CORRELATION BETWEEN TEACHERS' IMPLEMENTATION OF VIRTUAL FIELD TRIPS AND STUDENTS' ACHIEVEMENT IN GEOMORPHOLOGY IN SECONDARY SCHOOLS IN MURANG'A EAST SUB-COUNTY, KENYA

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A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Education of Murang'a University of Technology

July, 2026

DECLARATION

Student Declaration

I hereby declare that this Thesis is my original work and to the best of my knowledge has not been presented for a degree award in this or any other university. I understand what plagiarism is and I am aware of the University's policy in this regard. I understand that any false claim in respect of this work shall result in disciplinary action in accordance with the University Anti-Plagiarism Policy.

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Supervisors' Approval

The undersigned certify that they have read and hereby recommended for acceptance of Murang'a University of Technology a thesis entitled **"Correlation Between Teachers' Implementation of Virtual Field Trips and Students' Achievement in Geomorphology in Secondary Schools in Murang'a East Sub-County, Kenya".**

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DEDICATION

Special dedication to my dad Mr. James Githua for great inspiration that has sailed me this far.

ACKNOWLEDGEMENT

I thank God for giving me strength, good health, and guidance to accomplish this research work. I would also like to express my deep appreciation to my supervisors, Dr Alice Omariba and Dr. Eric Osoro Nyamwembe, for their patience, and assistance throughout this work. To all the staff in the faculty of education, department of Curriculum, Instruction and Administration, i acknowledge you all for your guidance and motivation.

Moreover, a huge thank you to all the research participants in this study. It was because of their permission and responses that the study was done successfully and results tabled for examination. Further, i acknowledge the authors of my references. Their work enabled me to get insights for my study. Lastly, to my friends, family, and fellow students, I wish to acknowledge you all for supporting and encouraging me at each level of this process.

ABSTRACT

Development of technology has transformed pedagogical practices across the globe, offering new opportunities for experiential learning. In geography, teachers have long relied on physical field trips when teaching geomorphological processes and to allow experiential learning. However, physical field trips are limited by financial, logistical, safety and accessibility difficulties. Low student performance in visualization dependent geomorphology has been evident in KCSE examinations as questions in this area consistently appear in the list of poorly performed topics. Virtual field trips (VFTs) provide an alternative to expose learners to real world geomorphological features and processes while still in classroom. Despite the potential of VFTs to bridge classroom theory with real world application, little is known about teacher's implementation of VFTs and how this relates to students' performance. The purpose of this study therefore was to investigate the relationship between teacher's use of VFTs and students' academic achievements in geomorphology. Guiding objectives of the study included; To determine the extent to which secondary school geography teachers in Murang'a east sub county use VFTs in teaching geomorphology. To investigate how geography teachers implement virtual field trips based the experiential learning model to enhance student achievement in geomorphology. To establish the relationship between teachers' use of VFTs and students' academic achievement in geomorphology. To explore the factors that influence the teachers' integration of VFTs in teaching geomorphology. This research was anchored by Experiential Learning Theory and Teacher Technological, Pedagogical and Content Knowledge (TPACK) model. The study adopted the descriptive correlational design. The target population included 9,058 students and 537 teachers in 33 secondary schools in Murang'a East. The sample size of this research study constituted of 364 form three geography students and their respective11 geography teachers. Purposive sampling was used to select 10 secondary schools, stratified sampling to select form three stratum, purposive stratified sampling to select form three geography class, proportionate sampling to distribute the student sample size (364) among the 10 selected schools based on each school's enrollment, simple random sampling to select form three geography students and census sampling to select all form three geography teachers. Data collection was done using teacher questionnaire, Classroom Observation Checklist and student marksheet. Quantitative data was analyzed using the descriptive statistics and inferential statistics while qualitative data was thematically analyzed. Findings revealed that VFTs were familiar to most geography teachers (90.9%) but only 72.7% used them in classroom teaching. Teachers partially engaged in experiential learning strategies with strong reflection practices and very weak application activities to real life. At the student level, frequency of VFTs use showed a strong positive correlation with individual student scores ($r = .658$, $p < .001$, $n = 314$), while implementation quality showed a moderate but highly significant correlation ($r = .535$, $p < .001$, $n = 263$). In addition, both were confirmed at the teacher level ($r = .784$, $p = .004$; $r = .719$, $p = .045$). Teacher motivation and awareness were high, however, lack of ICT skills, resources, poor internet availability and training minimized successful and common implementation of VFT. The data was presented in statistical charts, tables and graphs. The information will be useful in encouraging increased investment in ICT equipment necessary for implementation of VFTs.

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ACRONYMS AND ABBREVIATIONS

CBC	Competency-Based Curriculum
CK	Content Knowledge
COC	Classroom Observation Checklist
ELT	Experiential Learning Theory
ICT	Information and Communication Technology
K.C.S.E	Kenya Certificate of Secondary Education
KNEC	Kenya National Examinations Council
NACOSTI	National Commission for Science, Technology and Innovation
PCK	Pedagogical Content Knowledge
PK	Pedagogical Knowledge
SPSS	Statistical Package for the Social Sciences
TCK	Technological Content Knowledge
TFT	Traditional Field Trip
TK	Technological Knowledge
TPACK	Technological Pedagogical Content Knowledge
TPK	Technological Pedagogical Knowledge
TQ	Teacher Questionnaire
TSC	Teachers Service Commission
VFE	Virtual Field Experience
VFT	Virtual Field Trip
VR	Virtual Reality

DEFINITIONS OF TERMS

Geomorphology: This is the study of landforms and processes that shape the surface of the earth, as taught and assessed at the secondary school geography curriculum. Geomorphology includes topics like mass wasting, weathering, erosion, transportation and deposition as well as the resultant physical features such as valleys and gorges, mountains and coastal landscapes.

Virtual field trips: Digitally delivered educational experiences that enable learners to explore geographical sites and geomorphological features using multimedia tools such as videos, images, simulations, or virtual reality with the guidance of the teacher to ensure achievement of the curriculum objectives.

Virtual Field Trips Implementation: entails the process by which geography teachers plan, integrate, and deliver VFTs as part of their geomorphology lessons. This implementation will be measured by observing and documenting entire pedagogical process from planning stage, integrating stage to delivery stage

Student Achievement: refers to the measurable academic performance of form three students in geomorphology, geography, as determined by their scores in standardized classroom assessments and end-of-term exams on the topic "external land forming processes" taught using virtual field trips.

Extent of VFTs implementation; it is the level to which VFTs are used in teaching geomorphology. It will be measured by the frequency of use, the diversity of digital tools and platforms applied and how well the VFTs are integrated into the lesson plans.

VFTs integration procedure; it is the complete and observable pedagogical cycle within the experiential learning model, that a geography teacher undertakes to incorporate VFTs into their geomorphology instruction to improve student achievement. The procedure includes four stages which are; experiencing, reflecting, conceptualizing and experimentation/application.

Evaluation; refers to the numerical score that the form three geography students attained in geomorphology tests expressed in percentages.

CHAPTER ONE
INTRODUCTION

1.1 Background of the Study

Over the last five years, virtual field trips (VFTs) have widely been adopted globally in earth science and other related curricula with the aim of overcoming the logistical and safety constraints that are associated with traditional field trips (TFTs) and fieldwork. VFTs entail educational experiences that transform traditional field trips into digital explorations, enabling learners to study geographical sites and geomorphological features through fieldwork videos, images, simulations, or virtual reality with the guidance of the teacher (Wolf et al., 2021). These trips allow for the exploration of sites and concepts located far away, locations that are logistically challenging to physically visit, and locations that are financially expensive to afford a visit in person (Foley, 2022).

Geomorphology is a branch of physical geography that studies landforms and the processes that shape landforms and the Earth's surface (Shrestha et al., 2025). This sub-branch is an important area since it helps students make sense of their surrounding landscapes, appreciate natural features and make informed decision about agricultural activities, settlement, environmental conservation as well as disaster management. As evidence by Evelpidou et al. (2022), geography teachers have been seen to emphasize on field trips and field work when teaching topics under geomorphology, the main goal being to expose learners to real landscapes, landforms and physical geomorphological processes. Interestingly, this direct contact with the field encourages deep learning and differentiated learning that positively influences long-term memory. Nevertheless, Cheng & Tsai (2019) in Taiwan noted that practical fieldwork and field trips is associated with challenges that include; "complex transportation to intended locations, limitations of time, problems of arrangement, lack of financial support by the school administration, the difficult task of managing students during fieldtrips, safety concerns as well as issues of inclusivity since learners with disabilities are unable to take part in practical fieldwork and traditional field trips (TFTs)". Similarly, according to Kelfine et al. (2018), several barriers have been associated with full reliance on traditional fieldwork (TF), most notably from the research being time factor, cost, logistical issues, and planning that

discourage geography teachers from conducting physical fieldwork and frilled trips. In response to these challenges, academic institutions such as secondary schools and higher education institutions therefore have widely adopted virtual field trips as a partial alternative to the traditional field trips and fieldwork. VFTs in this case allow students to explore rivers, mountains, and other geomorphological features and processes virtually without having to leave the classroom Elvipidou et al. (2021).

VFTs at the global level have been associated with improved academic achievement. For instance, a study by Vandelli et al. (2024), discovered that 90% of the students exposed to a virtual tour on the impact of surface runoff in Greece, mud-volcanoes in Northern Italy's badland and karst landscape at the coast of Malta, declared the tour an enjoyable experience that aided conceptualization of basic geomorphological principles. Consequently, this experience greatly supported their understanding of geomorphic aspects. In corroboration, a study by Mayer and Makransky (2022) aimed at investigating VFTs' effectiveness in learning at the middle levels of schooling highlighted improved retention of acquired knowledge. This finding was as per the evidence obtained from both immediate post-tests and delayed tests. Additionally, navigating environments virtually enables access to completely inaccessible sites such as summits of massive outcrops, allowing a wide view of geomorphic features, hence developing learner's spatial thinking and 3D understanding, a manner impossible via actual tours (Pugsley et al. 2022).

Exposure to virtual field trips also increases students learning affection, like increased interest and expectations, and improved self-efficacy among middle schoolers (Petersen et al., 2020). Thus, streaming outdoor environments and distant features in the classroom pave the way for interactive learning where learners feel comfortable and well-accommodated, improving their confidence and self-belief.

In Africa, according to Oluwayimika, & Adeoye, (2023) teachers have taught using the traditional lectures and presentation methods as well as tutorials to enable students rehearse the presented content. Nevertheless, with increased awareness about VFTs, instructors in Nigeria, Rwanda and south Africa have incorporated the use of VFTs to

make learning a more engaging experience and improve learners' attention and retention of content (Nsekandizi, Karanganwa, & Andala, 2020). Interestingly a Nigerian researcher Salman, (2023) found out that learners achieved a higher score when taught using the VFTs as compared to other students who were taught using the traditional methods.

The expansion of initiatives like "computers for schools Kenya, establishment of National Information Communication Technology (ICT) and Integration Centre" was purposely done to upgrade the standards of education (Kipkoech, 2021). In Kenya, science and mathematics teachers particularly emphasized incorporating ICT and digital tools in their lessons (Mavu,2021). From the existing research, humanities have not emphasized VFTs and related technologies, given their power in allowing access to remote areas, features in different continents, and affordability compared to Traditional Field Trips (Kipkoech, 2021). For instance, according to Mutabari et al. (2024), only 50% of history education teachers in secondary schools in Murang'a county had used VFTs in their instructional activities.

Murang'a County is one of the few counties in Kenya with rugged terrain characterized by numerous geomorphological features and processes such as landslides (Njiraini, Omondi, & Okaka, 2022). The numerous steep slopes, river valleys, and dissected landscapes in Murang'a county may create barriers to accessing the sites for TFTs. Similarly, conducting TFTs to sites located very far away or in very remote areas is costly and challenging to plan. Platforms like Google Earth, YouTube (pre-recorded), and 360° video experiences can be used to replicate outdoor exploration without physically leaving the classroom with simple ICT equipment (Heuke Genannt Jurgensmeier et al, 2023).

Despite the widespread need for use of VFTs in the current instructional methods, VFTs are faced by infrastructural and technical limitations (Mead et al., 2019). However, offline videos or the pre-recorded virtual field trips maybe used in areas with poor internet connectivity alongside portable projectors for displaying the virtual tours, minimizing the need for one-to- one devices. For example, Boinett et al. (2023) found that schools with unreliable internet were able to successfully use ICT-based learning by

using 360^0 photos and pre-downloaded videos instead of streaming content online. According to Pugsley et al. (2024), virtual trips are less expensive to execute than traditional tours.

Although the Ministry of Education has encouraged digital learning innovations following the COVID-19 pandemic, existing studies generalize the impact of e-learning tools, with just a few narrowing down the specific effects of VFTs on science topics like geomorphology. Additionally, there exist minimal studies that explore influence of VFTs on teaching geomorphological aspects in secondary schools within the Murang'a East sub-county, despite the increased need for experiential learning approaches to geography education. Furthermore, there are even fewer studies examining whether teachers' use of VFTs has any actual connection to how well students perform in secondary schools' geomorphology topics. This gap now presents a lost opportunity to explore ways of harnessing VFTs to overcome instructional challenges associated with teaching geomorphology in rural and under-resourced education institutions in Kenya. Minimal local research evidence has denied education stakeholders access to the needed data to justify large-scale investments in VFT integration at the secondary school level in Kenya. Therefore, this study was done to provide empirical research evidence to bridge the gap by exploring the correlation between teachers' use of virtual field trips and students' academic achievements in geomorphology in secondary schools within Murang'a east sub-county, Kenya.

1.2 Statement of the Problem

In geomorphology, landforms such as ridges, valleys, cliffs and fluvial networks have three-dimensional structure. Therefore, visualization is essential in helping learners grasp elevation, slope, curvature and spatial relations that text alone cannot convey. In addition, geomorphological processes such as erosion, deposition and landscape changes occur over long timescales. Visualization enables animation or simulation to demonstrate how geomorphological processes occur and how landscape changes, which is otherwise abstract. Geography teachers have for a long time emphasized the use of field trips when teaching topics in geomorphology, to help learners visualize and comprehend geomorphic processes and features (Aksoy & Himmetoglu, 2023). Similarly, traditional

field trips have been the cornerstone for experiential learning, bridging the gap between theory and real-world application (Kelfine et al., 2018). Despite the essential influence of field-based learning on students' understanding of geomorphological processes, traditional field trips in Kenyan secondary schools, especially in rural areas such as Murang'a County remain a challenge in implementation. Factors such as limited budgets, tight school timetables, safety risks, and the challenging nature of accessing remote geomorphological sites have made these excursions more of a dream than a reality for learners in most public schools. Consequently, many geography students end up memorizing geomorphological facts. This rote learning mode truly hinders learners from understanding their environment, leaving them unprepared to tackle real-life challenges since they fail to make connection between classroom theory and real-life application.

Academic performance in geomorphology topics is also alarming with students consistently showing poor performance in these topics, as evidenced by the Kenya Certificate of Secondary Education geography reports (K.C.S.E). These topics in geomorphology, especially Glaciation, coastal geomorphology and internal land forming processes, have consistently dominated in the list of poorly performed questions in K.C.S.E geography paper one for a long time (KNEC, 2020-2024).

Table1.1 List of most failed topics/subtopics in geomorphology in K.C.S.E between 2020 and 2024, retrieved from K.C.S.E geography reports

Year	Poorly Performed Topics Under Geomorphology Sub-Discipline
2020	Action of wind and water in arid areas
	Internal land forming processes
2021	Glaciation and Karst Sceneries
2022	Seas, oceans and their coasts/coastal geomorphology
	Internal land forming processes (faulting)
	Glaciation
2023	Internal land forming processes (Volcanicity)
2024	Glaciation
	weathering

(KNEC, 2020-2024)

VFTs may be used to overcome the challenges associated with the physical field trips and revive the performance in geomorphological topics. In addition, as compared to actual field trips, virtual excursions are cost-effective (Pugsley et al., 2024). Yet, very little is known about how VFTs are actually used in Kenyan geography classrooms especially in teaching geomorphology, and whether they have any real link to how students perform academically. Therefore, investigating the correlation between teachers' implementation of virtual field trips and student performance in geomorphology will help bridge this gap.

1.3. Objective of the Study

This research study aims to study the relationship between teachers' implementation of virtual field trips and academic achievement in geomorphology among secondary school students in Murang'a east sub-county, Kenya.

1.3.1 General Objective

To explore the relationship between teachers' implementation of virtual field trips and academic achievement in geomorphology among secondary school students in Murang'a east sub-county, Kenya.

1.3.2 Specific Objectives

The study would be guided by the following four specific objectives:

i. To determine the extent to which secondary school geography teachers in Murang'a east sub county use VFTs in teaching geomorphology.
ii. To investigate the strategies used by geography teachers to implement virtual field trips based the experiential learning model to enhance student achievement in geomorphology.
iii. To establish the relationship between teachers' use of VFTs and students' academic achievement in geomorphology.
iv. To explore the factors that influence the teachers' integration of VFTs in teaching geomorphology.

1.4 Research Questions

i. To what extent do secondary school geography teachers use VFTs in teaching geomorphology?
ii. How do geography teachers implement virtual field trips within the experiential learning model to improve student achievement in geomorphology?
iii. Which factors influence the teachers' integration of VFTs in teaching geomorphology?

1.5 Research Hypothesis

i. **HO_1:** There is no statistically significant relationship between teachers' use of Virtual Field Trips and students' academic achievement in geomorphology.

1.6 Significance of the Study

This research study intended to explore teacher's implementation of VFTs and its correlation to students' academic achievement in geomorphology. This study therefore aimed at informing educators about the need to incorporate VFTs to create an opportunity for in-classroom experiential learning and ensure inclusivity in their instructional practices. Instructional designers and school administrators will use the results to support adopting digital and technological tools aligned with the competency-based curriculum (CBC). Geomorphology is also taught at the senior secondary level and therefore the results of the study will be of benefit in the CBC system. Similarly, for policymakers, this study will provide important evidence to guide integrating educational technologies into the national curriculum, thereby contributing to the broader digital transformation agenda in education. Finally, the results of this study will be a stepping stone for researchers who wish to investigate an area similar to this. Such significance showing the potential contributions of the research is a clear justification of the need to conduct the study (Kothari & Garg, 2019). The significance section also demonstrates the practical value of findings to the educators, policymakers and other researchers (sounders & Thornhill, 2019).

1.7 Assumptions of the Study

This study was conducted based on several assumptions.

i. Secondary school teachers in Murang'a east sub-county use virtual field trips in teaching and learning topics under geomorphology sub-discipline.
ii. Student's performance in geomorphology can be seen through test scores or classroom assessments.
iii. That, exposure to virtual field trips might affect how well students understand and perform in geomorphology.
iv. All schools that were selected for this study have covered the same topics in geomorphology, so their results can be fairly compared.

1.8 Scope of the Study

Mugenda and Mugenda (2019), noted that research can be conducted in any area as long as the location presents the characteristics necessary for investigating the research problem. Therefore, this investigation was done in secondary schools within Murang'a east subcounty, Murang'a county, Kenya. This study strictly focused on how teachers' use of virtual field trips in geography classroom lessons maybe connected to how well students perform in geomorphology sub-discipline. In terms of the participants of the study, form three students were selected to participate since most of the geomorphology topics are taught at this level. Respective form three geography teachers in schools within Murang'a east subcounty was the only focus, to allow establish relationship between teacher's implementation of VFTs and their own students' performance. Additionally, this study was limited to one sub-branch of geography subject which is geomorphology and therefore it did not cover any other area within the subject matter or other digital learning experiences away from virtual field trips. Geomorphology is also covered in the Competency Based Curriculum (CBC) right from grade 10 at senior secondary schools. Therefore, the study findings were generalized to also apply to CBC system of learning, particularly in geography. Finally, this study used correlational design which means that it can only show the relationship between teachers' use of virtual field trips and academic achievement of the students but cannot prove that one causes the other.

1.9 Limitations of the Study

This study has a limited focus to the secondary schools within Murang'a east subcounty, Murang'a county Kenya and specifically its focus lies on geomorphology as a sub-branch of geography. This means that the results may not necessarily represent the scenario within the schools in other regions with different teaching conditions or technology levels. In addition, the target respondent who were geography teachers only, were very few in the selected secondary schools resulting to a small teacher sample. Inadequate access to technology is another possibility. Additionally, form three students and their respective geography teachers in schools within Murang'a east subcounty purposively took part in the study creating biasness against the rest of the classes thus limiting generalization. There was also a possibility that teachers' replies on the questionnaires might not always be totally true, either because they forgot to mention some details or wanted to portray themselves in a good light. The study's focus was limited to virtual field trips and not any other learning experience that may correlate with the academic performance of students in geomorphology. Another limitation is research design, because the study used a correlational design, it was only able to prove whether or not there is some relationship between teachers' use of VFTs and students' performance but not whether one is the cause of the other. Finally other factors like teaching styles and home background might have also influenced the performance of students, but the central focus of this study was on exposure to virtual field trip. According to the university of Southern California (2022), such limitations are important in ensuring that generalization and interpretation of research findings is restricted.

1.10 Delimitations of the Study

The study included a mix of rural and peri-urban schools such that varying learning environments in the sub-county are reflected in the findings. This delimitation allowed replication of results to other locations with the same settings and characteristics as Murang'a east sub-county. To counter the problem of inadequate access to technology, the research considered both offline and online forms of VFTs such as pre-recorded videos and 360° virtual tours that can be accessed without the need for internet connectivity. The study also made use of a number of data gathering tools such as

questionnaires, observation checklists and student performance records in order to validate and verify what the teachers described. The research controlled the effect of other factors influencing students' performance by considering only those areas being taught by VFTs and schools teaching the same content. As stated by Creswell and Plano (2023), such delimitations are essential in ensuring that the study is feasible, although they also limit the extent to which the study findings can be generalized.

1.11 Contributions of the Thesis

The study demonstrated that despite the awareness of Virtual Field Trips (VFTs) by most teachers in geography in Murang'a East, the actual application in the classroom remained inconsistent. This showed that teacher awareness of VFTs does not translate to their integration in classroom teaching by geography teachers.

The study also contributes to pedagogy by uncovering that teachers use the experiential learning cycle by Kolb (1984) in an unevenly way when using VFTs. The stages of concrete experience, reflection, and conceptualization were quite practiced, whereas the application stage was least applied by geography teachers. The study therefore concludes that learners are less involved in the application of geomorphological concepts in real-life situations.

In addition, the research offers empirical evidence on the relationship between VFT use by geography teachers and the academic performance of students in geomorphology. This helps to argue that VFTs are also instructional resources that can be used to enhance performance of learners in addition to being used as visualization aids.

Lastly, the research contributes to the knowledge by determining the important factors that influence the adoption of VFTs in primary secondary schools in Kenya such as ICT competence, teacher motivation, enlightenment on digital resources and access to infrastructure. Therefore, the study noted that the incorporation of VFT cannot be achieved through individual teacher effort only but institutional and policy assistance is needed.

1.12 Organization of the Thesis

This study's structure appears as follows: The first chapter covers the introduction of the study. It entails the background of the study, statement of the problem, research objectives, research questions as well as research hypothesis. It also covers the significance of the study, assumptions, the scope, limitations, delimitations and the contributions of the study. Chapter two entails the literature review. This chapter covers the theoretical framework of the study, the conceptual framework as well as the empirical review of related literature. Further, this chapter presents the summary of the identified research gaps. Chapter three of the study presents the research methodology. It comprises of the research design, study area, the target population, sampling procedures, sample size and the data collection instruments. It also comprises of the pilot study, validity and reliability of the study, data collection procedures, data analysis and presentation as well as the ethical considerations of the study. Chapter four covers the study findings, interpretations and discussions. Chapter five entails the summary of the study findings, conclusions and recommendations of the study.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter contains a theoretical framework sub-section, conceptual framework as well as the empirical review of the existing literature. The empirical review in this chapter is done systematically guided by the research objectives. A summary of research gaps identified in the reviewed literature is provided at the end of the chapter.

2.2 Theoretical Framework

This study was guided by two theoretical frameworks which include the Experiential Learning Theory (ELT) by Kolb (1984) and the teacher Technological, Pedagogical and Content Knowledge (TPACK) by Mishra and Koehler (2006). ELT framework was chosen to explain how learners learn effectively using VFTs while TPACK model was selected to explain how teachers can design and deliver geomorphology content effectively using VFTs.

2.2.1 Experiential Learning Theory

This theoretical framework explores how the use of VFTs can actually enhance academic achievement in geomorphology using the Kolb's (1984) Experiential Learning Theory (ELT). The theory presents learning as a four-step cycle which include experiencing, reflecting, conceptualizing, and experimenting and in this case, knowledge emerges from transforming experiences. VFTs normally use digital platforms to simulate real-world environments and therefore align with this cycle by offering engaging and accessible learning opportunities to help learners excel. ELT appears as indicated in Figure 2.1.

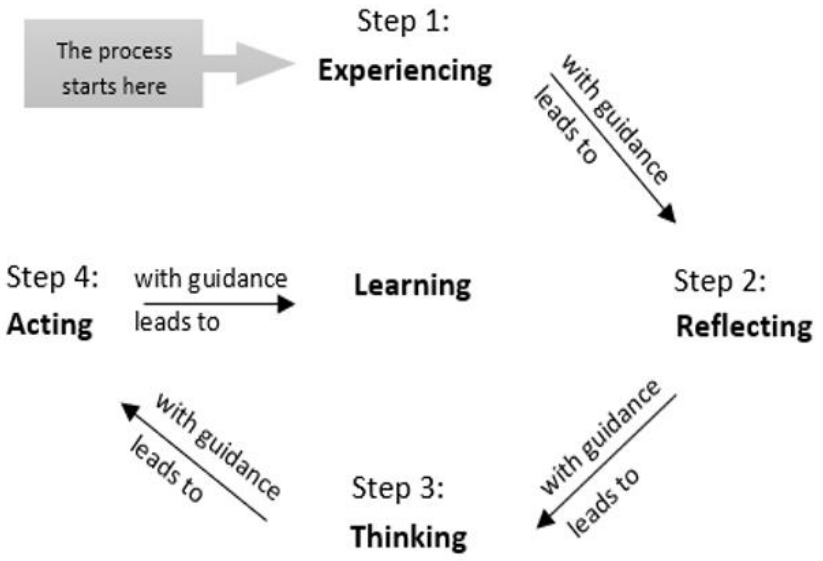


Figure 2.1: Model of Experiential Learning Theory (Egbert & Roe, 2019)

With access to VFTs, students can easily explore environments virtually creating realistic experiences that match “Kolb’s concrete experience” stage (Han, 2021). These moments during which students get exposed to VFTs triggers excitement and make learning feel more relevant and meaningful to these students. Guidance is offered by teachers to students to reflect on these experiences through discussions or writing, supporting the “reflective observation” stage. This reflective observation enables students to process deeply what they have seen. Sequentially, students connect their experiences now to broader concepts like linking a virtual tour to the respective topic in geomorphology making this stage fit “abstract conceptualization”. Finally, "active experimentation" stage is embodied when students apply the acquired knowledge through problem-solving or projects thereby reinforcing learning (Han, 2021).

The ELT-based learning approach boosts academic achievement by increasing engagement, sharpening critical thinking and improving retention. According to the existing studies, VFTs ease conceptualization by allowing visualization of physical features enhancing both motivation and performance (Cheng &Tsai, 2019). Teachers are key designers and providers of VFTs and therefore they align them with the curriculum

goals to make them relevant, while still using pre-trip and post-trips activities to guide students through the ELT cycle.

2.2.2 Teacher's Technological Pedagogical and Content Knowledge (TPACK)

The effectiveness of the experiential learning model heavily relies on the teacher's ability to integrate VFTs meaningfully into their teaching practices. Therefore, the teacher's Technological Pedagogical Content Knowledge (TPACK) by Mishra and Koehler (2008) becomes very essential for this study. Three interdependent forms of knowledge are emphasized in this TPACK framework. They include "content, pedagogy and technology" (Koehler & Mishra, 2008; Mishra & Koehler, 2006).

Content Knowledge (CK); Meaning teachers must have a solid understanding of geomorphology including processes such as erosion, weathering and mass wasting as well as their real-world occurrences. This content knowledge is important in ensuring that the chosen VFTs are relevant to curriculum goals (Mutabari et al., 2024)

Pedagogical Knowledge (PK): That teachers must also know how to design learning experiences, manage discussions, and apply strategies that align with experiential learning. For VFTs, PK may involve structuring pre-trip and post-trip activities or creating reflective group tasks. This will give students opportunities to experience, reflect, conceptualize and apply learnt geomorphological knowledge for learning actually to happen.

Technological Knowledge (TK); Finally, teachers really need skills to operate and adapt digital tools such as google earth, 360^0 videos, field work videos, interactive maps, or VR simulations that make it possible to use VFTs. The true strength of this TPACK lies in the intersections of these three domains as indicate in Figure 2.2.

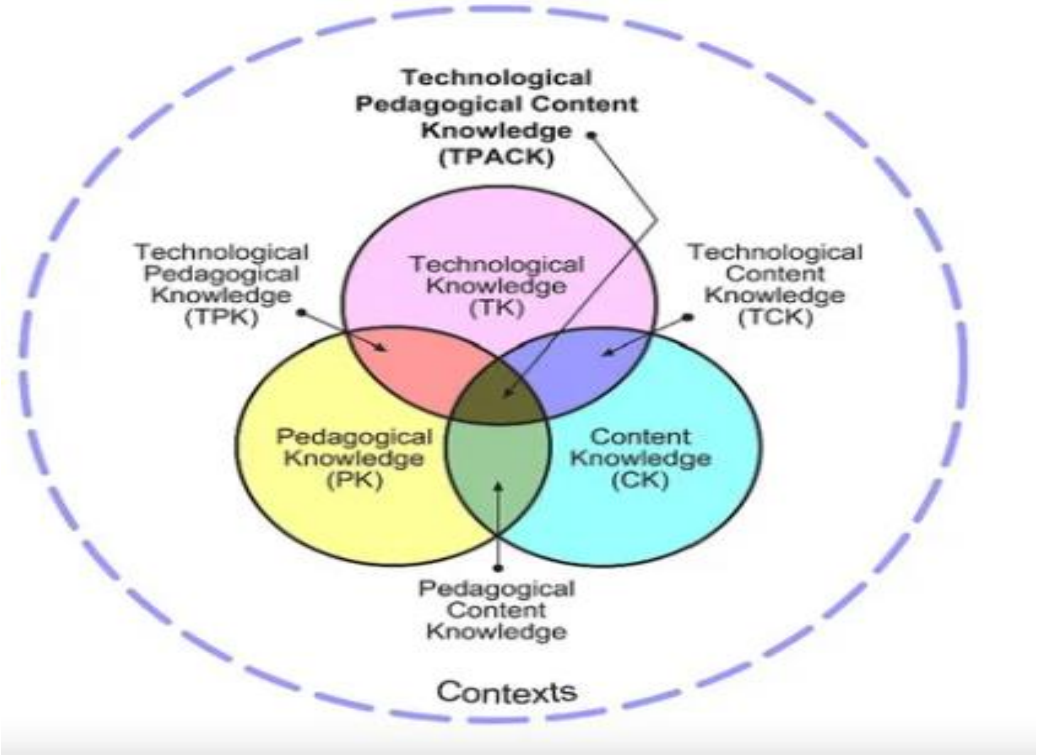


Figure 2.2: TPACK Model (Mishra & Koehler, 2006)

Pedagogical Content Knowledge (PCK) help teachers explain geomorphic processes in ways students can easily grasp, such as use of models. Technological Content Knowledge (TCK) on the other hand help explain how VFT tools maybe employed by teachers to represent physical landforms more clearly than they appear in the textbooks. Moreover, to guide teachers on the selection of the appropriate methodology to use when integrating technology calls for Technological Pedagogical Knowledge (TPK). TPACK at the core of this framework, represents the integration of all the three domains. In line with Mishra and Koehler (2006), TPACK would mean a teacher who can effectively combine geomorphology content mastery, sound pedagogy, and an appropriate digital tool to create rich and engaging learning experiences.

The alignment of this study with the TPACK framework is strong since the core purpose of the study is to investigate the teachers' use of VFTs and how this relates to students' achievement. The independent variables such as the extent of VFTs use and how VFTs are integrated are directly shaped by teacher's level of TPACK. Therefore, teachers with

strong TPACK are not only more likely to use VFTs frequently but are also better able to select tools that fit learning objectives perfectly (Mutabari et al., 2024). Additionally, such teachers with strong TPACK are able to design activities that sustain engagement and are capable of mitigating technological challenges experienced during use of VFTs. On the other hand, the dependent variable, students' academic achievement in geomorphology, is influenced by how well teachers are able to integrate the three knowledge domains (Mishra & Koehler, 2006)

In summary, the ELT framework explains how learners learn from VFTs through the four stages while the TPACK model clearly explains how teachers can design and deliver these experiences effectively. In this case, TPACK focuses on the teacher while ELT focuses on the learner. The teacher uses TPACK to create VFTs experiences, while the leaners learn from those experiences through the Kolb's four stages of experiential learning. Putting these models together provide a comprehensive framework for this research study, showing that the value of VFTs lies not just in their availability but in how teachers integrate them into pedagogy. Therefore, a more detailed view of the connection between students' academic achievement in geomorphology and teachers use of VFTs is made possible by this dual- theory approach.

2.3 Conceptual Framework

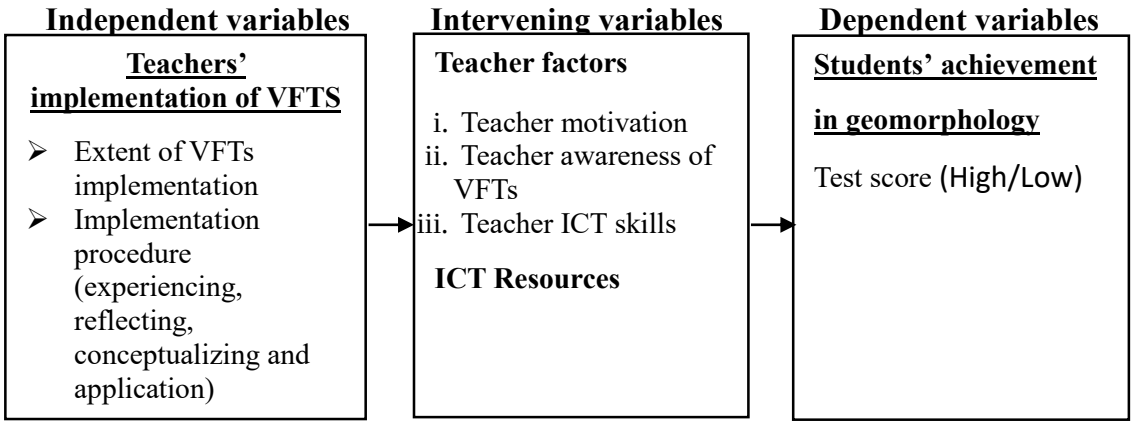


Figure 2. 3: Conceptual framework showing relationship among study variables

As per Figure 2.3, in this study, the teacher's implementation of virtual field trips (VFTs), including the extent of use and the implementation procedure acts as the independent variable that correlates to students' academic achievement in geomorphology which is now the dependent variable. However, this study perceives that this relationship is shaped by intervening factors that include teacher motivation, teacher awareness and teacher ICT skills. In addition, the researcher conceptualizes that ICT resources availability may as well influence the relationship and extent of VFTs use by teachers.

2.4 Empirical Review

This sub-section provides a review of existing empirical literature related to Virtual Field Trips, to bring out the current state of their utilization in teaching and learning. The sub-section systematically examines prior research on extent to which teachers use VFTs in teaching, how teachers integrate VFTs in their instructions to bring experiential learning, the documented relationship between teachers' use of VFTs and students' performance and the factors influencing teachers' integration of VFTs. Finally, by synthesizing this body of knowledge, the literature review identifies the gaps in the current knowledge thereby confirming the need for the present study.

2.4.1 Overview of Teachers' use of VFTs and Students' Performance

Since the COVID-19 pandemic forced worldwide school closures five years ago, Virtual Field Trips (VFTs) have grown from pandemic-ridden stopgaps to an innovative set of pedagogical practices for courses that depend on location-based observation such as geography. VFTs have widely been integrated in teaching science subjects (Cheng & Zhang 2023), with growing awareness among teachers of history and other humanity subjects. An increasing empirical literature obtained via controlled experiments, quasi-experimental classroom studies, and program evaluations confirms that high-quality VFTs such as 360° video, immersive video, and 3D virtual-outcrop models can boost student understanding. In addition, VFTs improve spatial thinking and 3-D cognition, and learners achieve quantifiable gains on immediate and delayed measures of learning when accompanied by appropriate instructional methods (Petersen et al., 2020; Makransky & Mayer, 2022; Pugsley et al., 2022). Some Systematic reviews and methodological pieces place VFTs neither as a complete replacement for in-situ fieldwork nor as substitutes.

Instead, VFTs are used as a supplement tool which may broaden access and support instruction when framed with well-defined learning goals. (Makransky & Mayer, 2022; Wolf et al., 2021).

There is growing evidence on awareness and use of VFTs by teachers in Africa (Lawal, 2023). Several quasi-experimental studies have been conducted in west African countries such as Nigeria and Ghana. Findings reveal that use of VFTs significantly improve students' performance (Hope et al., 2021 & Lawal, 2023).

In Kenya, with the increased ICT initiatives in secondary schools, use of technology tools has gained popularity. However, there is patchy empirical research on use of VFTs. This is because most of the studies generally explore the use of ICT (Otieno, 2022) without narrowing their focus to specific threads of technology such as VFTs. In Murang'a county, a current quasi experiment on history and government students by Mutabari et al. (2024) provides an ideal example on value of VFTs in enhancing students' achievement in Kenyan context. Yet, little is known about how geography teachers actually use VFTs and how this correlate to students' performance in geography specifically.

2.4.2 Extent to which Geography Teachers use VFTs in Teaching Geomorphology

A research study by Foley (2022) in Western Michigan University surveyed the extent to which geoscience professors in US universities use Virtual Field Experiences (VFEs). From focus groups with a total of 23 teachers, the study concluded that teachers are highly aware of VFEs, which they defined quite broadly to include tools like Google Earth, YouTube videos, and specialized interactive software. While educators valued VFEs for enabling learning for all students, they were very dissatisfied with available VFEs being "too surficial" or not being aligned with specific learning goals like data collection or analysis. Consequently, the study observed that educators spend a lot of time modifying or "cobbling together pieces" of VFEs, and they rarely used them exactly as they are given. The biggest barrier to the broader adoption of VFE use was the great time investment required of the instructor. This research measured awareness and left a gap in investigating the long-term adoption rate of VFE among the geography instructors at the secondary school level.

Chen and Zhang (2023) conducted a systematic review on VFTs adoption and integration in teaching K-12 classrooms in U.S.A. The research findings manifested that majority of the Virtual Field Trips (VFTs) were used in science teaching, with ten of the studies focusing on subjects such as geography and biology. There were fewer studies for humanities subjects such as history, which was five times, and English/literacy, which was a single occurrence. These findings were considered unsurprising. This is because the defining features of VFTs, that provided an opportunity to travel to inaccessible locations, to picture complex concepts, and to experience gaps in time (Elvipidou et al., 2021) aligned with the teaching requirements of science and history subjects. Furthermore, the research revealed that learning through VFTs mostly occurred at secondary levels, as thirteen of the studies investigated this category. When VFTs were used at the elementary level, the instruction tended to be directed towards older students. This finding indicated that the affordances of VFTs more naturally aligned with the character of adolescent learners. This was attributed to the level of development of these students beyond which the adolescent group was found to have a greater capacity for abstract thought and overall, the capability to engage more readily with technology. These were found to be making VFTs more effective and more engaging for this age group. However, there exist a gap in understanding the extent of VFTs adoption and integration by geography teachers in Kenyan context particularly Murang'a east.

Mnisi et al. (2024) conducted an investigation on the state of ICT integration in 36 South African secondary schools. This study used a descriptive research design where interviews and open-ended questionnaires were used to collect data from 10 teachers and one curriculum expert. The researchers found that teachers were using laptops and smartboards in their classroom teaching practices despite low internet coverage, especially during teaching and learning. While there still exists obstacles to technology integration to learning, there is also potential to strengthen the integration of ICT in school (Mnisi et al., 2024). Inconsistency in teacher training on ICT, with other teachers entirely lacking training was reported as factors leading to low motivation and limited use of ICT tools by teachers in their instructions. Nevertheless, this research study focused entirely on integration of ICT into classroom learning by teachers without

narrowing down to specific aspect of VFTs. In contrast the current study focuses on VTFs specifically and the extent of use by teachers in Murang'a county.

Research by Mutabari et al. (2024) provides direct evidence from Kenya where they conducted a quasi-experiment targeting 35 public schools in Murang'a county. The purpose of this study was to investigate the extent to which secondary schools use virtual field trips to teach history and government. Twelve History and government teachers were selected purposively and 360 students chosen at random to participate in the study in four selected schools. Questionnaires and interviews were employed to gather data from students and teachers respectively. According to the study's findings, 50% of the history teachers involved in the study were aware of VFTs use in history education while the other 50% of their counterparts were unaware of VFTs application in teaching history and government. In addition, it was evident that 156 of the History and government students had utilized VFTs before, whereas 156 others had not. Nevertheless, in this study, the extent of teacher utilization of VFTs was not broken down to frequency, tool variety, lesson integration or even relationship to student achievement. Therefore, the current study intends to fill the gap by focusing on geography teachers particularly and connecting that use of VFTs to real students' academic outcomes without experimentation.

2.4.3 Teachers' Implementation of Virtual Field Trips Guided by the Experiential Learning Model

VFTs aren't for exploration alone, but rather integrated into activities that generate stimulating discussions and social interaction between the teacher and the students and between the students themselves. Chen and Zhang (2023) made this point clear in their systematic review about the effects of VFTs on classroom teaching at the K-12 level in the United States of America (U.S.A). The systematic review categorized classroom interaction into two main types: teacher-learner interaction and learner-to-learner interaction. The results of this meta-analysis highlighted a coincidence between strong learner-to-learner interaction and strong teacher-to-learner interaction. Nevertheless, it's not necessarily that high teacher-to-learner interaction results in high learner-to-learner interaction. Therefore, the study suggested that designing relevant specific learning

activities to reinforce VFTs and to create room for learner-to-learner interaction should be put into consideration by teachers. Concerning pedagogical approaches, the research study reported that VFTs were properly utilized when combined with other diverse teaching and learning activities. Numerous studies globally, as suggested in the review findings, posit that VFTs have been effectively utilized alongside activities such as classroom learner collaboration, peer feedback, and demonstrations. These findings were in support of Cheng and Tsai (2019), Parmaxi, et al. (2021) and Peterson et al. (2020) who also alluded that VFTs incorporation can facilitate fresh teacher-students interaction and experiential learning. However, this there exist a gap in investigating how teachers integrate VFTs in classrooms guided by the experiential learning model which the current study seeks to investigate.

Teachers use different techniques to deliver content using VFTs and digital tools as noted by Cheng (2022) who conducted a study in Taiwan Asia. The aim of the study was to finding out what function primary school instructors thought the immersive virtual field trips would serve. Nineteen teachers took part in the investigation as the sampled respondents. The findings report that when putting VFTs into practice, the instructors recommended taking into account additional teaching strategies including role-playing, teamwork and learner autonomy for allowing in-depth exploration, experiential learning and comprehension of concepts. Five instructional approaches for delivering interactive VFTs were seen by educators. They included preparation, extension of learning, testing, cooperation, and role-playing. Extension of learning was most prominently mentioned, where virtual experiences were linked to real-world tasks, while other teachers indicated that students could return to familiar locations virtually for more engaging teacher-led discussions. Teacher's use of VFTs as an advance organizer is aimed at inspiring students and helping them comprehend newly introduced material (Cheng, 2021). The study suggested that it may be possible to improve learners' affective experiences and cognitive performance at the same time when teachers are able to utilize instructional strategies reported in this study. This study used only some stages in the experiential model. However, the current study intends to establish the use of the four stages of the experiential model as essential to improved academic achievements.

Nigerian scholars John & Dada (2025) conducted a major survey of various studies on how field trips and experiential learning affect social studies instruction. The meta-analysis gave evidence of strong support for the fact that experiential field visits enhance the performance of students. The authors showed that this experiential approach to learning, yields actual improvements in students' thinking, what they remember, and their interest in a topic. However, the study was purely on experiential learning, but it wasn't linked to how VFTs could be harnessed to bring experiential learning experiences in teaching and learning.

In a Kenyan context, Kelfine et al. (2018) provides a clear picture of the impact of experiential learning on students' performance in geography. To collect their data, the researchers used a sample of 188 students and 162 geography teachers in Bungoma County. The study found that there was a statistically significant positive correlation between physical field trips and increased student learning, where the field trips were found to improve learning in a practical manner and make the students remember concepts better. Additionally, the researchers noted that experiential learning environment especially field activities enable students connect theory with application, contributing to involvement and academic achievement. However, the study revealed the major challenges, including a lack of funds and time, which make physical trips difficult to organize. The study explains explicitly that because of these impediments, the majority of teachers have resorted to Virtual Field Trips (VFTs) as a substitute. While this study confirms that real field trips are effective, it provides no data on the integration procedure within the experiential learning model, a gap that the current study seeks to fill.

2.4.4 The Relationship Between VFT use and Students' Academic Achievement

Evelpidou et al. (2021) explored the use of VFTs for indirect geomorphological experience among geomorphology students in the "National and Kapodistrian University of Athens (NKUA)" in Greece, Europe. The specific study purpose was to assess the VFTs usability as a replacement for in situ fieldwork and as a way to get ready for actual field excursions. Google earth, a digital tool that allows users to virtually visit and study the region's landforms and examine relationships to ancient man-made interventions (Alfatikh et al., 2020), was used to visualize this virtual field trip. Based on the remarks

of students and questionnaire responses, over 80% of the students felt that they received assistance in comprehending the foundational concepts of the geomorphology course. In addition, a post-field trip exercise and the course's final semester tests were used to further assess the students understanding of the concepts, and 80% of the students were able to provide accurate answers to the questions in the assessment test. Furthermore, despite the above positive academic findings, approximately 82% of the students who participated in the virtual field trip had never used google earth based VFT before Nevertheless, the current study intends to explore the link between teacher use of virtual field trips and student achievement which the current study seeks to find out.

In Indonesia and China, a study was done by Shadiev, Sintawati, & Yu (2022) about the role of VFTs in enhancing intercultural competence where they develop technology-assisted intercultural learning exercises. Ten Chinese students and ten Indonesian university students created videos on local customs and culture, which they then shared with partners to facilitate virtual field trips. The results of this research study were gathered using interviews, videos, and questionnaires as part of their mixed-method approach. In accordance with results obtained, students showed improvement in intercultural competence since analysis revealed a significant difference in intercultural competence between the participant's pretest and posttest questionnaires. Through the learning activities, the participants gained and acquired cultural information, and they reported feeling more curious and prepared to learn about various cultures. Their ability to spot commonalities and advance customs and culture while interacting with their partners in real time was enhanced. In terms of cultural knowledge, the questionnaire asked the respondents to self-report their cultural knowledge. The findings indicated that the participants' cultural understanding had significantly increased due to exposure through partner's VFTs in the intercultural learning exercise. Nevertheless, study focused purely on the university students. The current study will investigate the relationship between teacher's use of VFTs and secondary school geography students' performance in geomorphology.

In Nigeria, Hope et al. (2021) conducted an investigation whose objective was to evaluate how effective VFTs are in terms of academic achievement among senior secondary

school Chemistry students. Quasi experimental design was adopted and 86 students were selected using the multi-staged sampling technique to participate in the investigation. Their findings manifested a significant dissimilarity in academic performance between learners exposed to instructions that incorporated VFT and a control group whose instructional approach was purely conventional. Those taught using VFT instructions obtained higher post-treatment scores of 77.30 as compared to their counterparts who achieved 59.67 post-treatment score. This study employed quasi experimental design to investigate the effectiveness of VFTs in chemistry at the senior secondary level. However, the current study seeks to employ the correlational design to establish the link between the use of VFTs and the student's academic achievement in geography.

This result concurs with the findings of a study by Lawal (2023) that aimed at comparing the effectiveness of VFTs with actual traditional field trips in terms of student's academic performance and their respective levels of motivation. Sample of eighty-one male and thirty-nine female biology students were randomly selected to represent the entire population of 357 students in Nigerian Certificate in Education (N.C.E) program. The results of the experimental group post-test indicated a higher mean score for learners exposed to VFTs than their counterparts exposed to actual traditional trips. Those taught using VFTs posted a mean score of 25.13 while those instructed using the traditional field trips achieved a mean score of 23.08 implying a difference of 2.05 that was in favor of students instructed using VFTs. This study focused on the cause-and-effect approach whereas the current study will focus on relationship between teacher's use of VFTs and students' academic achievement.

Mutabari et al. (2024) studied the effect of VFTs on history and government students' performance in Murang'a County. A sample size of 372 participants who comprised both the history and government teachers and students at the secondary school level was selected. Analysis of the results showed the scores for the treatment group (M=10.76, SD=1.49) and control group (M=7.70, SD=1.73) differed significantly. According to Mutabari et al. (2024), these findings imply that instructions, with or without VFTs, had an impact on students' academic achievement. The study however, did not explore how the use of these VFTs is related to how students perform in a normal learning situation.

However, this study focused on history subject while the current one is in geography. Since both subjects are social sciences, this study will examine whether the findings align.

2.4.5 Factors that Influence Teachers' Integration of VFTs.

Leininger-Frézal and Sprenger (2022) examined determinants influencing integration of Virtual Field Trips (VFTs) in geography education by teachers in binational teacher training institutions in France and Germany. It was seen that there were various supporting factors that facilitated integration, i.e., access to far-off or restricted locations, flexibility of use within constrained teaching time, and the ability of VFTs to facilitate digital literacy and inclusion of students with mobility or health complications. Teachers valued VFTs for their interactivity, motivational value, and compatibility with Education for Sustainable Development (ESD) goals. Integration was hampered by technical constraints, including sparse digital devices and slow network connectivity; insufficient teacher training in digital resources; impaired authenticity and sensory engagement compared to real fieldwork; and low motivation in students to engage when activities were uninteractive or ambiguous. Overall, the study set out that successful integration of VFTs relies on teachers' preparedness for computer-mediated learning, school administration support, and pedagogical conceptualization of VFTs so as to balance technological and experiential learning elements equally.

In recent research by Ogbu (2025) in Nigeria, 322 teachers from public secondary schools participated in a correlational study that modelled some teacher characteristics related to math teachers' successful use of ICT in the classroom. According to the findings of the study, secondary school math teachers use of ICT in classroom teaching is significantly impacted by, their desire for it, their attitude towards it as well as their level of self-efficacy. Furthermore, the link between teachers' use of ICT facilities in mathematics instructions and their access to ICT resources was significantly mediated with an indirect effect by teachers ICT attitudes that influenced how well they could deliver using ICT. This study however focused entirely on ICT. Therefore, the current study will conduct investigation to see whether the teacher factors influencing ICT integration discussed here align with VFTs.

Similarly, Abedi et al (2024) studied teachers' beliefs on integration of technology in teaching practices. In this Qualitative research, 20 public school instructors, 5 district education officers and 5 headteachers in two district schools in Ghana were selected to participate in the investigation. The study suggested that teacher's knowledge and abilities must be developed in connection with the development of their pre-existing values in order for them to implement relevant pedagogies using the current technology. According to the participants, educators used technology to boost engagement, spark interest among learners and simplify learning. As noted in the study findings, teachers mentioned that technology utilization also allowed introducing real-world experiences into classroom. Additionally, the researcher reports that teachers use of technology is crucial in enhancing curriculum practices and supporting the new learning methods. This finding aligned with the main themes of Ghana's basic school curriculum and ICT in education policy, that instructs teachers to use technology as a pedagogical tool to support student centered instruction and engage students in authentic learning (MoE, 2018). The current study intends to examine whether the same factors discussed in this study also apply to geography teachers in Murang'a east.

In Kenya, a study done in Rachuonyo South sub-county by Otieno (2022). The study goals were to determine the degree to which teachers' ICT literacy, pedagogy, attitudes, and the creation of geography student assessments affect the use of ICT in secondary schools' geography instructions. Both descriptive and correlational research designs were used in the research study, directed to form four learners, geography teachers and school principals. As indicated in the finding section of the study, the degree of ICT literacy of the instructors, pedagogy of teachers and instructors' attitudes have significant effect on how ICT is integrated in geography lessons by teachers. 100% of the geography teachers agreed that using ICT in the classroom can aid learners in comprehending abstract geographic material. In addition, the finding report that teachers could take an ICT training course to improve their abilities if given the chance. The current study explores how teacher motivation and ICT skills influence VFTs integration particularly in geomorphology topics.

2.4.6 Summary of the Gaps Existing in the Literature

From the reviewed literature, several studies have explored VFTs use as well as ICT integration. From these studies, several gaps have been identified that actually necessitate the need for the current research. For instance, Foley (2022) examined the awareness of VFT among professors of geoscience in the U.S but his study did not provide information on long-term adoption rates in secondary school geography. Chen and Zhang (2023) showed that VFTs are more common in science curricula and among adolescent students. Yet, little is known about the extent of their adoption in Kenyan secondary schools, particularly in geography.

Globally, scholars such as Cheng (2021), Chen and Tsai (2019), and Parmaxi et al. (2021) concentrated on pedagogical strategies and experiential learning in VFT implementation. However, the researchers did not investigate how teachers apply Kolb's experiential learning model in its entirety, something this research seeks to accomplish. In Kenya, Kelfine et al. (2018) also confirmed the positive role of physical field trips but provided. Nevertheless, Kelfne et al (2018) did not explore how teacher use VFTs to bring experiential learning.

VFTs have been linked to increased students' performance in university education and in sciences (Evelpidou et al. 2021; Hope et al. 2021, and Lawal 2023), but less known is whether such is true for secondary school-level geography in Kenya. Somewhat fewer studies have also aimed at establishing the link between teacher utilization of VFTs and student performance. For instance, Mnisi et al. (2024) considered ICT integration in South Africa but not VFTs use by teachers and how these correlates to students' performance. Mutabari et al. (2024) explored VFTs in history education but not geography teacher practice or associate VFT practices with students' achievement.

In addition, teacher-centered factors influencing technology integration have been broadly investigated, as seen in Ho (2020), Ogbu (2025), and Abedi et al. (2024). These scholars identified ICT competence, motivation, self-efficacy, and access to resources as influential. However, they did not clearly relate these factors to geography teachers' utilization of VFTs. In the Kenyan context, Otieno (2022) confirmed ICT literacy,

pedagogy, and attitudes as being significant in geography education but made no reference to motivation or ICT skills in relation to VFTs, specifically in geography education.

Therefore, the literature covered shows that while VFTs have been studied both across disciplines and contexts, gaps are present in relation to their extent of utilization, integration in experiential learning models, effect on students' academic achievement in geography, and the role of teacher-related factors within the context of Kenyan secondary schools. These gaps justify the current research that seeks to examine the use of VFTs by geography teachers in Murang'a East, guided by the experiential learning model, and their relationship with students' achievement in geomorphology.

2.5 Chapter Summary

This chapter reviewed literature related to teachers' implementation of VFTs and students' achievement in geomorphology. It covered the theoretical framework and conceptual framework guiding the study. The chapter also covered empirical review of literature in line with the study objectives, focusing on extent of use of VFTs by geography teachers, their implementation through experiential learning, teachers' use of VFTs and its relationship with student performance in geomorphology and factors influencing VFTs integration. The reviewed literature identified gaps that justified the need for the current study in secondary schools in Murang'a East Sub-county.

CHAPTER THREE
METHODOLOGY

3.1 Introduction

This chapter explains the methodology that forms the basis of this research study. Basically, it presents a detailed and systematic proposal for investigating the use of Virtual Field Trips (VFTs) by teachers and how it is related to academic performance of students in geomorphology in Murang'a East Sub-County. The decisions mentioned in this chapter aims to ensure the data collected is reliable and valid for addressing the research questions set out in Chapter One. The research design, the study setting, target population, sampling methods, instrumentation, data collection procedures, the data analysis procedures and ethical issues are discussed in this chapter.

3.2 Research Philosophy

The current study was underpinned by the pragmatist research philosophy, which emphasizes the significance of the research problem and the applicability of the results over any methodological belief. Pragmatism encourages researchers to use different types of methods, including both quantitative and qualitative methods, implying that the methodology should be chosen according to its efficiency (Morgan, 2014). From this perspective, mixed methods allow integrating numerical indicators and contextual considerations into a comprehensive analysis of an educational phenomenon (Timans et al., 2019).

For the present research, the adoption of a pragmatist philosophy allowed investigating the correlation between the implementation of virtual field trips (VFTs) by teachers and academic achievements among students quantitatively while concurrently analyzing the experiences of teachers and teaching practices qualitatively. The pragmatic research approach helped focus on 'what works' to resolve the research issues, thus providing credible and practical answers regarding enhancing geography education (Kaushik & Walsh, 2019).

3.3 Research Methodology

The study adopted a mixed methods research approach anchored on a descriptive correlation design. Mixed methods allow integration of both quantitative and qualitative data within a single study to provide a more comprehensive understanding of the research problem (Creswell & Plano Clark 2023). The quantitative component utilized the descriptive correlational design to determine the strength and direction of the relationship between teachers' use of VFTs and student academic achievement. On the other hand, the qualitative component involved open-ended responses to capture teachers' instructional experiences with data analyzed thematically to complement quantitative findings. This integration enhances validity by triangulating evidence from multiple sources (Makwana et al., 2023).

3.4 Research Design

A research design is a strategic research plan for conducting research in an ordered, rational manner to effectively address the research problem, as defined by Kumar (2018). Patten & Newhart (2018) went a step further by stating that research design provides guidance regarding sampling method, data collection process and data analysis procedures. This research study used a descriptive correlational design. According to Andrei Aprecia et al. (2022), in descriptive correlational design, the variables are described and the strength of the association between and among the variables is measured. Additionally, by using this correlational design, researchers portray phenomena as they occur in their natural context and give an estimate of the strength and direction of association between variables (Omariba, 2023). This choice was meant to record the state of practice, which is the teachers' use of VFTs. Also, correlational design helped explore the relationships between the teacher practice and students' geomorphology academic performance without any intervention.

3.5 Locale of the Study

Gay (1992) asserts that research may encompass any geographic location as far as the area presents characteristics and conditions relevant to the objective. The study was therefore conducted in Murang'a East sub-county which is one of the administrative units in Murang'a county, central region of Kenya. This sub-county is predominantly rural, and is characterized by hilly and dissected landscape (Maina, 2024) as well as agricultural landscape. Murang'a East Sub-County hosts geomorphological features and processes that presents both opportunities and challenges. This Physical terrain offers rich case material for the learning of geomorphology while at the same time offers logistical and accessibility constraints to conducting a physical field trip. Besides, there are a mix of peri-urban and rural schools in Murang'a East sub-county and thus offers a mixed socio-economic setting that may likely influence the access and utilization of technology.

According to Creswell and Plano Clark (2023), studies conducted in specific locales can generate insights which are contextually grounded and still allow replication in different environment as long as the methodology is maintained. Therefore, across comparable rural and peri-urban contexts the study findings also contribute to the broader debates on integration of VFTs into secondary geography education.

3.6 Target Population

The target population according to Omariba (2023), is the total group on whom a study finding is to be generalized. Similarly, it is the group that the researcher is interested in and wants to investigate Omariba (2023). The target population of this study was 4,950 boys and 4,108 girls in 33 secondary schools in Murang'a East Sub-County. Additionally, the study targets 537 secondary school teachers within Murang'a East sub-county.

Table 3.1: Distribution of the target population

S/N	Name of School	Category	2025 Student Enrolment		Teachers
			Boys	Girls	
1	SCH1	Secondary	49	35	9
2	SCH2	Secondary	121	120	17
3	SCH3	Secondary	66	41	9
4	SCH4	Secondary	43	33	6
5	SCH5	Secondary	174	130	16
6	SCH6	Secondary	0	214	16
7	SCH7	Secondary	71	50	10
8	SCH8	Secondary	48	30	8
9	SCH9	Secondary	200	159	14
10	SCH10	Secondary	84	77	12
11	SCH11	Secondary	304	289	28
12	SCH12	Secondary	153	118	20
13	SCH13	Secondary	0	502	26
14	SCH14	Secondary	65	33	8
15	SCH15	Secondary	329	-	22
16	SCH16	Secondary	200	195	19
17	SCH17	Secondary	107	102	13
18	SCH18	Secondary	190	135	17

19	SCH19	Secondary	103	93	14
20	SCH20	Secondary	0	1015	63
21	SCH21	Secondary	50	46	9
22	SCH22	Secondary	114	128	10
23	SCH23	Secondary	114	82	9
24	SCH24	Secondary	86	56	11
25	SCH25	Secondary	37	28	8
26	SCH26	Secondary	81	65	8
27	SCH27	Secondary	102	69	8
28	SCH28	Secondary	69	61	11
29	SCH29	Secondary	28	30	9
30	SCH30	Secondary	1783	0	84
31	SCH31	Secondary	29	42	7
32	SCH32	secondary	72	74	8
33	SCH33	secondary	78	56	8
TOTAL			**4,950**	**4,108**	**537**

Source: (Murang'a East Sub-County Education Office, 2025)

3.7 Sampling

Sampling is the process of selecting a subset of a specific population that can be used in research to represent the entire population. It is the total number of observers or participants (Creswell & Plano Clark 2023). This research study used multi-staged

sampling design to obtain a sample of secondary schools, teachers and students that will represent the target population.

3.7.1 Sampling Techniques

These are methods used to identify the representative subset of the entire target population (Omariba, 2023). Below are the sampling techniques that were employed in this research study.

3.7.1.1 Purposive Sampling

It entails choosing a sample based on the researcher's convenience (Lohr, 2021). This study used purposive sampling to select 10 secondary schools from the 33 secondary schools in Murang'a East Sub- County. The reason for using purposive sampling was because it allows the researcher to deliberately select schools that best represent the target population (Creswell & Creswell, 2017). Therefore, the schools were selected to ensure balance of categories in terms of gender and school level. Such balance is important in ensuring that the sample is representative of the actual distribution of school types in the sub-county. Moreover, according to Mugenda and Mugenda (2019), purposive sampling based on the criteria help increase validity of the findings since the sample reflect the actual diversity of the study population.

In addition, the researcher used purposive sampling to select geography teachers handling selected form three streams. These two choices allowed correlation between specific teacher's method of integrating VFTs and their own students' performance as recommended by Creswell and Creswell (2017).

3.7.1.2 Proportionate Sampling Technique

Proportionate sampling technique was used to determine the sample size for each of the 10 selected schools. The total student enrollment in the 10 selected school is 3982. Yamane's (1967) formulae at 95% confidence level and 5% margin error were applied to calculate the total sample size 'n'. The total sample size will then be distributed proportionately among the ten secondary schools:

Sample size $n = \frac{N}{1+N(e)^2}$ where N=3982 and e=0.05

$n = \frac{3982}{1+3982(0.05)^2}$

n=364

Thus, the sample size is 364 students

Each school share noted by "nh" was determined by;

$nh = \frac{Nh}{N} \times$ n, where Nh =Enrollment of each school, N=3982 (total enrollment in the ten selected schools), n=364 (sample size).

Table 3.2: Proportionate distribution of sample size to ten selected secondary schools in Murang'a East subcounty

School	Students' enrollment (Nh)	Proportion (Nh/N)	Sample (nh)
1.SCH 1	502	0.1261	46
2.SCH 2	1783	0.4477	163
3.SCH 3	325	0.0816	30
4.SCH 4	171	0.0429	16
5.SCH 5	107	0.069	10
6.SCH 6	121	0.0304	11
7.SCH 7	271	0.0681	25
8.SCH 8	209	0.0525	19
9.SCH 9	134	0.0337	12
10.SCH 10	359	0.0901	32
TOTAL	**3,982**	**1.00**	**364**

Source: (Murang'a East Sub-County Education Office, 2025)

According to Makwana et al. (2023), this type of sampling technique ensures that the sample is distributed proportionately to the size of each school enrollment. This ensures representativeness.

3.7.1.3 Stratified Sampling

Stratified sampling involves dividing the entire population into sub-groups that share common characteristics (Omariba, 2023). All classes were split into strata and stratified sampling was used to select the form three stratum in all the ten secondary schools selected. The reason behind this choice is that, most of the topics under geomorphological processes are taught at form three level. Furthermore, purposive stratified sampling was used to select form three geography class since they are the subjects of concern in this research.

3.7.1.4 Census Sampling of Teachers

Since geography teacher population in the ten schools is small, census sampling technique will be used (Omariba, 2023). All the form three geography teachers in each selected stream within the 10 secondary schools were selected to participate in the research study. This choice was made to accurately correlate a teacher's specific instructional method with the performance of their own students (Creswell & Creswell, 2017).

3.7.1.5 Simple Random Sampling

To grant every form three geography student an equal opportunity to participate in this study, a simple random sampling will be done in every geography class to obtain the specific student participants. This is justified by Omariba (2023) who suggested that simple random sampling provides a fair ground to all prospective research participants, by giving them an equal chance to be selected. Class attendance register was used as a sampling frame to select these participants randomly.

3.7.2 Sample Size

Sample size is the exact number of participants or subjects that represent the whole population under study (Berndt, 2020; Omariba, 2023). The sample size is usually represented by 'n' and it affects the accuracy and the ability to draw inferences from the data collected (Besekar Jogdand,&Naqvi, 2023).

Table 3.3: Sample size showing the teacher and student sample distribution in selected schools.

School	School gender	Student Sample	Teacher sample (form three teachers)
1.SCH 1	Girls	46	1
2.SCH 2	Boys	163	2
3.SCH 3	Mixed	30	1
4.SCH 4	Girls	16	1
5.SCH 5	Mixed	10	1
6.SCH 6	Mixed	11	1
7.SCH 7	Mixed	25	1
8.SCH8	Mixed	19	1
9.SCH 9	Mixed	12	1
10.SCH 10	Mixed	32	1
TOTAL		**364**	**11**

Using Yamane's (1967) formulae, the students sample size was 364. In addition, all 11 form three geography teachers in the ten selected secondary schools participated in this study.

3.7.3 Sampling Procedure

The entire target population of 9,058 students and 537 teachers was large to be studied in detail. Therefore, the researcher selected a representative sample across gender and school levels. The researcher selected a sample that was representative to enhance the likelihood that findings would reflect the characteristics of the wider population. This is justified by Creswell & Creswell, (2017) who suggested that a sample can be selected to represent a population and the findings from the sample can be generalized to represent the entire target population within reasonable limits.

Purposive sampling was applied in the selection of 10 secondary schools in Murang'a East. The researcher applied Yamane's formula to get the total student sample size in the selected schools. Thereafter, the 364 students sample obtained was distributed among the 10 schools proportionately depending on the school enrolment. Stratified sampling was

then used to select form three geography class from each school. Afterwards, specific student participants in every selected geography class were randomly chosen. Simple random sampling was employed because it gives every student an equal and independent chance of being chosen as suggested by Omariba (2023). For the teachers, the study population in the 10 selected schools was relatively small. Therefore, the researcher used census sampling by including all the Form Three geography teachers in the 10 schools. In schools with more than one form three geography stream, each steam with its own geography teacher was treated as a standalone unit. This allowed each teacher to contribute data and enable direct matching of teacher practices with pupil performance.

In summary, the study's participants were 364 students and 11 teachers of geography.

3.8 Data Collection Instruments

Data collection instruments are tools used to gather intended information from the research participants (Creswell & Creswell, 2017). Three instruments were used to collect data. Each instrument had its own specific purpose to ensure a systematic process of data collection.

3.8.1 Teacher Questionnaire (TQ)

A list of questions reflecting the objectives of the study (Omariba, 2023) was used to gather data from geography teachers. Both close-ended and open-ended questionnaire items were administered to geography teachers. The purpose of administering questionnaire was to gather data on the extent of VFTs use by geography teachers, methods of VFTs integration and the teacher factors influencing integration of VFTs. As indicated in appendix I, Questionnaire was divided into sections addressing demographic information (item 1-5), familiarity with VFTs and usage rate (item 5-9), a section for measurement of teacher motivation, awareness, and self-perceived ICT competency (item 10), implementation of VFTs based on experiential learning model (item 11) and open-ended questions (item 12-14). Afterwards, the questionnaire was then administered to well guided geography teachers for filling in. Closed-ended items resulted in quantitative data, while open-ended resulted in qualitative data.

3.8.2 Classroom Observation Checklist (COC)

This is a tool used by researchers to record and track behaviors or actions as they happen in real time (Kothari, & Garg, 2019). The researcher used a Classroom Observation Checklist (COC). TPACK and experiential learning models provided theoretical foundations on which Likert-scaled COC were developed. This was designed to provide systematic, objective assessment of pedagogical practice used by teachers when implementing VFTs, allowing systematic investigation of how this is achieved in practice, rather than teacher self-report (Appendix I). The researcher was directly involved in the in-classroom observation to gather data on how teachers integrate VFTs. Both quantitative and qualitative data was collected.

3.8.3 Student Performance Record Sheet

Finally, for each of the 364 students in the sample, the researcher used the Student Performance Record Sheet to anonymously record their scores in geomorphology tests for one term. These students' scores in geomorphology allowed the establishment of the magnitude of relationship between teachers' use of VFTs and students' performance. (Refer to Appendix I)

3.9 Piloting

Piloting is pretesting the research instruments before conducting the main study. Piloting is used to identify errors, ambiguous questions, and organizational issues (Creswell & Creswell, 2017). In addition, pilot also checks that instruments are valid and reliable (Lohr, 2021).

In this study, the pilot was carried out in two secondary schools that were not part of the main study. 40 students and their respective geography teachers were chosen as a pilot sample. The purpose of piloting is to test the questionnaire and observation checklist (Omariba, 2023). Later, the research experts evaluated the instruments in terms of content and clarity. Their feedback was used to fine-tune the items. This was conducted to ensure content validity. Pilot data was used in comparison to test reliability. Cronbach's alpha was used for questionnaires, and a value greater than 0.70 was accepted (Barbera, Naibert, Komperda, & Pentecost, 2020).

3.9.1 Validity of the Research Instruments

The ability of data collection tools to measure accurately what they are intended to measure is called validity (Omariba, 2023).

3.9.1.1 Content Validity.

The extent to which items of the instrument measure the intended item to be measured (Omariba, 2023), was established through expert judgment. The university supervisors were consulted to scrutinize the items. This therefore ensured that the content in the instruments is relevant and clear to accurately respond to the raised research questions. In addition, the data collection instruments were developed based on the existing literature and the theoretical frameworks to ensure exactness in tools content.

3.9.1.2 Construct Validity

This type of validity was estimated by aligning the items in data collection tools with the theoretical frameworks, both TPACK (Mishra & Koehler, 2006) and experiential learning model (Kolb, 1984). This alignment with the theoretical frameworks ensured the tools measure the intended concept around teacher's extent of VFTs integration, the pedagogy of implementation and student scores in geomorphology.

3.9.1.3 Criterion Validity

Criterion validity was enhanced through the comparison of teacher questionnaire responses with the classroom observation checklist entries. Consistency between questionnaire responses, classroom observations and student performance provided evidence that the research instruments measured the implementation of VFTs and its relationship to student performance.

3.9.2 Reliability

Consistency of an instrument in giving results (Omariba, 2023) was estimated through pilot testing in two secondary schools outside Murang'a East sub-county. The two secondary schools selected were not among the sampled schools but had shared characteristics. Using SPSS version 25, the results of pilot testing were analyzed using the Cronbach's Alpha coefficient. Teacher questionnaire yielded a coefficient of 0.782 which is beyond threshold for good reliability and the established standard within

educational and social science research (Makwana et al., 2023). These results indicated that the questionnaires and classroom observation checklist had satisfactory internal consistency and therefore they were considered for data collection.

3.10 Data Collection Procedures

Data collection procedures entail a clear operational requirement for gathering credible and ethical data. Effective protocols encompass approvals, calendars, training, materials, and data security plans (Omariba,2023).

After getting permission from the university, NACOSTI and Ministry of education in Murang'a county, the researcher proceeded for data collection. The researcher visited the sampled schools to obtain permission from the school principals and create rapport with the form three geography teachers. Data collection date was set depending on the availability of the teachers and students.

3.10.1 Teacher Questionnaires

The researcher made arrangement with the form three teachers on when to collect distribute the questionnaires. Participating teachers signed consent forms during the actual days of data collection. Following the provision of access and informed consent from teachers, questionnaires were personally administered by the researcher. Researcher's direct participation in fact allowed for items explanation, and good instrument return rate. The filled questionnaires were later collected, labelled and coded.

3.10.2 Classroom Observation

Date and time for classroom observations were well set and arrangement made with the form three geography teachers. Before the commencement of observation session, assent forms were distributed among participating students by the researcher without the help of the teacher to avoid teacher's influence. The filled assent forms were later collected, and student participants who had accepted to participate were engaged. The researcher with the help of experienced research assistants went to class to observe how geography teachers used VFTs. The guiding checklist developed based on the four stages of experiential learning model was used as an observation rubric during classroom

observations. Fully filled observation checklists were later labeled and coded ready for analysis.

3.10.3 Student Scores

For every observed geography teacher, his/her students' scores were collected to easily establish the relationships. Learners' whose geomorphology scores were to be collected were randomly selected to provide an equal opportunity to all student participants. Scores on two standard tests on external land forming processes were collected. The average score was obtained and used as the final student score.

3.11 Data Analysis and Presentation

After the completion of the data collection exercise, all questionnaires, observation checklists and student score sheets were checked for completeness and accuracy. The data were then coded and cleaned to eliminate errors. Afterwards, the data were then entered into the Statistical Package for Social Sciences (SPSS) version 25.0 for analysis.

The quantitative data were analyzed using both descriptive and inferential statistics. Descriptive statistics including frequencies, percentages, mean and standard deviations were used to summarize the data on teachers' implementation of VFTs and the factors influencing their use in teaching geomorphology. The analyzed data were presented in tables and bar graphs for easy interpretation.

Data obtained from classroom observation checklist were analyzed descriptively by examining the classroom practices observed during the lessons. All observations made were organized according to the four stages of experiential leaning model.

To establish whether there is a relationship between teachers' implementation of VFTs and student performance in geomorphology, Pearson product moment correlation coefficient was computed. Simple linear regression analysis was further conducted to determine the extent to which teachers' implementation of VFTs predicted students' academic performance. Inferential statistics were performed at the 0.005 level of significance and the results were presented using appropriate statistical tables accompanied by interpretation.

3.12 Logistics and Ethical Considerations

According to Omariba (2023), these are post field logistics. After the instruments are collected, the researcher checked for completeness and labelled them using serial numbers. Afterwards, the responses were coded and safely stored both the hard copies and electronic data for analysis and for future reference.

3.12.1 Ethical Issue on Related Research

Ethics in research deals with moral values that guide the researcher when conducting a study (Omariba, 2023). The principles of honesty and intellectual property were held with utmost concern. Therefore, the researcher acknowledged other people's work by proper citation of their work. Furthermore, the researcher did not conduct the research for personal gains neither he had negative intentions to the lives of the participants.

3.12.2 Ethical issue on Research Subjects

The researcher was be given permission for data collection by Murang'a University of technology, NACOSTI, ministry of education Murang'a county and the school principals of the sampled schools prior to teacher and student engagement in the study. The study allowed the teachers and student to voluntarily participate in the study after being assured of confidentiality of the information they will provide. The researcher only asked questions related to the study.

During classroom observation sessions, the lessons continued as usual and the research and research assistants remained passive observers. In addition, the researcher and research assistants sat at the back to minimize attention. Disruptive activities such as photography were also avoided. Students who felt uncomfortable with observation were assured of freedom to opt out or change sitting positions.

To safeguard participants, anonymity and confidentiality was maintained by the use of codes instead of names on all research instruments. No name or admission number was used to avoid accidental disclosure of the participants details during reporting of findings. The code 'T0n' was used to represent teachers while 'S00n' used instead of student's name or admission number. 'SCH0n' was used to represent the schools. Electronic data was protected using the passwords only known by the researcher, while the hard copies

locked in researcher's private cabinet. The data will be stored until the end of the research study and then it will be safely destroyed.

When the research was completed, the researcher provided the participating schools with a short and non-technical description of the study findings. No names or identifying information was involved. The feedback highlighted what the results were and what practical suggestions may be helpful for improved use of Virtual Field Trips and the teaching of geomorphology.

Finally, the researcher hereby confirms that the principal investigator and research assistants involved in this study were enlightened on matters related to research ethics, child protection, and safeguarding principles. They fully understood their responsibility in ensuring safety, dignity, and well-being for all student participants throughout the process of this research.

3.13 Chapter Summary

This chapter presents the methodology used in the study. It described the research design, study area, target population, sampling procedures and sample size. It also explain the data collection instruments, their validity and reliability, data collection procedures and methods of data analysis. Ethical considerations observed during the study were also outlined in this chapter.

CHAPTER FOUR
RESULTS AND DISCUSSION

4.1 Introduction

Study findings, interpretations and respective result discussions are presented in this chapter in a systematic manner according to the specific objectives. Descriptive statistics were provided for objective one, two and four while inferential statistics were provided for objective three to bring out the relationship between teachers' use of VFTs and students' performance in geomorphology.

As noted earlier, the specific research objectives of this study are:

i. To determine the extent to which secondary school geography teachers in Murang'a east sub county use VFTs in teaching geomorphology.
ii. To investigate the strategies used by geography teachers to implement virtual field trips based the experiential learning model to enhance student achievement in geomorphology.
iii. To establish the relationship between teachers' use of VFTs and students' academic achievement in geomorphology.
iv. To explore the factors that influence the teachers' integration of VFTs in teaching geomorphology.

4.2 General and Demographic Information of the Participants

The researcher proceeded for data collection exercise in the ten selected secondary schools. Three data collection tools including teacher questionnaire, classroom observation checklist and student academic score sheets were used to collect data for this study. Teacher questionnaires were administered to all the form three geography teachers in the 10 selected schools. The researcher administered these questionnaires by himself to boost response rate and ensure they are filled correctly. As a result, there was a 100% response rate for teacher questionnaires. Classroom observation was purposively done in seven secondary schools that had integrated the use of VFTs and related technologies in their classroom instructions.

Finally, students' scores on two tests done in geomorphology, specifically "external land forming processes" were collected.

4.2.1 Students' Information

The study aimed to obtain performance records of 364 students in the ten sampled secondary schools but only 314 student records gave complete data, which is equivalent to a response rate of 86.3%. The reasons behind the shortfall were the students' absenteeism, incomplete records, and the fact that some schools had fewer geography students who had taken the tests as compared to what was expected. According to Cohen et al (2018), these limitations are common in school-based studies. Nevertheless, the sample was adequate to perform the analysis and provide credible correlation outcomes (Kothari, 2019). In addition, according to Mugenda and Mugenda (2019), a response rate of 70% and above is considered adequate for data analysis. Therefore, the response rate achieved in this study was considered sufficient to support reliable analysis of findings.

4.2.2 Teachers Background Information

A total of 11 census sampled form three geography teachers completed the questionnaire in the 10 selected secondary schools. This happened because one of the schools had two geography streams. Teacher background information was as presented in Table 4.1 and Figure 4.1.

Table 4.1: **Demographic Characteristics of Respondents (N = 11)**

Variable	Category	Frequency	Percentage (%)
Sex	Female	5	45.5
	Male	5	45.5
	Prefer not to say	1	9.1
Teaching Experience	0–5 years	1	9.1
	6–10 years	3	27.3
	Over 15 years	7	63.6
Qualification	Degree	7	63.6
	Diploma	4	36.4
ICT Training	Yes	7	63.6
	No	4	36.4
Awareness of VFTs	Yes	10	90.9
	No	1	9.1

Teachers were almost equally distributed by gender, with 45.5% female and 45.5% male while 9% preferred not to say. This indicates that both genders were fairly represented in the study. In terms of teaching experience, the majority of respondents (63.6%) had more than 15 years of teaching experience. Only 27.3% had between 6 and 10 years of experience, and 9.1% had less than 5 years. Regarding academic qualifications, most respondents (63.6%) held a degree, while 36.4% held a diploma. This shows that the participants were academically qualified to provide reliable responses. The results also show that 63.6% of the respondents had received ICT training, while 36.4% had not.

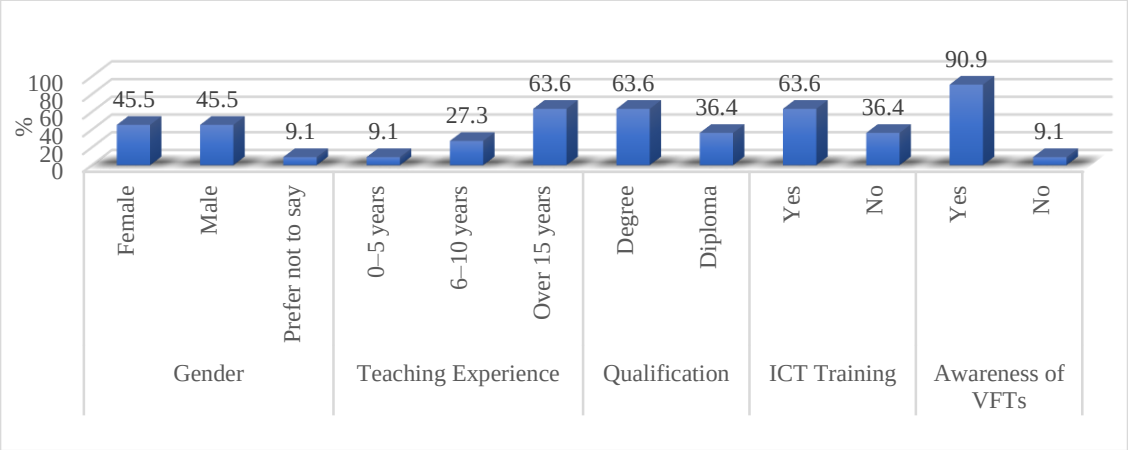


Figure 4. 1 :Distribution of Participants' Demographics

4.3 Results and Findings

4.3.1 Extent of Use of VFTs among Geography Teachers

One of the goals of this study was to establish the extent to which secondary school geography teachers in Murang'a East sub-county use Virtual Field Trips (VFT) in teaching geomorphology. According to Wolf et al. (2021), VFTs are online mediated instructional experiences that allow students to investigate real-world landscapes and environments by using visual media, such as videos, images, and simulations. In order to deal with this objective, the data were obtained through the teacher questionnaires and classroom observation checklists. At the analysis stage, descriptive statistical methods such as frequencies, percentages, means, and standard deviations were used. Descriptive statistics are especially effective when summarizing the patterns of practice in descriptive and correlational researches (Creswell & Plano Clark, 2023).

The results on extent of use of VFTs by form three geography teachers were as indicated in Table 4.2 and Figure 4.2.

Table 4.2: Teachers' Awareness and Use of VFTs (N = 11)

Variable	Category	Frequency	Percentage (%)
Awareness of VFTs	Yes	10	90.9
	No	1	9.1
Well informed about benefits if VFTs	Strongly Disagree	0	0.0
	Disagree	0	0.0
	Neutral	2	18.2
	Agree	4	36.4
	Strongly Agree	5	45.5
Know where to find VFTs	Strongly Disagree	1	9.1
	Disagree	1	9.1
	Neutral	1	9.1
	Agree	4	36.4
	Strongly Agree	4	36.4
Ever used VFTs	Yes	8	72.7
	No	3	27.3
Frequency of using VFTs	Never	3	27.3
	Rarely	1	9.1
	Sometimes	5	45.5
	Often	2	18.2
	Very often	0	0.0

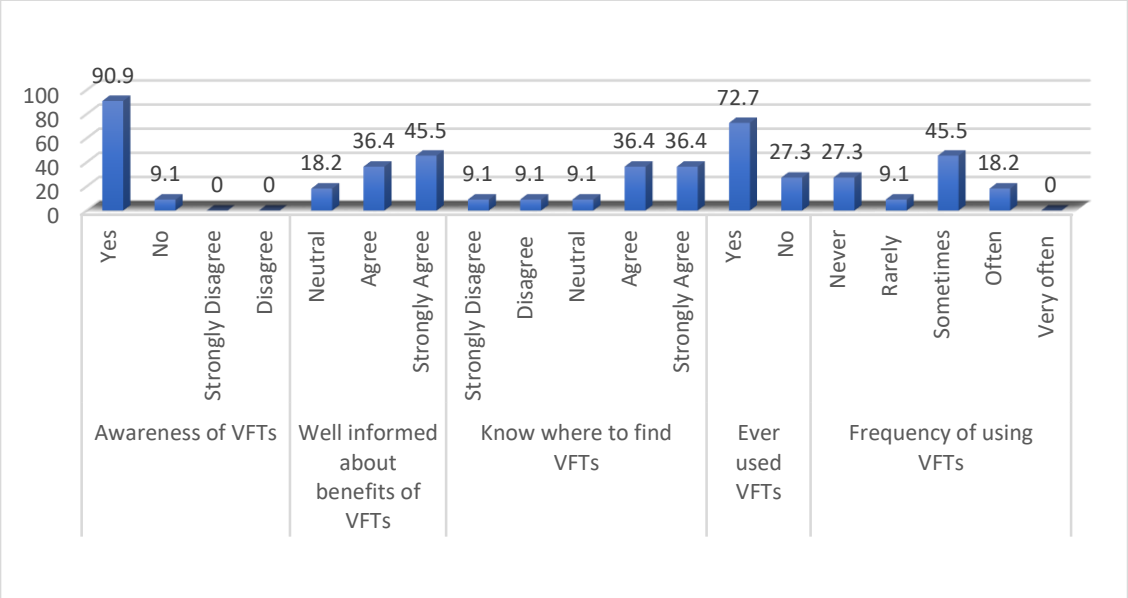


Figure 4.2: Teachers' Extent of VFTs Use

4.3.1.1 Teacher Awareness about VFTs

From Table 4.2 and Figure 4.2, the results show that Out of the 11 form three geography teachers sampled, 90.9% were aware of VFTs, while only 9.1% of them said they were not aware of them. This shows that a majority of geography teachers in the sampled schools had prior knowledge of VFTs.

Teacher awareness of VFTs was further examined using the teacher self-reported responses. These responses were measured in a five-point Likert scale ranging from 1(Strongly Disagree) to 5(Strongly Agree). Two statements were used at this level:

i) *"I feel well informed about the benefits of using VFTs in geography education"*
ii) *"I know where to find relevant VFT resources for my geomorphology lessons"*

The study established that majority of the teachers said they were well informed about the benefits of VFTs where 45.5% indicated that they strongly agree that they are aware of the benefits of VFTs and 36.4% agreed. This meant that most of the form three geography teachers understood the benefits of VFTs quite well. The findings also show that most teachers know where to find VFTs. About 36.4% of geography teachers agreed that they know where to find VFTs and another 36.4% strongly agreed. This

concurs with a study by Foley (2022), who stated that geoscience teachers in the United States had a significant level of awareness of Virtual Field Experiences and believed in their ability to supplement the instructional results

Further analysis showed that the questionnaire item *"I feel well informed about the benefits of using VFTs in geography education"* yielded a mean score of 4.27 with a standard deviation of 0.82 indicating that most of the teachers generally agreed that VFTs are beneficial for teaching geomorphology, with relatively little variation in their responses. On the other hand, the statement *"I know where to find relevant VFT resources for my geomorphology lessons"* the mean score was 3.82 with a standard deviation of 1.40. This suggests that teacher's familiarity with sources of VFT materials was moderate and varied considerably among respondents.

Table 4.3: Self-reported teacher awareness of VFTs

Awareness Statement	Mean	Standard Deviation (SD)
I'm Well informed about benefits of VFTs in geography	4.27	0.82
I know where to find VFT resources for geomorphology lessons	3.81	1.40
Overall awareness	**4.05**	**1.22**

Moreover, the current findings concur with a study by Mutabari et al. (2024) who found that only 50% of the teachers in their study were aware of VFTs use in the teaching of the history and government subject. As compared to that study, the present study revealed much more awareness in geography teachers with 90.9 percent of the teachers having familiarity. This is because of the disciplinary nature of geography that often requires the ability to visualize landscapes and physical processes that cannot be easily viewed in the traditional classroom environment (Evelpidou et al., 2022).

4.3.1.2 Use of VFTs by Geography Teachers in Teaching Geomorphology

Teachers were further asked whether they had ever used VFTs when teaching geomorphology topics. Out of the 11 geography teachers, 8 (72.7%) of them reported having used VFTs in their geomorphology lessons while 3(27.3%) of them indicated that they had never used VFTs. From these findings, the researcher noted that although a majority of the teachers reported to be aware of the VFTs, not all integrated them into their instructional practices. In addition, the study noted that, despite geography teachers recognizing the benefits of VFTs, real life limitations prevent the incorporation of these educational resources into daily teaching in some schools. The findings concur with the study by Chen and Zhang (2023) which established that although VFTs are widely recognized as efficient learning tools in K-12 curriculum, the application of these tools in classroom settings is still not consistent. Their systematic review established that the implementation of VFTs can be successful only when the teachers are prepared, resources are available, and their implementation is aligned with lesson goals.

4.3.1.3 Frequency of Use of VFTs in Teaching Geomorphology by Geography Teachers

Additionally, teachers that reported using VFTs were further asked how frequent they incorporated them into their geomorphology lessons. The frequency of their responses was as shown in Table 4.4.

Table 4.4: Frequency of VFTs use by geography teachers in Murang'a East

	Response	F.	%
Frequency of using VFTs	Never	3	27.3
	Rarely	1	9.1
	Sometimes	5	45.5
	Often	2	18.2
	Very often	0	0.0

Out of 11 geography teachers, 3(27.3%) had never used VFTs before, 1 (9.1%) of them reported using VFTs rarely while 45.5% used them sometimes. In addition, 18.2% of the geography teachers reported that they VFTs often and none of them used them very often.

The findings were subjected to further analysis and the findings indicated a mean frequency score of 2.2 with a SD=0.79 which indicates that on average, VFTs were incorporated between rarely and sometimes with moderate variation among users.

The gap between awareness and actual use was realized. This gap highlights that knowing about a tool does not automatically translate into actual pedagogical practice (Dong & Mertala, 2021). The study noted that, teachers may be aware and recognize the value of virtual excursions but struggle to fit them into already packed timetables or align them with learning objectives. This concurs with a study by Dong and Mertala (2021) which established that awareness of a technology does not guarantee actual application in teaching and learning.

4.3.1.4 Access to ICT Resources for VFTs

Moreover, an item in the questionnaire sought to establish access to the Information and Communication Technology (ICT) resources are a key factor in the implementation of VFTs to teach geomorphology (Leininger-, Frezal, and Sprenger, 2022). This item required teachers to mention the assets of ICT available in their respective secondary schools by choosing the most relevant answers on the questionnaire. The findings revealed that most of the sampled schools had basic infrastructural facilities of ICT able to sustain digital learning resources.

Table 4.5: ICT tools available in the selected secondary schools

ICT Tools	F	Percentage (%)
Computer	8	72.7
Projectors	8	72.7
Internet connectivity	3	27.3
Smart TVs	4	36.4
Virtual reality equipment	0	0

Computers and projectors were the most commonly mentioned tools each with 72.7% of the teachers reporting their use. 36.4% of the respondents reported the availability of at least one smart television in their ICT laboratories meant to deliver digital contents and

27.3% reported that they had internet connectivity, however some teachers noted that quality was inconsistent.

Based on the findings, despite the presence of the basic ICT tools in secondary schools, more advanced technologies that could enhance the quality of VFTs were largely lacking. No school reported to be using the virtual reality simulations equipment. Thus, the use of VFTs was mainly limited to video-based VFTs, imagery and map-based experiences. The presence of computers, projectors, internet access and smart TVs helped explain why some teachers reported using VFTs. These findings are consistent with the research findings by Mnisi et al. (2024) who found that teachers in South African secondary schools could use simple ICT-based methods like laptops and smartboards in classroom teaching in spite of poor internet access and inadequacy of other ICT tools.

4.3.1.5 Digital Tools and Platforms Used for VFTs

A total of 8 geography teachers reported using VFTs. They were asked to indicate the specific digital platforms they use. The data in Table 4.6 was obtained from teacher questionnaire and supported by evidence from classroom observation checklist.

Table 4.6: Platforms used for VFTs in geomorphology lessons

Data collection tool	Platform	F	Percentage (%)
Questionnaires (All 11 teachers)	YouTube videos	6	54.5
	Google earth	3	27.3
	3600 videos	0	0
	Virtual reality simulations	0	0
	Others (offline videos in flash discs and CDs)	3	27.3
Classroom observation (8-observed lessons)	YouTube videos	6	75
	Google earth	2	25

The questionnaire findings showed that teachers used various platforms for VFTs in geomorphology lessons. YouTube videos 54.5%, were the most commonly used platform

by teachers. Google earth 27.3% was used by less than half of the teachers. None of the teachers reported to be using 360^0 videos and virtual reality simulations whereas 27.3% indicated that they used offline Videos saved in flash disks and compact discs (CD). Furthermore, classroom observation findings showed that 75% of the observed lessons involved the use of YouTube videos while Google earth was observed in 25% of the lessons where teachers zoomed specific landforms such as river valleys.

The study concluded that teachers mainly used easily available digital platforms, especially YouTube. The heavy reliance on YouTube also implies that the VFTs are mainly used as a supplement in the form of videos and not as an immersive as there was no use of virtual reality technologies at all. This finding also showed the use of the low-level technology, as described by Trust and Whalen (2021), where the technology was used mainly for the purpose of presentation and not for any pedagogical change. This finding was consistent with the findings of a study by Otieno (2022) who found that teachers lack access to quality and adequate ICT tools to use in teaching and learning.

4.3.2 Teachers' Implementation of Virtual Field Trips Guided by the Experiential Learning Model

Further, objective two aimed at determining the ways in which geography teachers actually use Virtual Field Trips (VFTs) in the delivery of geomorphology lessons. Analysis of the data was guided by the Experiential Learning Model by Kolb (1984), which describes the process of effective learning in four phases: the learner has to experience, reflects on the experience, connects the experience to theory, and then applies the learning.

An item in the questionnaire set out to establish whether the teachers actually planned VFTs in a manner that covered the four phases of the experiential learning model. Data was collected from Section D of the Teacher Questionnaire and the Classroom Observation Checklist. The questionnaire provided information from the teachers' perspective, while the observation checklist provided information from the observed situation. Descriptive statistics were used in the analysis of the data.

4.3.2.1 Stage 1: Concrete Experience

The study sought to determine whether learners were actively involved in meaningful virtual experiences or whether they remain passive observers.

Questionnaire responses revealed that on a five-point scale (1=never to 5=very often), the item "*I provide learners with guiding questions during VFTs*" recorded a mean score of 3.4(with a SD=0.89). The results showed that, on average, teachers sometimes provided structured tasks to guide student interaction with the VFTs. Further, the item "*I ensure VFT is the central part of the lesson*" yielded a mean score of 3.1 (SD=1.02). This was a revelation of moderate integration of VFTs as a learning activity as shown in Table 4.7.

Table 4.7: Concrete experience practices by form three geography teachers (questionnaire responses)

ICT training	Mean	Standard Deviation (SD)
I Provide learners with guiding questions during VFTs	3.4	0.89
I ensure VFT is the central part of the lesson	3.1	1.02

Moreover, analysis was done based the classroom observations for triangulation (Omariba, 2023) to provide a clearer picture of what actually happened during lessons. Classroom observation was done in eight geography lessons as shown in Table 4.8.

Table 4.8: Observed Concrete experience practices by geography teachers

Concrete experience practices	Yes (n=8)	No (n=8)	Percentage Yes
Teacher facilitated direct VFT experience.	8	0	100
Teacher used VFTs to introduce geomorphological concepts.	5	3	62.5
Students actively explored the virtual environment.	3	5	37.5
VFT provided a realistic simulation of the real-world site.	7	1	87.5

The findings in table 4.8 show that in 5 lessons which was 62.5%, the VFT was specifically used to introduce a new geomorphology concept in accordance with the concrete experience stage of Kolb's experiential learning model whereas the VFTs were used to summarize the learned content in the remaining 3 lessons which was 37.5% where teachers displayed them at the summary stages of the lessons.

In terms of students exploring the virtual field trip actively, the study revealed that only 3 teachers which was 37.5% met this criterion whereas in the majority cases, 62.5%, students were passive viewers of the Virtual content. In addition, 7 lessons which is 87.5% used VFT content that provided realistic representations of geographical sites. Simple tools like Google earth, field work videos were used to simulate river valleys, escarpments, erosional features and other observed geomorphological features. These findings revealed that the visual authenticity of the learning materials remained of value despite the presence of basic ICT equipment. In contrast, the remaining 1 lesson which was 12.5%, the virtual material was not clear. The teacher played a short video that had low picture quality and did not show the landforms clearly. Students could see something related to the topic, but did not feel like a real field experience. This finding was consistent with results of a study by Alqudah and Khasawneh (2023) which revealed that active involvement of learners in learning activities was closely linked to better academic performance.

Additionally, the relatively high percentages for realistic VFT experiences 87.5% and direct facilitation showed commitment to enriching lesson or supplementing textbook descriptions. Hence, the lower percentages for student active exploration 37.5% revealed a structural limitation. According to Kolb's (1984), concrete experience involves active encounter. Therefore, in a context where learners were not able to individually manipulate digital tools, the experience now becomes more observational than exploratory. The study concluded that according to the experiential leaning model, this does not invalidate the experience but it reduces its depth. The finding confirmed the results by Cheng (2022) which established that active exploration of VFTs helped learners comprehend newly introduced learning material.

4.3.2.2 Stage 2: Reflective Observation

After the students have been exposed to an experience, they should be guided to reflect on what they have observed (Kolb's 1984).

The questionnaire findings revealed that, teachers reported a stronger pattern of reflective practice as compared to stage one.

Table 4.9: Reflective observation practices by form three geography teachers

Questionnaire item	Mean	Standard deviation (SD)
After VFT, I lead a whole-class discussion to share observations	3.9	0.74
I ask students to write a short summary about their virtual experience	2.8	0.91

An item in the questionnaire on "*after VFT, I lead a whole-class discussion to share observations*" yielded a mean score of 3.9(SD=0.74). This revealed that reflection through discussion was a common classroom practice among geography teachers whereas the item "*I ask students to write a short summary about their virtual experience*" resulted to a mean score of 2.8 with a SD=0.91, revealing that written reflection is less consistently used. This difference showed that reflection in the classrooms tend to be interactive and verbal rather than written. The findings contradict the findings by Sudirman et al. (2024) which revealed that in many educational institutions, reflective writing was intentionally fostered and deeply integrated into instruction as a vital reflective practice.

Further, for triangulation, Classroom observation checklist confirmed this pattern as shown in Table 4.10.

Table 4.10: Observed Reflective Observation practices by geography teachers

Reflective Observation	Yes (n=8)	No (n=8)	Percentage Yes
Teacher encouraged students to reflect on the VFT.	7	1	87.5
Teacher facilitated discussion about observations.	6	2	75
Students wrote down observations or feelings about the VFT.	3	5	37.5
Students were given opportunity to ask questions.	8	0	100

Unlike stage one, where active exploration was limited, stage two shows stronger engagement in classroom dialogue. Out of the 8 lessons observed, 7 lessons which is 87.5%, teachers encouraged students to reflect on VFTs. For instance, some teachers paused the video or Google earth projection and asked learners to describe features, identify processes and explain what they noticed. This finding revealed that reflection was learner centered. In 6 lessons which is 75%, teachers facilitated discussions about observations as a way of reflection. Further, the study established that weakness of this stage lied clearly in written reflection. Out of 8 lessons observed three lessons which is 37.5% required students to write down their reflection while in majority cases 62.5%, once the discussion ended, the lesson moved forward without students documenting their reflections. Finally, in 8 lessons which is 100% of the observed lessons, learners were given opportunities to ask questions concerning the VFTs they observed/watched. The study concluded that majority of the geography teachers mostly encourage learners to reflect through classroom discussions. The findings went contrary to the findings by Chen (2023) who reported that written reflection is commonly used as a central reflective strategy and not just as an occasional add on.

4.3.2.3 Stage 3: Abstract Conceptualization

As noted by Kolb's (1984), stage three of Experiential Learning model focuses on helping learners make sense of what they experienced by linking the experience to broader concepts or connecting it to the theory.

The findings through questionnaires showed that teachers sometimes linked the VFT content to theory.

Table 4.11: Conceptualization practices by form three geography teachers

Questionnaire item	Mean	Standard deviation (SD)
I explicitly link VFT content to geomorphology terms and concepts	3.3	0.95
I use the VFT to compare and contrast different geomorphological features	3.1	1.0

An item "*I explicitly link VFT content to geomorphology terms and concepts*" recorded a mean score of 3.3 with a SD=0.95. This revealed that teachers really tried to connect experience to concepts but this practice wasn't done on regular basis but averagely sometimes. Further, similar results were revealed on item "*I use the VFT to compare and contrast different geomorphological features*" which recorded an average mean of 3.1 with a SD=1.0. These findings revealed that comparison occur from time to time but less systematic across all lessons. The researcher noted that the implementation of 'conceptualization' stage of experiential learning model was average. The findings were consistent with findings by Sprenger (2025) which showed that VFTs can deepen conceptual understanding when designed appropriately, but in actual practice the actual linking of experience to theoretical concepts often varied.

Moreover, Classroom observation was then conducted to confirm the self-reported teacher practices concerning the implementation of stage three of the experiential learning model. The findings are summarized in Table 4.12.

Table 4.12: Observed abstract conceptualization practices by form three geography teachers

Reflective Observation	Yes (n=8)	No (n=8)	Percentage Yes
Teacher help students connect their virtual experience to broader geomorphological concepts.	5	3	62.5
Teacher linked the VFT content to the specific topic in the geomorphology topic.	5	3	62.5
Students were guided to form generalizations based on their observations.	2	6	25
Teacher uses VFT to explain abstract geographical processes.	5	3	62.5

Observation checklist revealed that 5 teachers which is 62.5% guided students to connect their virtual experiences to broader geomorphological concepts while 3 teachers which is 37.5% did not demonstrate this practice during observation. This meant that teachers did not always help students connect what they see during the VFT to the theory taught while some lessons students only described what they observed without any attempt to deeply think why it happens or probably what it means.

In addition, 5(62.5%) of the teachers observed, linked the VFT content to the specific geomorphology topic being taught. This revealed that majority of the teachers selected VFTs that aligns with the learning objectives whereas, 37.5% of the observed lessons did not demonstrate proper linkage with the lesson objectives. As noted during classroom observation, the video content was vague and not specific to the learning outcomes set for the lesson.

Further, the study revealed that only 2(25%) of the observed teachers encouraged students to synthesize ideas independently to form generalizations while the majority of the teachers 75% did not provide opportunities for learners to formulate generalization based on observations. This revealed that conceptualization was majorly teacher-centered with students receiving explanations instead of constructing their own understanding.

Moreover, 5(62.5%) of the teachers used VFTs to explain the abstract geographical processes like deposition. This showed that explanations of abstract processes were not consistently emphasized in all lessons. The study is consistent with the findings of Mishra & Jarvela (2022) which revealed that unless teachers design task to scaffold conceptual thinking, technology-mediated experiences often remain teacher centered with many students mostly observing rather than independently synthesizing.

4.3.2.4 Stage 4: Application

To acquire data on this section, the researcher requested geography teachers to self-report how often they assist learners apply the new knowledge learned through VFT. Questionnaire results were summarized in Table 4.13.

Table 4.13: Application practices by form three geography teachers

Questionnaire item	Mean	Standard deviation (SD)
I assign tasks that require students to use information from the VFT	3.8	0.96
I encourage students to use knowledge from the VFT to solve a problem or analyze a local geographical issue	2.9	0.97

The item "*I assign tasks that require students to use information from the VFT*" had a mean of 3.8(SD=0.96). This showed that geography teachers sometimes provided follow-up activities for students to apply the knowledge acquired. The second item "*I encourage students to use knowledge from the VFT to solve a problem or analyze a local geographical issue*" recorded a mean of 2.9(SD=0.97). This suggests that real-life application of knowledge was less frequent.

Classroom observation contradicted these findings as indicated in Table 4.14.

Table 4.14: Application practices by form three geography teachers

Application of knowledge gained	Yes (n=8)	No (n=8)	Percentage Yes
Teacher provided opportunities for students to apply VFT learning.	3	5	37.5
Students engaged in problem-solving activities related to the VFT	2	6	25
Students applied knowledge to a different but related scenario.	0	8	0
Lesson included activities reinforcing learning from the VFT	5	3	62.5

Classroom observation results in Table 4.14 showed that the fourth stage of experiential learning model was the least implemented stage. Out of the 8 observed geography lessons, 3 lessons which is 37.5% allowed students to apply their gained knowledge whereas 2 lessons which is 25% of the lessons engaged learners in problem-solving activities that relate to VFTs. None of the observed teachers helped students apply knowledge to a different but related scenario. The findings revealed limited application of knowledge to solving real world problems. In addition, activities reinforcing learning from the VFT were observed in 5 lessons which is 62.5%. These reinforcement activities included note-making and drawing diagrams.

There were fewer opportunities created by geography teachers to help students apply their acquired knowledge. The limited implementation of "application" stage of experiential cycle may be attributed to inadequate lesson time as forty minutes lesson may not be enough for students to apply their newly gained ideas in real-world issue such as controlling erosion. Furthermore, examination pressure may have contributed to limited implementation of stage four. This is because teachers focused on the content that is tested in classroom examination thereby failing to expose learners to real-world application of knowledge. The study therefore concluded that geography teachers rarely engage learners in knowledge application task that creates a barrier between theory and

application. The finding concurs with a study by Agyei & Voogt (2020) who established that assessment and curriculum pressure limits application tasks.

The findings in objective two concur with the study by Chen and Zhang (2023), who noted that VFTs reach an increased level of significance when they enable educators and learners to interact, and when learners interact with each other. Similarly, the use of guiding questions and instructions observed in the current study resonates with the argument by Cheng (2022), who pointed out that teachers usually combine VFTs with facilitating pedagogical techniques, including guided tasks and demonstrations, to improve the understanding of geographical concepts among learners.

Furthermore, findings revealed that students were rarely given a chance to explore the virtual environments on their own and to apply the knowledge gained to real-life situations. This implies that the experiential learning process was not realized in most of the lessons. Even though it is generally believed that experiential learning can enhance the knowledge base, retention and affective learning involvement of students, as pointed out by John and Dada (2025), the findings of this current study showed that application phase of experiential learning cycle was rarely practiced. These results are consistent with the findings by Kelfine et al. (2018), where the authors found that experiential geography teaching enables the connection between theory and the real-world, but practical barriers usually limit the full application of the methods within the classroom.

4.3.3 Correlation between Teachers use of VFTs and Student's Performance

Further, the study sought to establish the relationship between teacher's use of VFTs and students' performance in geomorphology. Teacher's use of VFTs was analyzed in terms of teacher's frequency of use of VFTs as well as the quality of their implementation as guided by Experiential learning Model. Therefore, Analysis of this section was done by comparing the frequency of VFTs use by geography teachers and level of implementation guided by experiential learning with the student's performance in geomorphology specifically external land forming processes topic.

4.3.3.1 Correlation between Teacher's Frequency of VFTs Use and Student's Performance

Pearson product-moment correlation and linear regression was used to quantify the degree to which teachers' frequency of use of VFTs is associated to students' academic performance across the ten sampled secondary schools.

During coding, frequency categories were assigned numerical values on a scale ranging from never (1) to very often (5). Table 19 presents the distribution of geography teachers by their reported VFTs frequency group alongside the number of students taught by teachers in each group.

Table 4.15: Distribution of Geography Teachers and Students by VFT Frequency Group

Frequency Score	Frequency Label	N (Teachers)	N (Students)	% of Students
1	Never	3	51	16.2%
2	Rarely	1	26	8.3%
3	Sometimes	5	161	51.3%
4	Often	2	76	24.2%
Total		**11**	**314**	**100%**

Frequency scores coded on a five point likert scale. No teacher reported using VFTs "very often"

Table 4.15 shows that majority of the students 51.3% were taught by teachers who sometimes used VFTs, while 24.2% were instructed by teachers who often used VFTs. In addition, 24.5% of students were taught by teachers who used VFTs rarely or never and represented a significant proportion of learners with limited exposure to VFTs.

To establish the relationship between teachers' frequency of VFTs use and individual student performance, a student level analysis was conducted using the individual score of all the 314 form three geography students. Each student score was paired with their own respective geography teacher's VFTs frequency score. Through this approach the researcher was able to link each student's academic outcome to frequency of VFTs use of their own teacher. Table 4.16 presents the descriptive statistics of individual student scores by teacher VFTs use frequency group.

Table 4.16: Descriptive Statistics of Individual Student Scores by Teacher VFT Frequency Group (n = 314)

Frequency Score	Frequency Label	N (Students)	Mean Score (%)	SD	Min	Max
1	Never	51	24.61	10.54	12	59
2	Rarely	26	19.31	4.51	13	30
3	Sometimes	161	52.61	15.76	16	98
4	Often	76	61.03	15.75	31	98
Total		**314**	**47.34**	**20.37**	**12**	**98**

The descriptive statistics in Table 4.16 revealed an upward trend in the mean scores as the teacher's reported frequency of VFTs use increased. Students whose teachers never used VFTs recorded a mean score of 24.61% (SD=10.54), while students whose teachers rarely used VFTs recorded a mean of 19.31% (SD=4.51), which was the lowest of all the groups. In contrast, students whose teachers sometimes used VFTs achieved a mean score of 52.61%(SD=15.76). In addition, those whose teachers often used VFTs recorded the highest mean score of 61.03% (SD=15.75). The overall, student mean score of 47.34% (20.37) falls below 50% mark underscoring the significance of frequency of teacher VFTs use. These findings were consistent with a study by Vandelli et al. (2024) who established that 90% of the students regularly exposed to structured virtual tours of geomorphological sites in Greece, Italy and Malta reported improved conceptualization of geomorphological concepts.

Pearson correlation was conducted and the result of the analysis at the student level were presented in Table 4.17.

Table 4.17: Pearson Correlation between Teachers' Frequency of VFTs Use and Individual Student Scores (n = 314)

		Frequency of VFTs Use	Individual Student Score
Frequency of VFTs Use	Pearson Correlation	1	.658**
	Sig. (2-tailed)		<.001
	N	314	314
Individual Student Score	Pearson Correlation	.658**	1
	Sig. (2-tailed)	<.001	
	N	314	314

***. Correlation is significant at the 0.01 level (2-tailed).*

A strong positive correlation was realized between teacher's frequency of VFTs use and individual student scores in geomorphology (r=.658, p<.001, n=314). This showed that students whose teachers used VFTs more frequently, achieved higher score in geomorphology. The finding was in agreement with the findings of Salman (2023) who found out that learners taught using VFTs achieved higher scores compared to those taught using traditional methods, confirming positive relationship between exposure to VFTs and student performance.

Further, a linear regression analysis was conducted to determine the predictive strength of teacher frequency of VFTs use on individual student performance. The result was presented in Table 4.18.

Table 4.18: Linear Regression Model Results: Frequency of VFTs Use Predicting Individual Student Score (n = 314)

Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	8.381	2.432		3.446	<.001
	Frequency of VFTs Use	13.745	0.891	.658	15.421	<.001

Model Summary: R = .658, R^2 = .433, Adjusted R^2 = .431, Std. Error of the Estimate = 15.371, F(1, 312) = 237.819, p < .001

Regression model explained 43.3% of the variance in individual student score in geomorphology (R^2 = .433; Adjusted R^2 = .431). In addition, the overall model was statistically significant (F (1, 312) =237.819<.001). From the table finding, the study concludes that for every one unit increase in their teacher's reported frequency of VFTs use, an individual student's geomorphology score was predicted to increase by approximately 13.745%.

To further confirm the student-level findings, a teacher-level Pearson correlation and linear regression were conducted using each teacher's VFTs frequency and their students weighted mean performance score. Since census sampling was applied to select all available form three geography teachers in the ten sampled schools, n=11 therefore represents the entire accessible teacher population. This justifies the use of correlation analysis at this level (Creswell & Plano 2023). The Pearson correlation results are presented in table4.19.

Table 4.19: Pearson correlation between teachers' frequency of VFTs use and weighted student mean score (n=11)

		Frequency of VFTs Use	**Weighted Student Mean Score**
Frequency of VFTs Use	Pearson Correlation	1	.784**
	Sig. (2-tailed)		.004
	N	11	11
Weighted Student Mean Score	Pearson Correlation	.784**	1
	Sig. (2-tailed)	.004	
	N	11	11

***. Correlation is significant at the 0.01 level (2-tailed).*

The findings revealed that there was a strong positive correlation (r = .784, p=.004) between the frequency with which teachers use virtual field trips (VFTs) and students' mean scores in geomorphology. This finding corroborates the student-level finding (r = .658, p < .001), confirming that the relationship between teacher frequency of VFT use

and student performance is strong at both levels of analysis. Further, the teacher-level linear regression results were presented in Table 4.20.

Table 4.20: Linear Regression Model Results: Frequency of VFTs Use Predicting Weighted Student Mean Score Versus Teacher Level (n = 11)

Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	15.106	7.872		1.919	.087
	Frequency of VFTs Use	10.793	2.849	.784	3.789	.004

Model Summary: R = .784, R^2 = .615, Adjusted R^2 = .572, Std. Error of the Estimate = 10.163, F(1, 9) = 18.88, p = .004

Linear regression analysis was conducted to examine whether the frequency of teachers' use of virtual field trips (VFTs) predicted students' mean scores in geomorphology. The regression model explained a 61.5% of the variance in student mean scores (R^2 = .615; adjusted R^2 = .572). The results showed that the overall regression model was statistically significant (F (1, 9) = 18.88, p = .004). Furthermore, the frequency of VFT use was a positive predictor of student performance (β = .784, B = 10.793, p = .004). The study also realized that for every one-unit increase in reported frequency of VFT use, student mean scores are predicted to increase by approximately 10.793 points. The consistency between teacher-level and student level findings strengthens confidence in the study's conclusion that teachers' frequency of VFTs use is a strong predictor of student achievement in geomorphology. These results corroborate the findings of a study by Mutabari et al. (2024) who demonstrated that VFTs integrated instruction in History education produced significantly higher scores as compared to non VFTs instruction.

Considering the frequency of use of VFTs by geography teachers, the hypothesis "There is no statistically significant relationship between teachers' use of Virtual Field Trips and students' academic achievement in geomorphology" was rejected.

The findings of this research concur with results by Evelpidou et al. (2021) who proved that the repeated exposure to Google Earth-based VFT activities positively influenced

the student's comprehension of the geomorphology-related concepts and excelling in assessments. This revealed that regular usage reinforced the learning outcomes.

Further correlation analysis was done to look into the variables that could account to the variation in frequency of VFT use by geography teachers. The findings were summarized as indicated in the Table 4.21.

Table 4.21: Correlation between teachers' frequency of use of VFTs and teachers' knowledge of where to find VFTs, teacher awareness of VFTs and teachers' knowledge of VFTs benefits to learners

		Frequency of VFTs use	I know where to find VFTs
Frequency in VFTs use	Pearson Correlation	1	.740**
	Sig. (2-tailed)		.009
	N	11	11
I know where to find VFTs	Pearson Correlation	.740**	1
	Sig. (2-tailed)	.009	
	N	11	11

**. Correlation is significant at the 0.01 level (2-tailed).

		Frequency in VFTs use	Teacher awareness of VFTs
frequency in VFTs use	Pearson Correlation	1	.454
	Sig. (2-tailed)		.160
	N	11	11
Teacher awareness of VFTs	Pearson Correlation	.454	1
	Sig. (2-tailed)	.160	
	N	11	11

		Frequency in VFTs use	Teacher knowledge of benefits of VFTs
frequency in VFTs use	Pearson Correlation	1	.492
	Sig. (2-tailed)		.124
	N	11	11
Teacher knowledge of benefits of VFTs	Pearson Correlation	.492	1
	Sig. (2-tailed)	.124	
	N	11	11

The findings revealed that the frequency of VFT use and knowledge of teachers regarding the location of VFT resources showed a positive and statistically significant correlation (r = .740, p =.009). This showed that the teachers who were knowledgeable about where to find VFT materials were more prone to using them regularly in their teaching. Furthermore, teacher awareness of VFTs had a moderate relationship with frequency of use (r = .454, p =.160) revealing that awareness can result in higher usage but the association was not significant since the p-value was greater than the standard 0.05. Frequency of VFT use also had a moderate positive relationship with teacher's knowledge about the advantages of VFTs (r =.492, p =.124) revealing that teachers who knew the instructional worthiness of VFTs were more likely to use them frequently.

The study concludes that teachers' frequency of use of VFTs was highly influenced by knowledge about where to find VFTs, awareness of VFTs and knowledge of the VFTs benefits to teaching and learning.

4.3.3.2 Correlation between Teachers' level of VFTs Implementation Guided by Experiential Learning Theory and Student Performance in Geomorphology.

In addition, the study sought to establish the relationship between the teachers' level of VFTs implementation guided by Kolb's (1984) four stage experiential learning theory. Before conducting this correlation analysis, the level of teachers' implementation of experiential learning during the virtual field trip lessons was quantified using the classroom observation checklist. The structure of the observation checklist was aligned with the four stages of experiential learning model; Concrete Experience (CE), Reflective Observation (RO), Abstract Conceptualization (AC) and Active Experimentation (AE). Each stage had four observable Yes/No indicators. A score of 1 was given for "Yes" and 0 for "No". Therefore, each stage could score between 0 and 4 points. The four stage scores were then summed to give a maximum of 16 points. The total was divided by four to produce an average implementation score ranging from0 to 4 for each lesson. All this was done to convert observation data into numerical values suitable for correlation with student performance in the 8 observed lesson/teachers as shown in Table 26.

Table 4.22: Distribution of Observed Teachers by VFT Implementation Score Group with Averaged Stage Scores

Implementation Score	T0n	S0n	CE Stage Mean	RO Stage Mean	AC Stage Mean	AP Stage Mean	% of Students
1.75	2	38	3.0	2.0	2.0	0.0	14.4%
2.25	2	62	3.0	3.0	2.5	0.5	23.6%
2.50	2	51	3.5	3.5	1.5	1.5	19.4%
3.00	1	57	4.0	2.0	4.0	2.0	21.7%
3.50	1	55	4.0	3.0	4.0	3.0	20.9%
Total	**8**	**263**					**100%**

Note T0n=Number of Teachers; S0n= Number of students; CE = Concrete Experience; RO = Reflective Observation; AC = Abstract Conceptualization; AP = Active Application. Stage means represent the average score (0–4) for teachers within each implementation group.

Table 4.22 revealed important patterns on how experiential learning stages were implemented across groups. The application stage was the weakest across all groups, with teachers in the lowest implementation group (1.75) recording a mean of 0.0. This showed that the application stage was entirely absent in those two lessons. Even in the highest group (3.50), the application stage mean was at 3.0 confirming the finding realized in objective two analysis. In contrast, concrete experience and abstract conceptualization stages showed stronger implementation.

To establish the relationship between implementation quality and individual student performance, a student-level analysis was conducted using the individual scores of all the 263 students whose teachers had implemented VFTs in their teaching and learning. Each teachers' implementation score was paired with their own individual students score. The descriptive statistics of individual scores by implementation score group is presented in Table 4.23.

Table 4.23: Descriptive Statistics of Individual Student Scores by Teacher Implementation Score Group (n = 263)

Implementation Score	Teachers in Group	N (Students)	Mean Score (%)	SD	Min	Max
1.75	T08, T10	38	28.63	16.34	13	74
2.25	T01, T05	62	51.15	14.98	16	98
2.50	T09, T11	51	45.80	11.64	20	72
3.00	T02	57	64.18	15.49	31	98
3.50	T03	55	61.04	15.76	20	94
Total		**263**	**51.75**	**18.79**	**13**	**98**

Descriptive statistics in Table 4.23 revealed that there was a positive trend in student scores as implementation quality increased. Students taught by teachers with the lowest implementation score of 1.75 recorded the lowest mean score of 28.63% (SD=16.34) while students of teachers with scores of 3.00 and 3.50 recorded the highest mean scores of 64.18% and 61.04% respectively. There was a slight dip at the 2.50 level compared to 2.25 that reflected within the group variation rather than a reversal of the overall trend. The student-level Pearson correlation was conducted an output presented in Table 4.24.

Table 4.24: Pearson Correlation between Level of VFT Implementation and Individual Student Scores (n = 263)

		Level of VFT Implementation	Individual Student Score
Level of VFT Implementation	Pearson Correlation	1	.535**
	Sig. (2-tailed)		<.001
	N	263	263
Individual Student Score	Pearson Correlation	.535**	1
	Sig. (2-tailed)	<.001	
	N	263	263

**. *Correlation is significant at the 0.01 level (2-tailed).*

A moderate positive correlation was established between the level of teacher's VFTs implementation and individual student score in geomorphology ($r = .535$, $p < .001$, $n = 263$). Further, student-level analysis was conducted using the linear regression and thereafter presented in Table 4.25.

Table 4.25: Linear Regression Model Results: Level of VFT Implementation Predicting Individual Student Score (n = 263)

Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	5.873	4.362		1.346	.179
	Level of VFT Implementation	17.311	1.694	.535	10.219	<.001

Model Summary: $R = .535$, $R^2 = .286$, Adjusted $R^2 = .283$, Std. Error of the Estimate = 15.943, $F(1, 261) = 104.420$, $p < .001$

The student-level linear regression model explained 28.6% of the variance in individual student scores ($R^2 = .286$; Adjusted $R^2 = .283$). The overall model was statistically significant ($F(1, 261) = 104.420$, $p < .001$). The analysis revealed that for every one unit increase in their teacher's implementation score, an individual student's geomorphology score was predicted to increase by approximately 17.311%. This finding corroborated Chen and Zhang (2023) in their systematic review also noted that VFTs are traditionally most instructionally useful in case they are backed by a series of structured activities that allow teacher-student, as well as student-student, interaction, which is likely to be the pattern with the maximum applicability of the experiential learning cycle that was applied in this research.

To confirm the student level findings, a Pearson correlation and simple linear regression were conducted at the teacher level using 8 observed teacher's average implementation score and their students weighted mean performance scores. The results are presented in Tables 4.26 and 4.27.

Table 4.26: Pearson Correlation between Level of VFT Implementation and Weighted Student Mean Score (n = 8)

		Average Implementation Score	Weighted Student Mean Score
Average Implementation Score	Pearson Correlation	1	.719*
	Sig. (2-tailed)		.045
	N	8	8
Weighted Student Mean Score	Pearson Correlation	.719*	1
	Sig. (2-tailed)	.045	
	N	8	8

The teacher-level analysis confirmed a strong positive correlation ($r = .719$, $p = .045$) between the average VFTs implementation score and students weighted mean achievement across the 8 observed teachers. This corroborated the student-level finding ($r = .535$, $p < .001$) as both gave positive correlation.

Further, the teacher-level linear regression was conducted and results presented in Table 4.27.

Table 4.27: Simple Linear Regression Model Results: Implementation Score Predicting Weighted Student Mean Score and Teacher Level (n = 8)

Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	15.106	7.872		1.919	.087
	Implementation Score	17.165	6.563	.719	2.616	.045

Model Summary: $R = .719$, $R^2 = .517$, Adjusted $R^2 = .436$, Std. Error of the Estimate = 11.164, $F(1, 6) = 6.422$, $p = .045$

The teacher model explained a 51.7% of the variance in weighted student mean scores ($R^2 = .517$; Adjusted $R^2 = .436$). Generally, the model was statistically significant ($F(1, 6) = 6.422$, $p = .045$). Moreover, the model also revealed that for every one-unit increase

in the implementation score, weighted student mean scores were predicted to increase by approximately 17.165%

On both aspect of VFTs use which were frequency and level of VFTs implementation, the combined evidence from the student level and teacher level analysis corroborated. At the student level, frequency of VFTs use showed a strong positive correlation with individual student scores ($r = .658$, $p < .001$, $n = 314$), while implementation quality showed a moderate but highly significant correlation ($r = .535$, $p < .001$, $n = 263$). In addition, both were confirmed at the teacher level ($r = .784$, $p = .004$; $r = .719$, $p = .045$). Since all p-values fall below the significance level of 0.05, the null hypothesis "$H0_1$- there is no statistically significant relationship between teachers' use of VFTs and student's academic achievement in geomorphology was conclusively rejected"

In addition, the study established that implementation correlation ($r =.535$) was moderate in comparison to the frequency correlation ($r=.658$) this finding revealed that it is not sufficient for a teacher to merely use VFTs frequently, but the quality and completeness of the four stages of experiential learning model also significantly predicts how well individual students perform.

These findings concur with the findings of a study by Evelpidou et al. (2021) who found that over 80 percent of the students who went through planned VFT exercises demonstrated the right knowledge in the post-test assessments. Similarly, Hope et al. (2021) and Lawal (2023) reported an extremely better academic performance through VFT-aided instruction compared to the traditional one. As demonstrated by Mutabari et al. (2024), the students in the Murang'a County who received teaching based on VFT instruction using different instructional methods in teaching history received much higher results in comparison with students who were not taught the instruction in the Kenyan environment to which the current research is applied to geography and geomorphology.

Furthermore, the findings revealed as suggested by Kolb's experiential learning model, meaningful learning occurs when learners move through a cycle of concrete experience, reflective observation, abstract conceptualization and active experimentation (Kolb,

1984). Based on the findings of this study, classrooms that recorded higher implementation score in the four stages revealed higher academic performance. Therefore, the study concluded that better performance was realized where teachers guided learners through the four stages of learning as pointed by Kolb (1984). This finding concurred with Mayer (2021) whose study pointed out that learners construct knowledge and understanding when instructional designs balance visual and verbal processes instead of relying on passive observation alone.

In addition, these findings concur with a study by Evelpidou et al. (2021) which found out that most participants had a better knowledge of geomorphological concepts after accessing Google Earth-based VFTs. Similarly, Hope et al. (2021) and Lawal (2023) reported better academic performance with the use of VFT-supported teaching compared to the one based on traditional mode of teaching whereas Mutabari et al. (2024) noted that students in the Murang'a County that were taught VFT-based instruction in history education scored significantly high compared to those who were not.

4.3.4 Teacher Factors Influencing VFTs Implementation

The study sought to establish teacher factors that influence the implementation process of Virtual Field Trips (VFTs) in geomorphology lessons. To achieve this purpose, the researcher used Teacher Questionnaire Sections C and E, and also included the information of the Classroom Observation Checklist. Quantitative data was run through SPSS and the qualitative part was also analyzed to get an idea of what was happening.

Table 4.28: Teachers' Motivation, Beliefs, and Skills in Using VFTs (N = 11)

Statement	Category	Frequency	%
I am motivated to use new technology	Neutral	2	18.2
	Agree	4	36.4
	Strongly Agree	5	45.5
I believe VFTs can make learning more engaging	Neutral	1	9.1
	Agree	3	27.3
	Strongly Agree	7	63.6
I feel well informed about the benefits of VFTs	Neutral	2	18.2
	Agree	4	36.4
	Strongly Agree	5	45.5
I know where to find VFTs	Strongly Disagree	1	9.1
	Disagree	1	9.1
	Neutral	1	9.1
	Agree	4	36.4
	Strongly Agree	4	36.4
I am confident in my ability to use digital tools for VFTs	Neutral	4	36.4
	Agree	4	36.4
	Strongly Agree	3	27.3
I have the necessary technical skills to integrate VFTs	Disagree	2	18.2
	Neutral	2	18.2
	Agree	4	36.4
	Strongly Agree	3	27.3

The findings in the Table 4.28 showed that teachers were generally motivated to apply new technology, with 45.5% strongly agreeing, 36.4% agree and 18.2% neutral while the statement that VFTs enhance the interest in learning, 63.6% strongly agreed, 27.3% agreed, and 9.1% was neutral. In addition, on whether the teachers were informed about the advantages of VFTs, 45.5% strongly agreed, 36.4% agreed and 18.2% was neutral.

When asked about the location of VFTs, 36.4% strongly agreed, 36.4% agreed, 9.1% were neutral, 9.1% disagreed and 9.1% strongly disagreed. Concerning the confidence in the use of digital tools to VFTs, 36.4% agreed, 27.3% strongly agreed, and 36.4% were neutral. Lastly, about the teachers' technical skills to integrate VFTs, 36.4% agrees, 27.3% strongly agreed, 18.2% indicted neutral, and 18.2% strongly disagreed.

The study realized that high motivation and the belief that VFTs can make the learning process more interesting concurred with the findings by Ghani et al. (2024), which showed that positive attitudes towards technology and perceived usefulness were the main predictors of technology adoption in education. Moreover, revelation that a significant portion of teachers are informed about VFT benefits is consistent with the study by kimmons (2020) that reported the presence of awareness of the pedagogical value of technology whereas reactions to confidence and technical competence are consistent with the findings by van Braak et al. (2023), who reported that despite teachers appreciating technology, confidence and real skills were still left behind.

Additionally, descriptive statistics was run to establish factors influencing VFTs implementation as shown in Table 4.29.

Table 4.29: Descriptive statistics for teacher factors influencing VFT implementation (N=11)

Variable	Statement	Mean	Standard Deviation
Teacher Motivation	I am motivated to use new technologies like VFTs in my teaching	4.30	0.78
	I believe VFTs can make learning geomorphology more engaging for students	4.51	0.69
Teacher Awareness	I feel well-informed about the benefits of using VFTs in geography education	4.27	0.79
	I know where to find relevant VFT resources for my geomorphology lessons	3.82	1.33
Teacher ICT Skills	I am confident in my ability to use digital tools for VFTs effectively	3.91	0.82
	I feel I have the necessary technical skills to integrate VFTs into my lessons	3.73	1.10

The findings revealed that educators were motivated to use new technologies like VFTs in their teaching practices as the questionnaire item ha a mean of 4.30 and a SD 0.78. They also believed that VFTs helped them to make the lessons on geomorphology more interactive to the students (M = 4.51, SD = 0.69). The mean scores of teacher awareness of VFTs were also high. According to teachers, they were quite knowledgeable about the advantages of VFTs in geography teaching (M = 4.27, SD = 0.79). The score was slightly lower when they were requested whether they could tell where they would locate good VFT materials in order to use in their lessons (M = 3.82, SD = 1.33). The finding revealed that most of the teachers have no problems locating the appropriate digital source. Nevertheless, some teachers indicated that they find it hard to get VFTs that align with the curriculum and the learning objectives.

R5: "*Some videos are too general and don't specifically answer the class objectives. Others are too long and extend past normal class time* "

Moreover, the teachers were moderately confident in the usage of digital tools in VFT instruction (M= 3.91, SD =0.82). The rating on actually possessing the technical ability to incorporate the VFTs in the lessons was a little less (M = 3.73, SD = 1.1). This finding revealed that teachers possess a general level of digital competence, although some might require additional practice to make VFTs run effectively in the classroom.

In addition, the qualitative data in Section E of open-ended questionnaire helped to point out some of the challenges that withheld VFT implementation. Teachers repeatedly cited low internet connectivity, inadequate ICT devices, inefficiency of specialized training, and insufficient prep time as some of the reasons that kept them behind the use of virtual learning tools in their respective schools.

R1 *"There is limited number of ICT tools in school meaning that a teachers may require to use ICT tool at a time but may fail to use since its being used by another teacher"* similarly, R4 noted that "*apart from network failure, the ICT resources are not enough for whole class use*"

To counter the challenges experienced during VFTs execution, teachers proposed increased availability of VFTs supportive tools, teacher training on the use of ICT and VFTs in particular as well as workshops to allow teacher exposure on the emerging technologies. For instance:

R5 "*I propose increased workshop sessions on developing video content that specifically targets the curriculum*" the respondent also added "*provision of offline videos that will be used even without internet connection"*

The study concludes that teacher motivation is vital in implementation of virtual field trip in geography teaching. The teachers of sampled schools showed a great desire to implement new technologies in facilitating learning especially in subjects like geomorphology which needs visualization of physical landscapes. Good attitudes of teachers towards instructional technology have been widely selected as a major determinant of effective technology implementation in education. The teacher believes and takes motivation as a strong factor in determining whether digital innovations will

be implemented in classroom practice or not (Ding et al., 2019). The use of VFTs in the current study was also affected by the teacher awareness on instructional resources. Even though the majority of teachers acknowledged the importance of virtual field experience, some of them complained that they lacked the ability to find appropriate resources, which were relevant to the syllabus. The findings are consistent with the findings of Makransky and Petersen (2021) who also revealed that educators tend to use general online resources instead of specialized virtual learning materials because they lack awareness about their existence in education platforms.

ICT competence also appeared a significant factor that defines VFT implementation. During classroom observation, teachers who reported greater confidence in the use of digital tools were more likely to lead the students through structured virtual learning activities. This result can be attributed to Technological Pedagogical Content Knowledge (TPACK) framework established by Mishra and Koehler (2006) which underlines that to be successful in integrating technology, a teacher must possess a combination of technological knowledge, pedagogical knowledge and knowledge of the subject content. This finding concludes that the more ICT competent teachers are, the more meaningfully they can use digital tools like VFTs in learning.

Nevertheless, qualitative responses and observations in the classroom setting indicated that institutional elements also play an important role in the implementation of VFTs. The study realized that teachers commonly reported poor internet connectivity and poor ICT equipment in their schools which they pointed out as major hindrances to access online virtual resources for teaching geomorphological processes. These findings concurred with the results by Ghani et al. (2024) who pointed out that similar obstacles on the implementation of digital learning technologies within developing educational settings were realized.

The other issue raised by educators was the unavailability of specialized professional training on the way to design and implement VFT-based lessons. It was also observed that most of the teachers were not trained specifically on how to incorporate the virtual field experiences in teaching geography despite their basic ICT skills. The study

concludes that professional development was found to be one of the determinants of the effective technology integration in schools. The finding agrees with the results of Gümüs (2022) who realized that, when teachers are given systematic training, they develop abilities to make good use of digital learning tools more regularly.

Moreover, the study realized that there were positive outcomes mentioned by teachers in the open-ended questions section. concepts like river erosion, volcanic landforms, and coastal geomorphology were explained as being easier to learn by the students in the presence of virtual visualization. These findings are consistent with the study by Chen & Zhang (2023) that established that an experience in a virtual field trip can contribute to the development of conceptual knowledge in geography by enabling students to gain access to real-world settings that would otherwise be unreachable.

4.4 Chapter Summary

This chapter presents findings and interpretations on the extent of use of VFTs by geography teachers, VFTs implementation strategies based on the four stages of Experiential Learning Model, relationship between VFTs use by geography teachers' and students' academic performance in geomorphology as well as factors influencing VFTs implementation by geography teachers. The study aimed at establishing the correlation between teachers' implementation of VFTs and students' achievement in geomorphology in secondary schools in Murang'a East sub-county Kenya. Study findings revealed a strong positive correlation between teacher frequency of VFTs use and students' academic achievement in geomorphology. Moreover, the study established a positive correlation between VFT implementation quality and students' performance in geomorphology.

CHAPTER FIVE
SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

In this study, the researcher identified the correlation between the introduction of Virtual Field Trips (VFTs) by the teachers and the performance of students in the geomorphology subject in the secondary schools of Murang'a East Sub-County in Kenya. The motivation behind the study was the continuous difficulties that students encountered in learning concepts of geomorphology where most concepts involve visualization of landforms and physical processes that are not easily conceptualized in the traditional rote learning. Physical field trips have long been used as supplementary and important in aiding the experiential learning in geography but they are limited to financial, logistical, and safety concerns. Virtual Field Trips, therefore, have become an alternative mode of instruction that can be used in exposing learners to the geomorphological real-world environment using digital technologies like videos, images, simulations, and interactive systems.

The major research goal of the study was the establishment of a connection between academic performance of students in geomorphology and the implementation of Virtual Field Trips by geography teachers. Experiential Learning Theory, according to which learning occurs through experience and reflection (Kolb, 1984), and Technological Pedagogical and Content Knowledge (TPACK) framework, according to which the effectiveness of the technological integration in teaching is determined by the relationship between technological, pedagogical, and content knowledge (Mishra & Koehler, 2006) guided the study.

In order to attain the aim of the study, there were four objectives, which were formulated and systematically investigated.

The aim of the first objective was to establish the extent to which teachers of secondary school geography in Murang'a east Sub-County currently employ Virtual Field Trips to teach geomorphology. Results of teacher questionnaires and classroom observation checklists demonstrated that the level of actual implementation into classroom teaching was moderate, despite the fact that the majority of teachers were knowledgeable about

Virtual Field Trips and their possible educational benefit. Digital materials were found to be used occasionally by some teachers during a lesson, but were not a frequently used for instructions. The results also revealed that the knowledge of digital learning tools does not always lead to a regular use of technology in classrooms, especially in cases involving teachers who are limited by time, technology, and pedagogical support.

Objective two sought to investigate how geography teachers integrate VFTs in classroom teaching guided by experiential learning model. The findings revealed that the first three stages were fairly implemented but the last application stage was low. Classroom observations revealed that VFTs were facilitated in all the lessons, in majority cases learners were passive observers. During the reflective observation phase, discussions were more practiced by teachers and mostly, whole-class discussion was realized. Further, findings revealed that students were mostly given the chance to ask questions and reflection was encouraged in most of the lessons. In addition, written reflection was not common. The results of questionnaire in the abstract conceptualization stage demonstrated that teachers occasionally associated VFT experiences with the concepts of geomorphology, but students hardly associated their own generalizations (25 percent) indicating that conceptual learning was teacher-centered in most cases. Lastly, the application stage was least implemented. only a small proportion of teachers gave real opportunities to apply knowledge which showed that VFTs were primarily used as a visualization and discussion tool instead of assisting learners to apply knowledge to a real geographical problem.

The third objective aimed at determining the relationship between the application of the Virtual Field Trips by teachers and the academic performance of students in geomorphology. To meet this aim, the inferential statistical analysis was done using Pearson Product-Moment Correlation Coefficient measuring the strength and direction of the relationship between two variables (Creswell and Creswell, 2017). In addition, linear regression was conducted to confirm results and predict the impact. Findings have showed that there was positive correlation existing between the application of Virtual Field Trips by teachers and student performance in geomorphology. Schools with teachers who had a higher score in Virtual Field Trip integration and frequency of use

were more likely to have comparatively higher student performance in geomorphology tests.

The fourth objective was to study the variables that affect the adoption of Virtual Field Trips in geomorphology teaching by teachers. The results demonstrated that there are a number of important factors that influence implementation. These were the levels of ICT competence of teachers, teachers level of motivation, technological awareness alongside technological resources including computers, projectors and access to internet. The educators who had high technological confidence and access to digital infrastructure indicated using Virtual Field Trips in their classes. On the other hand, teachers that were exposed to a low level of technological resources or lack of technical assistance recorded low VFT integration. These results align with the TPACK model that emphasizes that successful technology integration is not only about technology access, but also about the skills of the teacher to integrate the technological knowledge with the right pedagogical practices (Mishra and Koehler, 2006).

5.2 Conclusions

This study aimed at determining the connection between the use of Virtual Field Trips by the teachers and students' academic performance in geomorphology in secondary schools in Murang'a Sub-County of Murang'a East. Resting on the results given and elaborated in chapter four, a number of conclusions may be drawn concerning the aims of the research.

To begin with, the study finds that even though most teachers are familiar with the educational value of Virtual Field Trips, but not all have integrated them into their teaching practices. In addition, those teachers who have integrated these VFTs, only a few use them on regular basis. This indicates that although there has been an increased supply of digital learning resources, technology implementation in the teaching of geography has not been fully.

secondly, the study concludes that effective learning takes place when the teacher guides learning through the four-stage cycle of experiential learning model. From the descriptive

analysis, the study revealed that learners who were taught by a teacher with a higher VFT implementation score comparatively performed better.

Third, the research found that there was a positive correlation between the application of Virtual Field Trips by the teachers and the academic success of the students in geomorphology. The schools, where teachers incorporated Virtual Field Trips more often, were more likely to document improved results in geomorphology tests. This implies that the application of Virtual Field Trips can be used effectively to improve the teaching process and learning outcomes in geography.

Lastly, the researcher concluded that achieving the successful integration of Virtual Field Trips in the secondary school geography requires several enablers. These are the technological competence of the teachers, the accessibility of ICT infrastructure, access to sound internet connectivity and institutional support by the school administration. In case these factors exist, there is a higher likelihood that teachers will embrace new digital teaching techniques that will help in making the learning experience of students more meaningful.

5.3 Recommendations

5.3.1 Recommendations for Action

Based on the study findings, the following recommendations were made:

a) The teaching of the geomorphological concepts should incorporate more use of Virtual Field Trips (VFTs) by geography instructors. Since the research proved that there is a positive relationship between teachers' implementation of VFTs and the academic performance of students, then there is a likelihood that systematic incorporation of virtual field experiments would enhance the understanding of complex geomorphological events or landforms among students.
b) Geographers are expected to create Virtual Field Trips that adhere to the entire experiential learning process, that is, experiencing, reflecting, conceptualizing, and applying. This type of design will make sure that virtual experiences are not

just viewed but also discussed, interpreted and used in the resolution of geographical problems, thus becoming stronger in terms of students' conceptual knowledge.

c) Schools are supposed to have frequent professional development program to empower teachers with ICT skills and either pedagogical skill that are necessary to make virtual field trips very successful in teaching geography. Such programmes will empower the educators to combine digital tools alongside the right instructional strategies with a lot of confidence.
d) The administrations of schools ought to modernize the ICT infrastructure by availing the necessary facilities like computers, projectors, and a good internet connection. This will be done through the provision of adequate technological facilities enabling teachers to access and use virtual resources in a better way when teaching geomorphology.
e) The study aligns with the CBC which stresses on learner centered instructions and technology use. Therefore, geography teachers at both Junior Secondary School and Senior Secondary School levels should incorporate the use of VFTs in their instructions.

5.3.2 Recommendations for Further Research

a) Future research needs to be conducted in other counties in Kenya to determine whether similar correlations occur between using Virtual Field Trips and academic performance of students in geography by teachers.
b) Future studies should explore the effectiveness of particular Virtual Field Trip tools and platforms in the teaching and learning of various geography sub-branches other than geomorphology.
c) Other variables like the attitude of students, their digital literacy, and school learning conditions that could also affect the success of Virtual Field Trips in geography learning should also be investigated.
d) Future studies should investigate the role of school administration in supporting the implementation of Virtual Field Trips (VFTs) in secondary schools and how

such support influences their effective integration in geography teaching and learning**.**

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APPENDICES

Appendix 1: Data Collection Tools

A. Teacher Questionnaire (TQ)

Instructions for the Teacher

Please respond to the following questions as accurately as possible. Your responses will be kept confidential and used for research purposes only.

Section A: Demographic Information

1. Gender: Male [ ] Female [ ] Prefer not to say [ ]
2. Years of teaching experience: 0-5 years [ ] 6-10 years [ ] 11-15 years [ ] Over 15 years [ ]
3. Highest academic qualification: Diploma in Education [ ] Bachelor's Degree in Education [ ] Master's Degree in Education [ ] PhD in Education [ ]
4. Have you received any professional development or training on integrating ICT in teaching? Yes [ ] No [ ]

Section B: Use of Virtual Field Trips (VFTs) in Teaching Geomorphology

A virtual field trip is a digital learning experience that enables learners to visit real world environments through videos, images, or simulations under the teacher's guidance (Wolf et al., 2021)

5. Are you aware of Virtual Field Trips (VFTs) as a teaching tool? Yes [ ] No [ ]
6. Have you ever used VFTs to teach geomorphology topics? Yes [ ] No [ ]
7. If yes, how frequently do you use VFTs in your geomorphology lessons? Never [ ] Rarely (Once or twice a term) [ ] Sometimes (Once or twice a month) [ ] Often (Once a week) [ ] Very Often (More than once a week) [ ]
8. Which of the following digital tools and platforms do you use for VFTs? (Select all that apply) YouTube videos [ ] Google Earth [ ] 360° videos [ ] Virtual reality simulations [ ] Other [ ] (please specify): _____
9. Which ICT tools are available in your institutions (please tick in the box)
   i) Computers [ ]
   ii) Projector [ ]
   iii) Internet connection (WIFI) [ ]
   iv) Smart televisions (TV) [ ]
   v) Virtual reality headsets [ ]

vi) Tablets/smartphones (for classroom learning) [ ]

Section C: Factors Influencing VFT Integration

10. Please indicate your level of agreement with the following statements on a scale of 1 to 5, where 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree.

Variable	**Statement**	5	4	3	2	1
Teacher Motivation	I am motivated to use new technologies like VFTs in my teaching					
	I believe VFTs can make learning geomorphology more engaging for students					
Teacher Awareness	I feel well-informed about the benefits of using VFTs in geography education					
	I know where to find relevant VFT resources for my geomorphology lessons					
Teacher ICT Skills	I am confident in my ability to use digital tools for VFTs effectively					
	I feel I have the necessary technical skills to integrate VFTs into my lessons					

Section D: Implementation of VFTs based on the Experiential Learning Model

11. This section aims to understand how you implement VFTs in your lessons. Please indicate how often you perform the following actions when using a VFT.

Stages of experiential learning model	**Statement**	**Always**	**Often**	**Sometimes**	**Rarely**	**Never**
Experiencing (The Virtual Tour Itself)	I provide students with guiding					

	questions or a worksheet to complete during the VFT					
	I ensure the VFT is the central part of the lesson, allowing for focused exploration					
Reflecting (Thinking about the Experience)	After a VFT, I lead a whole-class discussion to share observations					
	I ask students to write a short summary or journal entry about their virtual experience					

Conceptualizing (Connecting to Theory)	I explicitly link the VFT content to specific terms and concepts in the geomorphology syllabus					
	I use the VFT to compare and contrast different geomorphological features					
Application (Using the Knowledge)	I assign a task (e.g., a short report, drawing a diagram, a presentation) that requires students to use					

	information from the VFT					
	I encourage students to use the knowledge from the VFT to solve a problem or analyze a local geographic al issue					

Section E: Open-Ended Questions

Please provide detailed answers to the following questions. Your insights are highly valuable.

12. What are the biggest challenges you face when implementing Virtual Field Trips in your geomorphology lessons?

……
……
……

13. Can you give an example of a geomorphology topic where a virtual field trip helped students understand the content better? What made it successful?

……
……
……

14. What kind of support, training, or resources would most help you to use VFTs more effectively or more frequently in your teaching?

……

……

B. Classroom Observation Checklist (COC)

This checklist is designed for objectively assessing the implementation of VFTs in geography lessons based on Kolb's (1984) Experiential Learning Theory.

Observer: _____ Teacher Observed (code): _____

Date: _____ Topic of the Lesson: _____

School (code): _____

Instructions for the Observer: For each stage of the experiential learning cycle, check "Yes" or "No" to indicate if the described pedagogical practices were observed during the lesson. Provide specific examples or comments where possible.

Stage 1: Concrete Experience (Experiencing)

i. Did the teacher facilitate a direct, immersive experience for the students using VFTs?
   Yes [ ] No [ ]
   Comments/Examples……...
   ……
   ….

ii. Teacher uses VFTs (e.g., video, Google Earth) to introduce a new geomorphological concept or location. Yes [ ] No. [ ]
   Comments……

iii. Students actively explore the virtual environment presented. Yes [ ] No [ ]
   Comments……

iv. The VFT provides a realistic simulation of a real-world geographical site. Yes [ ] No [ ]
   Comments……

Stage 2: Reflective Observation (Reflecting)

i. Did the teacher encourage students to reflect on their virtual experience?
   Yes [ ] No [ ]

Comments……

ii. Teacher facilitates a discussion about what students observed during the VFT. Yes [ ] No [ ]

comments……

iii. Students are asked to write down their observations or feelings about the virtual tour. Yes [ ] No [ ]

Comments……

iv. Students are given opportunities to ask questions about the virtual experience. Yes [ ] No [ ]

Comments……

Stage 3: Abstract Conceptualization (Conceptualizing)

i. Did the teacher help students connect their virtual experience to broader geomorphological concepts? Yes [ ] No [ ]

Comments……
…

ii. Teacher links the VFT content to the specific topic in the geomorphology topic. Yes [ ] No [ ]

Comments……
…

iii. Students are guided to form generalizations or theories based on their observations. Yes [ ] No [ ]

Comments……
…

iv. Teacher uses the VFT to explain abstract geographical processes. Yes [ ] No [ ]

Comments……
…

Stage 4: Active Experimentation (Application)

i. Did the teacher provide opportunities for students to apply what they learned from the VFT? Yes [ ] No [ ]

Comments……

ii. Students are engaged in problem-solving activities or projects related to the VFT.

Yes [ ] No [ ]

Comments……

iii. Students are asked to apply their new knowledge to a different but related scenario. Yes [ ] No [ ]

Comments……

iv. The lesson includes activities that reinforce the learning from the VFT.

Yes [ ] No [ ]

Overall comments:

……

……

C. Student Performance Record Sheet

This sheet will be used to anonymously record the geomorphology test scores of the 385 student participants.

Researcher: _____

Date of Data Collection: _____

Instructions: Anonymously record the geomorphology test scores for each student. Ensure that student identities are protected by using unique codes.

School Code	Student Code	Teacher Code	Score on external land forming processes		
			Test 1	Test 2	Avg
SCH01	S001	T01			
SCH02	S002	T02			
SCH03	S003	T03			
SCH04	S004	T04			
SCH10	S364	T10			

Appendix 2: Form Three Geomorphology Topics

1. Weathering
2. Mass Wasting
3. Hydrological Cycle
4. Action of Rivers
5. Drainage Patterns
6. Lakes
7. Oceans, Seas, and Coasts
8. Karst (Limestone) Scenery
9. Glaciation
10. Soil Formation and Soil Catena

Appendix 3: Consent and Assents Forms

Informed Consent Form (Teachers)

My name is Charles Karugu Githua, and I am conducting a research study titled *"correlation between teachers' implementation of virtual field trips and students' achievement in geomorphology in secondary schools within Murang'a east sub-county, Kenya".* The purpose of the research is to establish how teachers are using Virtual Field Trips when teaching geomorphology and how this corresponds to learners' performance in the subject. If you consent to participate, you will be asked to complete a short questionnaire. I may also attend one of your lessons to unobtrusively observe how the Virtual Field Trip is used. In total, this will require about 30 to 45 minutes of your time. Participation in this research study is strictly voluntary, and you are, therefore, free to choose whether or not to participate or to terminate participation at any time without any deleterious consequences. There are no known risks beyond what you would experience in your usual teaching, and though you may not benefit directly and personally from this research, the information obtained might be useful for enhancing the teaching and learning of geography in schools. In addition, all information provided shall be treated as confidential. Your name, the identity of your school, and personal information shall not appear in the report. Information shall be kept securely and accessed only by the researcher. In case you have any questions or concerns, you can contact me on *0705487117* or the ISERC office through *iserc@mut.ac.ke*. By signing below, you indicate that you have read this explanation, that your questions have been answered, and that you freely consent to participate in this research study.

ACCEPTANCE

I accept / do not accept (tick appropriately) to participate in the research study.

I accept [ ]

I do not accept [ ]

Assent Form (Students)

You are invited to participate in a research study titled "*Teachers' Implementation of Virtual Field Trips and Its Correlation to Students' Performance in Geomorphology in Secondary Schools*." We have invited you because you are a Form Three geography student studying topics on geomorphology. The research will seek to find how the Virtual Field Trips used by your teacher, like videos, online tours, or simulations, help you understand the work and how they are related to performance. If you decide to participate, your scores on geomorphology topics will be collected to allow establish relationship between VFTs use by the teacher and the performance in geomorphology sub-branch of geography. The researcher might also sit quietly at the back of the class during a lesson and observe how the Virtual Field Trip is used. All this will take approximately one hour in total. Participation is completely voluntary, and even if your teacher is present, participation should only occur if you want to. You are free to withdraw at any stage, and nothing unpleasant will happen if you decide not to continue. If you have any questions, you may ask the researcher or your teacher. By signing below, you confirm that you have been informed about what the study is about and that you agree to participate.

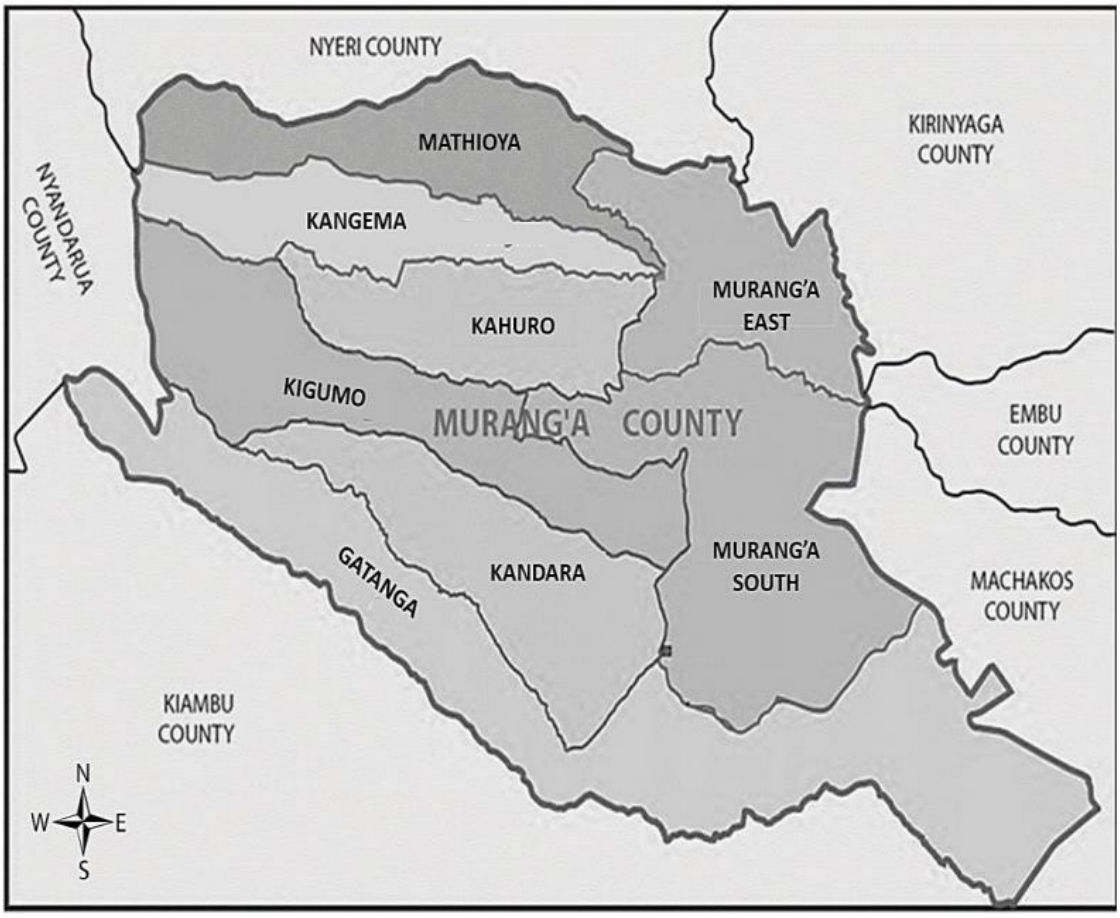
ACCEPTANCE

I accept / do not accept (tick as appropriate) to participate in the research study.

I accept [ ]

I do not accept [ ]

Appendix 4: A Map of Murang'a County



SOURCE; Google maps

Appendix 5: Letter to the Ministry of Education Murang'a County

The County Director of Education
Murang'a County

Dear Sir/Madam,

I am Githua Charles Karugu, a postgraduate student at Murang'a university of technology. I'm pursuing a master of education specializing in geography education. I respectfully request permission to conduct academic research in public secondary schools in Murang'a east sub-county. The research study is titled; "***correlation betweeen teacher's implementation of virtual field trips and students performance in geomorphology in secondary schools within murang'a east sub-county"***

The study will involve selected secondary schools and will engage form three geography teachers and students. Ethical guidelines will strictly be adhered to and school activities will not be disrupted.

I kindly request for your approval to enable me to carry out the study. Thank you.

Githua Charles Karugu

Master of education (geography education)

EH401/5131/2024

Appendix 6: Lettter to the Principals

Principals

Murang'a east sub-county

Dear sir/madam

RE: SEEKING PERMISSION TO CONDUCT ACADEMIC RESEARCH IN YOUR SCHOOL

I hope you are well. I go by the name githua charles karugu, im a postgraduate student at murang'a university doing master of education (geography education).

Im kindly requesting for your permission to conduct an academic research in your institution. The research study is titled; "***correlation betweeen teacher's implementation of virtual field trips and students performance in geomorphology in secondary schools within murang'a east sub-county"***

The study will involve engaging form three geography teachers through a brief questionnaire, reviewing student performance record sheet and a classroom observation session. This exercise is strictly for academic purposes. The engagement will be done at convenient time and will not interfere with the normal school activities or disrupt learning. In addition, participation is voluntary and all the information collected will be strictly kept confidential. All approval documents will be provided.

I will highly appreciate your permission and support. Thank you.

Githua Charles Karugu

Master of education (geography education)

EH401/5131/2024

Appendix 7: Letters of Approval and Permission

A. Letter of Approval of Research proposal and supervisors

MURANG'A UNIVERSITY OF TECHNOLOGY

Office of the Director, Postgraduate Studies

E-mail: bps@mut.ac.ke
Website: www.mut.ac.ke
P.O. Box 75-10200
Murang'a, Kenya

Ref: MUT/ARP/PGS/19/2020 /VOL.1 **Date:** 9th February, 2026

MR. GITHUA CHARLES KARUGU- EH401/5131/2024

School of Education,
Murang'a University of Technology,
P.O. Box 75-10,200
Murang'a.

Dear Mr. Githua,

RE: APPROVAL OF RESEARCH PROPOSAL AND SUPERVISORS.

I am pleased to inform you that the Directorate of Postgraduate Studies on 28th January, 2026 considered and approved your Masters research proposal entitled ***"Correlation Between Teachers Implementation of Virtual field Trips and Students' Achievements in Geomorphology in Secondary Schools within Murang'a East Sub-County, Kenya."*** and appointed the following as supervisors:

1. Dr. Alice Omariba - Murang'a University of Technology
2. Dr. Eric Osoro – Maasai Mara University

You may now proceed with your data collection subject to obtaining research permit from NACOSTI, if required. You should also begin consulting your supervisors and submit through them quarterly progress reports to the Director Postgraduate Studies through your CoD and School Dean. Progress Reports forms can be accessed in the Student Portal.

It is the policy and regulations of the University that you observe deadlines. The guidelines on Postgraduate supervision can be accessed in the post graduate Handbook.

Your responsibilities as a student will include, among others;

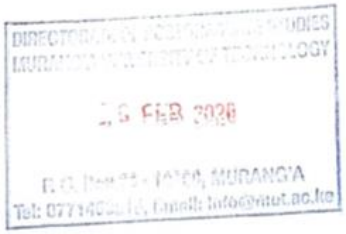
i. Maintain regular consultation with your supervisor(s), at least once a month

ii. Submit quarterly reports on time, through your supervisors, CoD, Dean and to the Director of Postgraduate Studies;
iii. Ensure quality work all through;
iv. Present your research findings at 2-3 seminars/conferences prior to thesis examination.
v. Publish one article from your research findings in a refereed journal prior to thesis examination.

For any further clarification please contact the undersigned.

Yours Sincerely,

Prof. Geoffrey Muchiri, PhD
Director, Postgraduate Studies
GM/MMK



Copy to:
1. Registrar – Academics and Students Affairs
2. Dean, School of Education

B. Letter of approval by Ethics Review Committee

OFFICE OF INSTITUTIONAL SCIENTIFIC ETHICS REVIEW COMMITTEE
MURANG'A UNIVERSITY OF TECHNOLOGY
Website: www.mut.ac.ke ; Email: iserc@mut.ac.ke

Ref: **MUT-ISERC/A/016** 25TH NOVEMBER 2025

GITHUA CHARLES KARUGU
Reg. No: EH401/5131/2024

Dear Charles,

RE: Correlation between teachers' implementation of virtual field trips and students' achievement in geomorphology in secondary schools within Murang'a East Sub-County, Kenya (P016/11/2025)

This is to inform you that the Murang'a University of Technology Institutional Scientific Ethics Review Committee (MUT-ISERC) has reviewed and **approved** your above research proposal. The approval period is **25th November 2025 to 24th November 2026.**

This approval is subject to compliance with the following requirements:

a) Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
b) All changes (amendments, deviations, violations etc) are submitted for review and approval by MUT-ISERC before implementation.
c) Any adverse events (death, life-threatening problems) whether related or unrelated to the study, must be reported to the MUT-ISERC within 72 hours of occurrence.
d) Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to MUT-ISERC within 72 hours.
e) Clearance of export of biological specimens must be obtained from relevant institutions.
f) Submission of Progress reports at a regular interval, at least every 6 months.
g) Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. (*Attach a comprehensive progress report to support the renewal).*
h) Submission of an *executive summary* report within 90 days upon completion of the study to MUT-ISERC.

Prior to commencing your study, you will be expected to obtain a research license from NACOSTI, and other clearances as applicable.

Yours sincerely

Dr. D. Otieno, PhD
Chairman, Murang'a University of Technology ISERC

INSTITUTIONAL SCIENTIFIC ETHICS REVIEW COMMITTEE
MURANG'A UNIVERSITY OF TECHNOLOGY
25 NOV 2025
CHAIRMAN

MUT IS ISO 9001 : 2015 & ISO/IEC 27001 2013 CERTIFIED

C. Introduction letter

OFFICE OF INSTITUTIONAL SCIENTIFIC ETHICS REVIEW COMMITTEE
MURANG'A UNIVERSITY OF TECHNOLOGY
Website: www.mut.ac.ke ; Email: iserc@mut.ac.ke

November 25, 2025

National Commission for Science Technology & Innovation (NACOSTI)
Off Waiyaki Way, Upper Kabete
P.O. Box 30623-00100
NAIROBI, KENYA.

Dear Sir/Madam,

RE: GITHUA CHARLES KARUGU. Reg.No.: EH401/5131/2024

The purpose of this letter is to introduce the above named student who is pursuing Master of Education (Geography Education) at Murang'a University of Technology.

The title of the research is *"Correlation between teachers' implementation of virtual field trips and students' achievement in geomorphology in secondary schools within Murang'a East Sub-County, Kenya."*

The research proposal has been cleared by the University's MUT-ISERC Committee (approval letter attached) and now has to proceed to the field to collect data between 25th November 2025 and 24th November 2026.

Any assistance accorded to the student will be highly appreciated.

Thank you.

Yours sincerely

Name Dr. Dennis Otieno, PhD.
CHAIRMAN- MUT ISERC

INSTITUTIONAL SCIENTIFIC ETHICS REVIEW COMMITTEE
MURANG'A UNIVERSITY OF TECHNOLOGY
25 NOV 2025
CHAIRMAN

MUT IS ISO 9001: 2015 & ISO/IEC 27001:2013 CERTIFIED

D. Research License from NACOSTI

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **311857**

Date of Issue: **17/December/2025**

RESEARCH LICENSE



This is to Certify that Mr.. CHARLES KARUGU GITHUA of Murang'a University of Technology, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Muranga on the topic: CORRELATION BETWEEN TEACHERS' IMPLEMENTATION OF VIRTUAL FIELD TRIPS AND STUDENTS' ACHIEVEMENT IN GEOMORPHOLOGY IN SECONDARY SCHOOLS WITHIN MURANG'A EAST SUB-COUNTY, KENYA for the period ending : 17/December/2026.

License No: **NACOSTI/P/25/4182919**

311857

Applicant Identification Number

Ag. Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

See overleaf for conditions

E. Research Authorization Letter from the ministry of Education

REPUBLIC OF KENYA
MINISTRY OF EDUCATION
State Department for Basic Education

Email: cdemuranga@gmail.com
Telephone: 060 2030227
When replying please quote

COUNTY DIRECTOR OF EDUCATION
P.O BOX 118 – 10200
MURANG'A

REF: MGA/CTY/EDU/RESEARCH/GEN.64/Vol. V/7 22nd December, 2025

CHARLES KARUGU GITHUA
MURANGA UNIVERSITY OF TECHNOLOGY

RE: RESEARCH AUTHORIZATION

We are in receipt of your letter dated 17th December, 2025 and a copy of the Research License from NACOSTI Ref No.311857 license number **NACOSTI/P/25/4182919** dated 17th December, 2025 requesting for authority to carry out research on ***"Correlation Between Teachers' Implementation of Virtual Field Trips and Students' Achievement in Geomorphology in secondary schools within Murang'a East Sub-County, Kenya".***

Permission is hereby granted to carry out the research (Physical) for the period ending **17th December, 2026** as requested.

You are kindly advised to submit a copy of the final research report to this office.

COUNTY DIRECTOR OF EDUCATION MURANG'A COUNTY 12 DEC 2025 P.O. BOX 118-10200, MURANG'A

Agnes Waithaka
For: County Director of Education
MURANG'A

Copy to

Sub County Directors of Education
MURANG'A

Appendix 8: Publication

This thesis has produced the following publication:

Githua, C. K., Omariba, A., & Osoro, E. (2026). Correlation Between Teachers' Frequency of Virtual Field Trips Use and Student Achievement in Geomorphology in Secondary Schools in Murang'a East Sub-County. East African Journal of Education Studies, 9(2), 670-680. https://doi.org/10.37284/eajes.9.2.5077