information.	✓	X	✓	✓	X	X	X	X	X	✓
Student knows Microsoft word and how to type using word.	✓	X	✓	✓	X	X	X	X	X	✓
Student knows can save word document.	X	X	X	X	X	X	X	X	X	X

Participant	Participants Reflections After test
P1	No one has taught me how to save so I do not know how to save my work.
P2	I have never got a chance to practice how to use the computer. When I have to use of other learner push me away
P3	I don't know how to save word document because I was not taught properly.
P4	I was struggling to find Microsoft word but I saw my classmate open Microsoft office to find it so I do that too and find it
P5	Madam I don't know how to put computer on because I find it on. I also don't know how to search because we were given. It is also difficult to save because there were many things in the computer.
P6	I did not know to find Microsoft word so I did not type the information I found on Google.
P7	Madam I did not know how to do computer properly. When we went in the computer I did not see what other learners were doing. I did not do anything.
P8	I don't like computers. The computer has so many buttons and they confuse me.
P9	Thing of computer is hard, making it light is worse
P10	The test was not difficult but last time when we came here I did not see where I should press to put the computer on and we did not save so I do not know to save the work.

Appendix 7: Interviews after pre-test

My name is 'Mafane Rants'o I am currently pursuing my final year at the National University of Lesotho, enrolled under Master of Arts in Education(geography). I am conducting research on the topic Incorporating PICRAT model to develop geospatial technological skills of geography student in one secondary school in Lesotho. I would love to interview based on the following questions. And if you allow me, I will be recording. So, you are free to choose whether I should record you or not however, I assure you that you identity will confidential.

Participant Name or pseudonym _____

1. In which ways do your teachers teach geography? (Which materials, teaching methods or learning platforms do they use)
2. Are there instances where your teachers use technology to teach Geography?
3. What is your understanding about technology?
4. Which technological machine (devices) do you know?
5. Are there any times where you use technology? If yes, what task do you perform and if no in what ways do you think technology can be used?
6. Are you satisfied with the way technology is used in school?
7. What do you think is needed for better use of technology in learning Geography?
8. Which technologies do you think can help you with the location and direction?

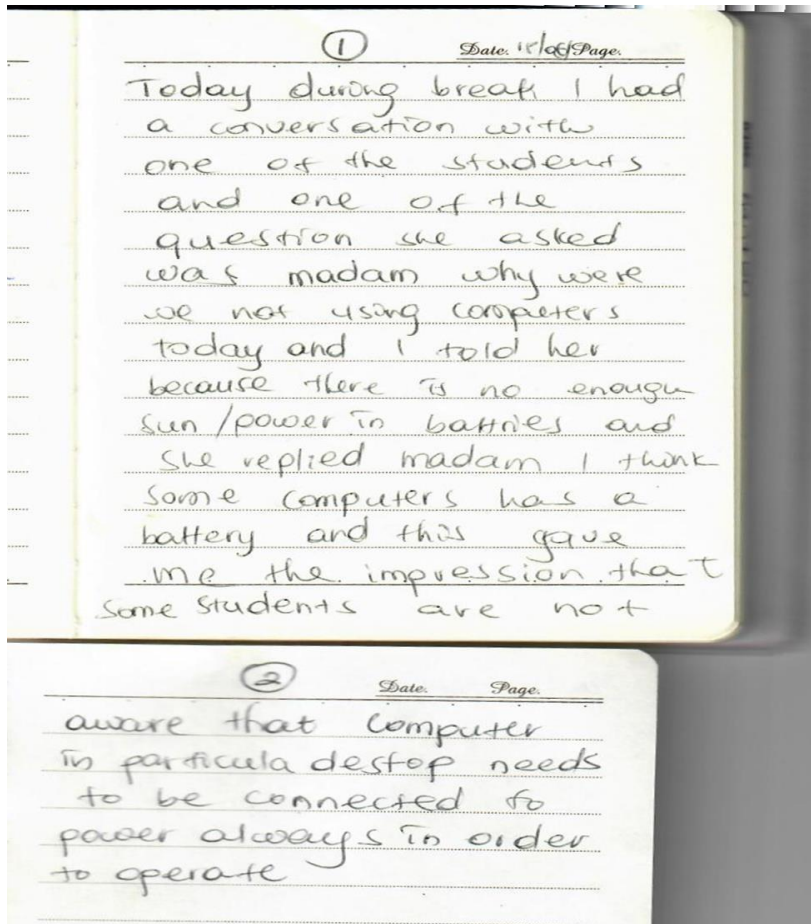
Appendix 8: Weekly lesson evaluations

using earth 3D map and google earth					some	Majority	
Students managed to add placemark of the places they have accessed						Majority of the class	
Students were able to save their project					Some not all	Majority of the students	
Students were able to access their project saved on the previous lesson					Not all		

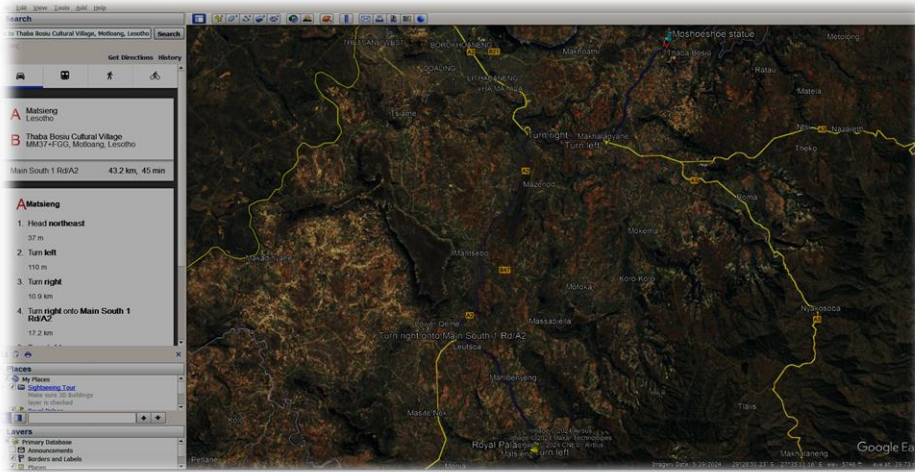
General evaluation for the week:

- All the 28 grade 10 Geography students know the basic computer skills like switching computer on and off, opening microsoft office and then word, typing correct way of positioning hands on a computer and searching for information.
- Technology helped in motivating them and encouraged them to learn
 - Majority seem to have acquired a lot of google earth / earth 3D map features
 - A larger number is able to access geography information through google earth.
 - Majority of learners needs help in saving their projects in google earth.

Appendix 9: Reflective journal



Appendix 9.1: Classroom assessments



Appendix 10: Observation results

Principle of PICRAT	Classroom observations
Passive interaction	<p>Passive interaction helped my students to comprehend the features of google earth, google map and earth 3 dimensional and how they can be used. This was apparent because some students indicated, <i>“madam while observing you and the video I learned a lot of google earth features I can use.”</i></p>
Replace old classroom practices	<p>Also, by passively watching they saw guidelines on how to use google earth and this in return assisted the students to participate in the classroom because during discussion they had something to share as a result they were productive during creative interaction with technology. On the 27th of June I had conversation with some of the students and one of the views was that <i>“observing and watching the video show me the way, if it was not by watching the video, I would not know the how google earth works and how I could use it in Geography learning”</i>.</p> <p>Improve technological knowledge, they seem to learn more technologies from the video they watch.</p> <p>During the summary of the lesson one participant said, <i>“teacher I only use my phone for social media and watch videos on Facebook, I did not know that there is so much I could do with my phone that will help me in my studies such as accessing educational videos like this one”</i>. Whereas the other one said, <i>“madam I only knew smartphone and computer (desktop) but I now knows that laptop is a computer, visitesotho website, google earth and google map.</i></p> <p>One said, <i>“I was not aware that computer is an umbrella term for other computers like laptop, desktop and tablet”</i>.</p>
	<p>Some learners seem to forget some of the things they learned from the video they watched. This was evident because as I asked them what they have watched some did not participate and when I volunteer them, they had nothing to share to the class. However interactive relationship seems to bridge the gap;</p>
Interactive Amplify classroom practices	<p>Learners were motivated and engaged when learning with technology, they were participating when asked probing question and they as well were asking questions, one learner asked, <i>“Madam, are you going to allow us to search for the places?”</i></p>

	One of my learners said, <i>“I find this software interesting because I can see the world without being in physical contact with, I cannot wait to be the one using it”</i> .
	Through classroom discussion learners were able to remind one another the technological devices they have learned for instance one whispered, <i>“you should stop saying computer remember this is a desktop and that one is a laptop”</i> . and they were able to share with one another what they learned while observing their teacher.
	When technology is used to amplify classroom practices students remember what they have been taught or have seen on the video. This was evident because they were able to tell what they have learned from the video and how they think they can use the features they saw in their learning of Geography classroom and at home. For instance, a particular student had said, <i>“madam in map reading we are taught how to calculate time and distance so I think that feature which is like a ruler it can be used to measure distance and area of a place”</i> . The interactions enhanced students critical thinking Learners learned a lot of google earth features from the video they watched, they were able to summarise what they have learned from the video, and this made it easier for them to use google earth, google map and earth 3D,
	Students were learning from one another during group work and were motivated to try when they see others use computer, one participant had said <i>“I did not see that feature can you please explain to me how it works”</i> .
Creative interaction	Students were able to switch on the laptop and computers
	Students are scared and not willing to try new things
	Some students get discouraged and frustrated when they are struggled to use computer but when encouraged students managed to deal with their phobia and usen computers to access information. In support, one student even stated, <i>“madam you really have a good communication skill you help us to deal with our fears, when you spoke to me about the importance of technology that changed my mind about technology and even when I struggle nne ke sa ts'abe ho kopa thuso (I was not scared to ask for your assistance”</i> .

	When instructed to go to google earth and open it they were able to follow the instruction and managed to acquire information using earth 3D map and google earth.
	They created their maps of the places for sightseeing (managed to save their project on google earth and added placemark of the places they have accessed
	Students managed to take a virtual field trip by exploring on place of tourist attraction
	When not monitored and not given an extra task students play games in the class.
	Students were able to access their project saved on the previous lesson and it was easier for them to tell the things they have learned from the previous class

Appendix 11: Post-test questions

1. Switch on computer
2. Go to google chrome/ search and search for the meaning of tourism
3. Type the definition in Microsoft word
4. Save the work
5. Search for tourist attractions using google earth or earth 3D
6. Choose one tourist attraction and zoom the place for clearer view
7. Add place mark
8. View the place in google map
9. Take a screenshot and paste it on Microsoft word name the photographs according to the tourist attraction name
10. Find the direction from Matsieng to one of the tourist attractions you have accessed
11. Save your project on google earth.

Appendix 11.1: Post-test scripts

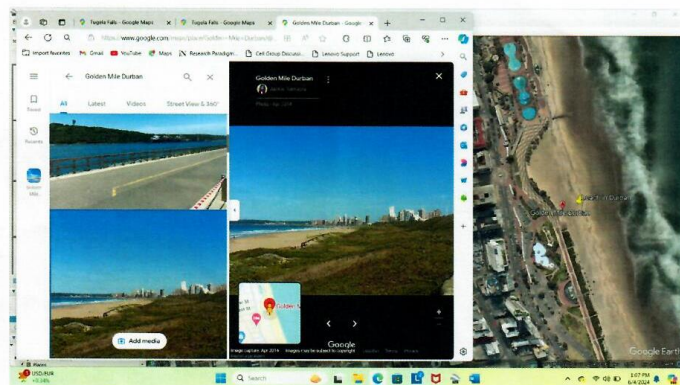
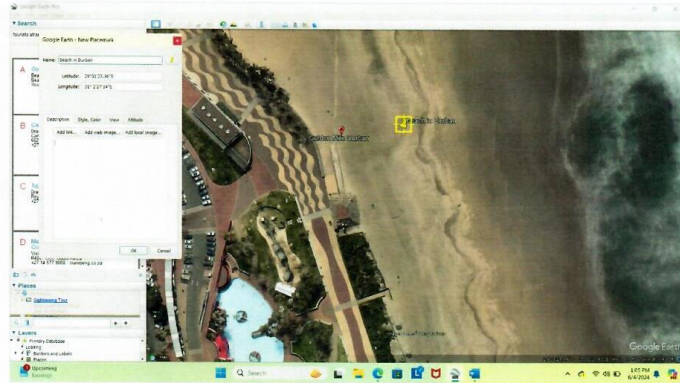
Grade 10

Geography

18
19

Post test

Name: Rethabile Bosiu



Remarks: Managed to save your project on google earth however you didn't take your pictures

Grade 10

Geography

18
19

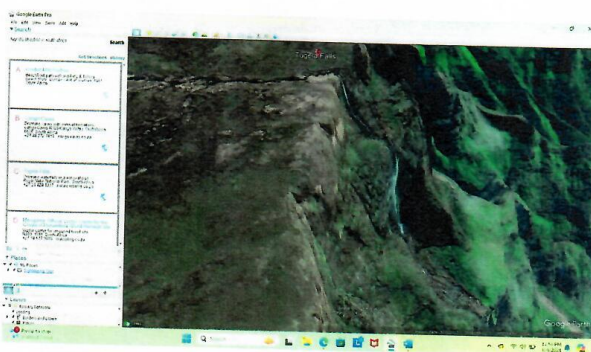
Post test

Name: Rets'elisitsoe Rants'o

Tugela Falls with its photograph



Tugela falls when zoomed



Remarks: You did well however this project was not saved

19
19

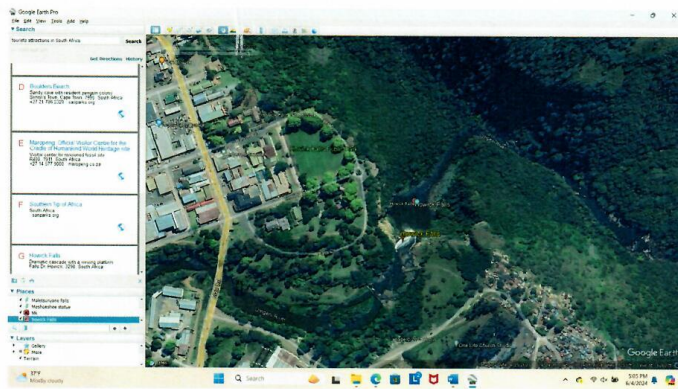
Grade 10

Geography

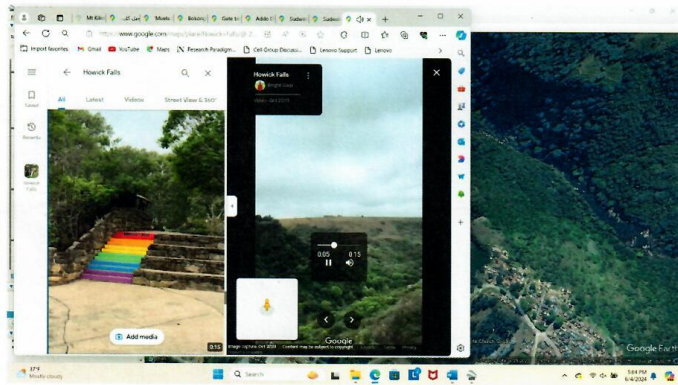
Post test

Name: Mankhasi Mafa

Howick falls with landmarks



Howick falls with the video on google map (and I watched the video



Remarks :

- Project saved
 - Added place mark
 - view clear photographs & clear
- I am really impressed

Well done

Grade 10

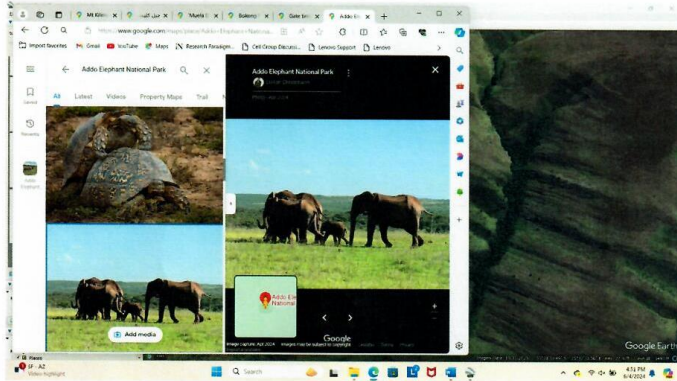
Geography

16
19

Post test

Name: Mats'eliso Khoachele

Addo elephant National Park



- Project not saved on google earth application
- No place mark
- Google earth photograph not clear

However I am amazed you managed to access the place.

Grade 10

Geography

18
19

Post test

Name: Katleho Mokone



- No lablog of this tourist attraction
- Well done

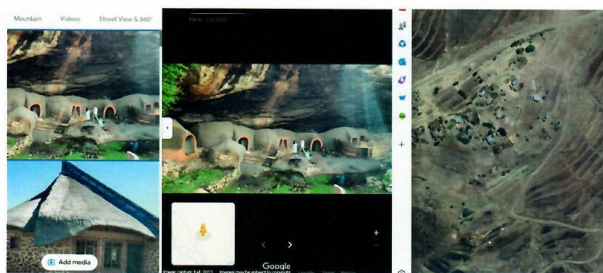
17
19

Grade 10

Geography

Post test

Name: Thato Sefuthi



- No labelling (name of the tourist attraction)
- Project not saved on google earth application

Grade 10

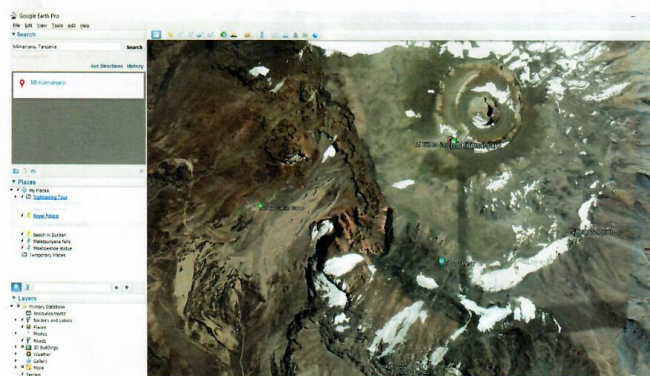
Geography

18/19
19/19

Post test

Name: Nteboheleng Moabi

Mount Kilimanjaro in google earth



Comments and remarks

- able to switch on the laptop, use google earth to access classroom content (teacher's instruction)
- used ' add place mark feature
- zoomed the place
- however did not save the project.
- Project saved as MK on google earth application

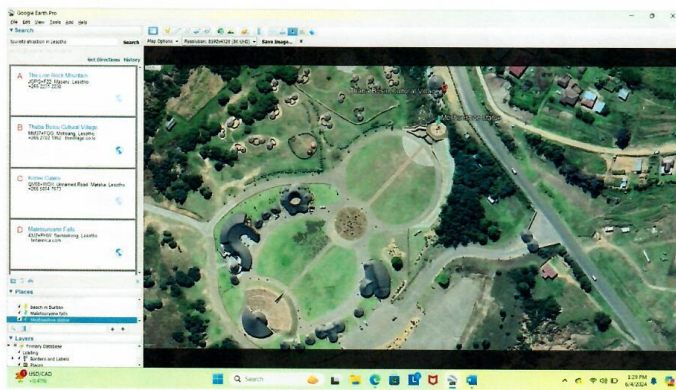
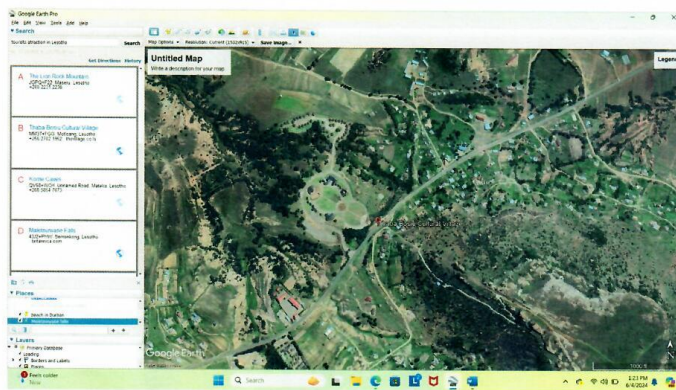
18
19

Grade 10

Geography

Post test

Name: Mpho Moiloa



- No labels
- if add placemark feature used
- project saved to google earth.

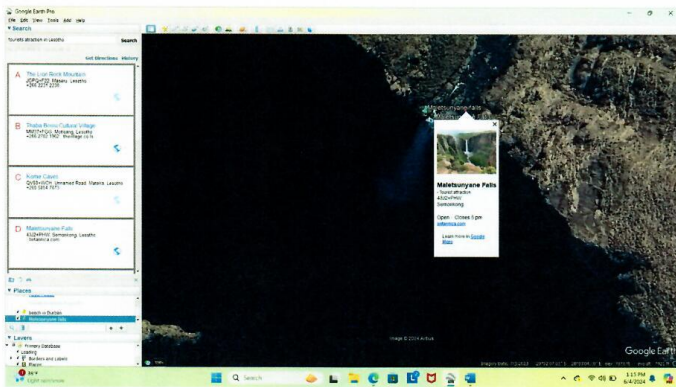
18
19

Grade 10

Geography

Post test

Name: Tankiso Moorosi



- Task well done however the view is not too clear, you did not zoom the full

- you were able to save your project and use "add placemark" feature.

18
19

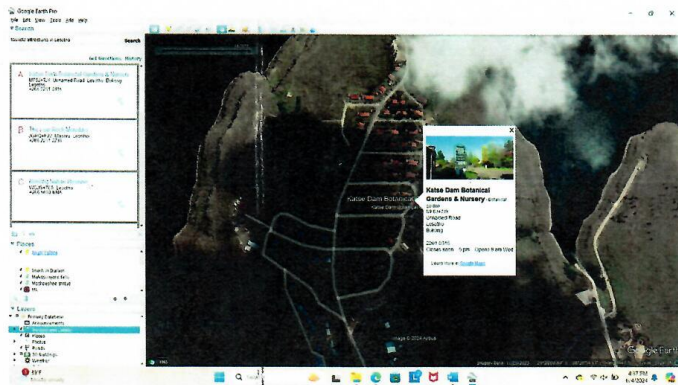
Grade 10

Geography

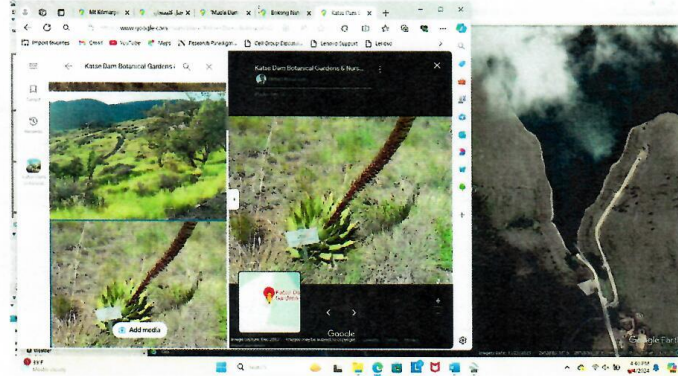
Post test

Name: Mats'eliso Mojaki

Katse Botanical Garden and Nursery



Natural resource found at Katse botanical Garden and Nursery



- The project not saved on google earth

Appendix 12: Semi-structured interview after post-test

My name is 'Mafane Rants'o I am currently pursuing my final year at the National University of Lesotho, enrolled under Master of Arts in Education (geography). I am conducting research on the topic Incorporating PICRAT model to develop geospatial technological skills of geography student in one secondary school in Lesotho. I would love to interview based on the following questions. And if you allow me, I will be recording. So, you are free to choose whether I should record you or not however, I assure you that you identity will confidential.

Participant's name/ pseudonym and grade

1. Passive interaction with technology

- a. What are the educational technologies did you learn that you did not know before?
- b. In what ways did watching a video on how to use google earth help you in using Google earth?
- c. How did observing your teacher use computer, laptop and phone using google earth, 3d earth help you?

2. Interactive relationship with technology (using technology to amplify and)

- d. Did you find classroom activities using technology interactive?
- e. If yes, in what ways did you interact with technology
- f. Can you say your interaction with technology contributed to the development of GST skill?
- g. If yes, how did your interaction with technology influence geospatial technology skills?

3. Creative relationship with technology (using technology for transformation)

- h. How did accessing information through technology help your technological skills?
- i. What do you think helped you to acquire the skills you mentioned above?
- j. What are the classroom practices and activities that you found efficient in the development of your GST skills?

4. Students' perspective about integration of technology

- k. Do you think geospatial technologies are transforming Geography education? Yes/ No; Please explain
- l. Do you think use of technologies is more helpful when you are the one using them or when you are observing others? Please explain your answer

Appendix 13: Similarity index (from Turnitin plagiarism checker)



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Appendix 14: Proof of editing

National University of Lesotho
Faculty of Education

18 September 2024


The Supervisor Department of Languages and Social Education National University of Lesotho

Dear Supervisor

Re: proof of language editing

This letter proves that I read and edited 'Mafane Rants'o's dissertation titled: **Incorporating PICRAT model to develop Geospatial technological skills in Geography learners: a case of one secondary school in Maseru district, Lesotho.**

Sincerely,



Mahao Mahao (PhD)