MULTIMODAL INSTRUCTIONAL METHOD AND LEARNERS' ENVIRONMENTAL CONSERVATION CORE-COMPETENCES IN LOWER PRIMARY SCHOOLS IN THARAKA NITHI COUNTY, KENYA

JOACHIM NJAGI

A Thesis Submitted to the Graduate School in Partial Fulfilment of the Requirements for the Award of the Degree of Doctor of Philosophy in Early Childhood Education and Development of Chuka University

CHUKA UNIVERSITY

OCTOBER 2024

DECLARATION AND RECOMMENDATION

Declaration

This thesis is my original work and has not been presented for award of diploma or conferment of degree in any other university.

Signature..... Date..15/10/2024

Joachim Njagi
ED19/58173/22

Recommendation

This thesis has been examined, passed and submitted with our approval as University supervisors.

Signature..... Date..15/10/2024

Dr. Hannah Wanjiku Kang'ara
Chuka University

Signature..... Date..16/10/2024

Dr. Monica Ituma
Chuka University

DEDICATION

This dissertation is dedicated to my family Madgaline Majuuri, Stella Murugi, Derrick Kimathi, Lemmy Mutuma and Silvance Munene who have been my constant source of love, encouragement, support and inspiration throughout my academic journey. I am grateful for the sacrifices you made to help me pursue my dream.

ACKNOWLEDGEMENT

I acknowledge the Almighty God who is the source of all knowledge, wisdom and understanding, for protecting me throughout the period of my study and granting me the panache to reach this far in my doctoral studies.

I am candidly indebted to Chuka University for enrolling me into doctoral programme of Early Childhood Development and Education and providing me with the necessary learning resources that have enabled me to complete my studies in a record time. I owe magnate gratitude to dons in the faculty of Education and Resource Development for their instrumental support, guidance and mentorship. Special accolades go to Dr. Hannah Wanjiku Kang'ara and Dr. Monica Ituma for their invaluable guidance, ideas and perspectives that enriched and improved the lucidity of this work. Thank you for shaping and enriching my learning experience.

I also acknowledge with much appreciation the crucial role of teachers and learners in lower primary schools in Tharaka Nithi County who participated in this study. Your immense contribution in providing the required data made it possible for me to accomplish this task.

Finally, I would like to express my sincere gratitude to my elaborate network of friends Prof. Humphrey Kirimi, Dr. John Ogembo, Dr. Julius Mwamba, Dr. Grace Murithi and Dr. Joseph Kimathi among others for your invaluable support and encouragement throughout this research project. Your unwavering belief in me and willingness to lend support during my challenging times were instrumental in keeping me motivated and focused.

ABSTRACT

Ecosystem degradation is a global challenge, worsened by unsustainable resource use and a lack of effective educational practices, especially the underestimation of how instructional methods for young learners can contribute to sustainable environmental conservation. The research gap identified was the lack of emphasis on the role of instructional methods in fostering sustainable environmental conservation among young learners. This study addressed this gap by exploring the use, frequency, influence, challenges, and effectiveness of multimodal instructional methods in teaching environmental activities and enhancing the acquisition of environmental conservation competencies among lower primary school learners in Tharaka Nithi County, Kenya. The study was anchored on engagement theory, which posits that knowledge, skills, and competencies are acquired through prolonged learning engagements using diverse pedagogical methods. The study population comprised 3323 teachers and 43900 learners totaling to 47223. Sampling for this study was conducted in two distinct phases. A representative sample of 14 schools across Tharaka Nithi County were selected, from which 322 learners and 59 teachers were randomly sampled in the survey phase. Intervention phase focused on grade three level, selecting 8 teachers and 372 learners for intervention evaluation. Data collection involved use of various tools, including questionnaires for teachers, observation schedules for monitoring teaching practices and assessments of learners' attainment of environmental conservation core-competencies through direct observation, pre-and post-tests. The pilot study was conducted in two schools in Tharaka Nithi County, involving two teachers and 37 grade three children (39 respondents in total). Quantitative data was coded and analyzed using SPSS Version 29, while qualitative data was subjected to thematic analysis using NVivo 12 Plus. Raw data was reviewed for completeness, usefulness and accuracy. Statistical tests including the Shapiro-Wilk test, Mann-Whitney U test, t-test and Chi-square test were employed to compute the relevant statistics. The study found that visual instructional resources were not commonly employed while auditory methods were frequently used. There were no statistically significant differences among the various instructional methods in their influence on learners' acquisition of environmental conservation core competencies. Inadequate teacher training, time constraints, technological challenges, teacher incompetence, curriculum dictates and costs emerged as significant challenges in delivering environmental activities lessons. A model guideline for multimodal learning activities was developed and utilized by teachers. The acquisition of environmental conservation core-competencies among learners was significantly improved by the application of the model guidelines. To enhance the effectiveness of environmental conservation education in lower primary schools, teachers are encouraged to integrate multimodal learning activities into their lessons. Ministry of Education may consider revising the lower primary environmental education curriculum to include structured and age-appropriate environmental conservation concepts. Policy makers may consider incorporating environmental conservation education as a key component of national education policies, with specific objectives and measurable outcomes for early childhood and primary education. County governments may collaborate with local schools to create context-specific environmental education programs that focus on the unique environmental challenges faced by the community such as deforestation, waste management, water conservation.

TABLE OF CONTENT

PAGE

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS AND ACRONYMS

ABCD:	**:**	Audience, Behaviour, Condition and Degree
ADDIE:	**:**	Analysis, Design, Development, Implementation and Evaluation
ANOVA	**:**	Analysis of Variance
BCEF :	**:**	Basic Education Curriculum Frame-Work
CBC:	**:**	Competence Based Curriculum
DBR:	**:**	Design-Based Research
ECDE:	**:**	Early Childhood Development Education
EFL:	**:**	English as a Foreign Language
ETL:	**:**	Engagement Theory of Learning
ICC:	**:**	Intra-class Correlation Coefficient
IDM:	**:**	Instructional Design Model
IGFT:	**:**	Interview Guide for Teachers
IPM:	**:**	Information Processing Model
IRBs:	**:**	Institutional Review Boards
KICD:	**:**	Kenya Institute of Curriculum Development
MMIM:	**:**	Multimodal Instructional Methods
NACOSTI:	**:**	National Commission for Science, Technology and Innovation
OECD:	**:**	Organization for Economic Co-operation and Development
OOT:	**:**	Observation of Teaching
PCI:	**:**	Pertinent and Contemporary Issues
PPtC:	**:**	Pre-and Post-Tests for Children
QFT:	**:**	Questionnaire for Teachers
SDGs:	**:**	Sustainable Development Goals
SEPA:	**:**	Science Education Programme for Africa
SPSS:	**:**	Statistical Package for Social Sciences
UK:	**:**	United Kingdom
UNDP:	**:**	United Nations Development Programme
UNEP:	**:**	United Nations Environment Programme
UNESCO:	**:**	United Nations Educational, Scientific and Cultural Organization
UNICEF:	**:**	United Nations Children's Fund
VARK:	**:**	Visual, Auditory, Read/Write, Kinesthetic
VIFs:	**:**	Variance Inflation Factors

CHAPTER ONE
INTRODUCTION

1.1 Background to the Study

Environmental conservation has emerged as a critical priority in major global blueprints and visions, including the United Nations Sustainable Development Goals (SDGs), Africa's Agenda 2063, the East African Community Vision 2050, and Kenya's Vision 2030 (Okitasari & Katramiz, 2022). These frameworks recognize that safeguarding the environment is fundamental to sustainable development, influencing key areas such as climate action, biodiversity, health, clean water, energy access, and sustainable consumption (Kumar, Paramjit & Anand, 2023). Specifically, SDGs 13, 14, and 15 underline the urgent need to protect our planet. Sustainable Development Goals number 13 serves as the cornerstone for climate action, calling for comprehensive mitigation and adaptation strategies. It emphasizes the importance of reducing greenhouse gas emissions, building resilience to climate-related impacts, and embedding climate considerations into broader development agendas. This goal sets a global benchmark for environmental policies aimed at addressing the climate crisis (Halkos & Gkampoura, 2021). In tandem, SDGs 14 and 15 highlight the necessity of preserving ecosystems essential for the survival of the planet. These goals remind us of the collective responsibility to protect terrestrial and marine biodiversity, underscoring that sustainable development cannot be achieved without concerted efforts to restore and preserve ecosystems. Achieving these targets demands a coordinated, methodical approach that aligns national and international policies with urgent environmental objectives.

The world is facing an escalating crisis of environmental degradation, driven by the unsustainable exploitation of natural resources (Chondrogianni & Tsalaporta, 2023; Herat, 2021). This widespread degradation has fueled climate change, which in turn has unleashed increasingly severe consequences on ecosystems. The impacts range from shrinking water bodies and declining rainfall to soaring temperatures, biodiversity loss, deforestation, and worsening air pollution all of which are intricately tied to the health of the environment (Hite & Seitz, 2021). Despite concerted global efforts, countries continue to struggle with reversing the tide of environmental deterioration. The repercussions are dire, affecting not only the health of ecosystems but also human well-being, with profound consequences for both environmental sustainability and public

health. The need for decisive action is paramount. As emphasized by Luo, Wang, and Guo (2022), the United Nations Educational, Scientific and Cultural Organization (UNESCO) identifies environmental education as a critical pathway to addressing this global crisis. By fostering greater awareness and equipping individuals with the knowledge and skills needed to act, environmental education stands at the forefront of efforts to promote sustainable resource use and achieve long-term environmental conservation.

The United Nations Educational, Scientific and Cultural Organization (UNESCO) advocates for introducing environmental education from the earliest stages of learning, aiming to instill in children a deep understanding of environmental issues and shape their motivation and capacity for responsible conservation (Duoblienė, Kaire & Vaitekaitis, 2023). Environmental education offers invaluable opportunities for learners to acquire the competencies needed to address real-world challenges beyond the classroom. As Hogan and O'Flaherty (2022) assert, it equips learners with the tools to become effective advocates and innovative problem-solvers by helping them make vital connections between their academic pursuits and the complex environmental challenges our world faces today. In alignment with this vision, the United Nations Development Programme (UNDP), United Nations Environment Programme (UNEP), and United Nations Children's Fund (UNICEF) underscore the importance of instructional strategies that foster hands-on learning. The UNDP, UNEP and UNICEF highlight that environmental conservation hinges on learners gaining fundamental knowledge and practical skills through active, experiential education (Spiteri, 2023; Kagawa, 2022). A notable example of this approach is multimodal instruction, which integrates various teaching methods to enhance learners' engagement and understanding.

Multimodal learning involves utilizing a variety of methods or modes to teach a concept, engaging multiple sensory systems simultaneously rather than relying on a single mode of instruction, such as a visual diagram or lecture (Mills, Heck, Brown & Funnell, 2023). By integrating different teaching approaches, multimodal learning aims to activate as many learning modalities as possible, allowing learners to absorb material more effectively. This approach recognizes that individuals learn in diverse ways and reinforcing acquisition of concepts through multiple channels enhances retention and

comprehension. The repetition of material across different modalities solidifies understanding, giving learners multiple opportunities to grasp and internalize information. Additionally, quizzes and tests serve as valuable tools for teachers to assess which modalities are most effective for their students, allowing for tailored instructional strategies that cater to diverse learning needs. Ultimately, multimodal learning creates a more inclusive and engaging educational experience that benefits all learners.

Fleming and Bonwell (2002) introduced four main methods of multimodal learning which are visual, auditory reading and writing and kinesthetic. According to Fleming et al. (2002), visual learners respond well to videos, graphics, illustrations, diagrams, cartoons, artwork like color coding and drawing, power point presentations among other visual content. Auditory learners thrive in environments where information is communicated through spoken words, lectures, discussions and use of audio materials. Enthusiasts of reading and writing and writing absorb knowledge effectively through textual materials, notes and reflective writing assignments. Hitherto, kinesthetic learners flourish when physically engaged in activities such as experiments, simulations, hands-on experiences and interactive activities. Instructors should create materials for different learning styles like visual, reading, auditory, writing, and kinesthetic. Multimodal instructional resources include a mixture of linguistic, visual, gestural, spatial, and audio elements that engage learners in sensorial learning, as opposed to unimodal, text-only materials; for example, picture books, newspapers, brochures, storyboards, e-books, videos among others.

According to Padios, Pascua and Orleans (2023), the benefits of multimodal learning includes enhanced learner engagement and improved retention. Multimodal learning allows instructors to be creative with course content and makes learning fun as learners engage with different content types rather than being stuck with one mode of learning. This, in turn, encourages creativity in learners as they apply the material to their work. Multimodal instructions have proven to increase learners test scores, enhance their communication as well as problem solving skills (Padios et al., 2023). Banga (2023) argues that multimodal instructional methods can foster the development of a wide range of competences, encompassing cognitive, social-emotional, and practical skills. Competency is a set of demonstrable characteristics and skills that enable, and improve

the efficiency of, the performance of a job (Umeze, 2022). According to Abdullah, Hidayati, Andriani, Silvani, Ruslan, Tandiana and Lisnawati (2022), some of the core-competencies that can be developed using multimodal instructional approaches include critical thinking, communication skills, creativity and innovation, collaboration and teamwork, adaptability and flexibility as well as problem-solving skills which are essential for environmental conservation

The Organization for Economic Co-operation and Development (OECD) champions the integration of multimodal instruction in environmental education as a key strategy to foster critical competencies in learners (Lefebvre, 2022). Multimodal teaching approaches have garnered increasing recognition for their effectiveness in cultivating core environmental conservation competencies (Mangaroska, Martinez-Maldonado, Vesin & Gašević, 2021). While a variety of competencies such as functional, technical, personal leadership, and management skills can be developed through instructional methods, Wilmes and Siry (2020) argue that core-competencies hold particular significance in this context. These competencies represent the abilities and skills that give individuals a competitive advantage and are essential for empowering learners to actively engage in environmental stewardship and conservation efforts.

In Britain, research on multimodal pedagogy by Crescenzi-Lanna (2020) established that multimodal learning offers the possibility to promote effective learning in complex environments. In a similar way, Kaminski (2019) mentions that multimodal pedagogy could help English language learners develop their language and multimodal literacy skills by allowing them to experience learning not only in ways they are most comfortable, but also in challenging them to experience and learn in other ways as well. In Malaysia, Seau (2021) found that if utilized through thoughtfully planned activities, multimodal presentations can facilitate understanding. For instance, when a concept cannot be fully communicated by written words, a visual representation can remedy the communication problem. Although multimodal techniques have been found to be beneficial in a variety of educational contexts, there aren't many thorough studies that focus explicitly on how they might be incorporated into early years' education settings (Bengochea, Sembiante & Gort, 2020). As a result, it is essential to explore how educators can effectively integrate multimodal techniques into their pedagogical practices in early years' education settings. This includes identifying best practices for

designing and implementing multimodal learning activities that align with the developmental needs and interests of young children.

In South Africa, Olivier (2020) established that self-directed multimodal learning improves learners acquisition of scientific concepts, skills and developing learner autonomy and creativity. In East Africa, researchers, Mandilla (2021), Karmali et al. (2023) and Masinde et al. (2023) have clearly postulated that multimodal instructions assist and increase the amount of comprehensible input and boosts comprehension among all levels of learners. Despite these critical viewpoints in favor of the approach, Maijala (2023) asserts that multimodal learning is still comparatively underutilized in the field of environmental education, particularly in primary schools. To put it succinctly, the empirical research into multimodality in early childhood education classrooms has been neglected, resulting in a dearth of studies and a lack of theoretical underpinnings beyond heuristic reasoning.

Several African nations are taking progressive steps by updating their curricula to incorporate teaching strategies that equip learners with the knowledge, skills, attitudes, and behaviors essential for environmental conservation (Cheruiyot, 2019). South Africa, Zambia and Ghana, for example, have revised their curricula to prioritize project-based learning over traditional approaches, aiming to deepen students' understanding of environmental stewardship (Pan, Seow & Koh, 2019). In Rwanda and Tanzania, curriculum reforms have emphasized instructional methods that actively engage learners in addressing environmental challenges (D'Angelo, Marcus & Ngabonzima, 2022). However, despite these promising efforts, Osuntuyi and Lean (2023) express concern that environmental degradation in these countries continues to worsen at an alarming rate. The consequences of continued environmental degradation include disruption of natural ecosystems that are essential for maintaining balance in the environment, decreased agricultural productivity threatening food security and accelerated climate change. This suggests that while curricular reforms are a positive step, more comprehensive action may be needed to address the escalating environmental crises.

Kenya has also undertaken a significant review of its education system, adopting the Competency-Based Curriculum (CBC), which places a strong emphasis on environmental education (Matere, 2024). Unlike traditional fact-based learning, the CBC focuses on skill acquisition and the development of key competencies, aiming to equip learners with practical abilities that extend beyond the classroom. In alignment with the Basic Education Curriculum Framework (BECF), the lower primary school curriculum covering Grades 1 to 3 and designed for learners aged 6 to 9 has been specifically structured to reflect this approach. At this foundational level, learners are introduced to a diverse range of learning areas, including Indigenous Language Activities, Kiswahili and Kenya Sign Language Activities, English Language Activities, Mathematics, Religious Education, Environmental Activities, Creative Arts, and Pastoral Instruction. By incorporating environmental learning into these early stages, the CBC seeks to cultivate a generation of learners who are not only academically capable but also environmentally conscious and socially responsible.

According to the BECF, environmental conservation is a contemporary and pertinent issue designed to make sure education is relevant to the needs of society and the economy which is why it has been incorporated into CBC. Nyatuka (2020) posits that the goal of competency-based curriculum is to respect cultural diversity while enabling learners to make educated decisions and act responsibly for the preservation of the environment, the health of the economy, and a just society for current and future generations. The content of CBC include values, knowledge, and abilities related to environmental conservation. These are taught in environmental activities at the pre-primary and lower primary levels, as well as at higher levels in social studies, geography, and science and technology (Kimalel, 2023). As a result, CBC offers the chance to develop each learner's skill competence for environmental conservation. This is the ultimate goal of Education for Sustainable Development. Despite the widely understood role of education as a catalyst for building a better, more sustainable future for all, Kenya’s basic education curriculum has been faulted of not fully preparing learners to meet a wide range of sustainable development challenges (Nyatuka, 2020). This implies that there may be a problem with the methods formal education utilizes to address environmental deterioration problem through instructional practices.

The necessity for curriculum adjustments that prioritize the use of multimodal teaching and learning approaches to enhance the acquisition of environmental conservation concepts and abilities is being emphasized by education scholars (Cirkony & Kenny, 2022; Firmansyah, 2021). These modifications will result in children who appreciate environmental conservation because they can think critically, encode and decode scientific communication, conduct research and solve issues. To increase children's understanding of environmental conservation, it is important to engage them in learning that instills skills competence for environmental conservation (Tulim & Eva, 2020). To achieve this goal, teachers should adopt multimodal science instruction (OECD, 2020). The Kenya early childhood curriculum establishes guidelines for teaching children environmental education (Lilian, 2022). During this stage, children are taught concepts regarding environmental conservation through environmental activities learning area.

Environmental degradation exacerbated by unsustainable resource utilization and inadequate educational instructions is a matter of concern in Kenya and especially in Tharaka Nithi County as it has led to significant environmental and socio-economic consequences that include among others loss of biodiversity, reduced agricultural productivity and drying up of wetlands, which are critical for biodiversity, making it difficult for both humans and livestock to survive. This contributes to increased poverty levels as agriculture and pastoralism, the main sources of income for most households in Tharaka Nithi County to decline. To address these issues, sustainable environmental conservation practices are essential for restoring ecosystems and improving the well-being of local communities. Successful acquisition of environmental conservation core-competencies in the early years of education is necessary to nurture a generation of environmentally conscious individuals (Hernández-Barco et al., 2020). To increase learners understanding of environmental conservation, the competence based curriculum frames learning on a continuum of acquisition of certain core-competencies (Nguyen, 2021).

Instructional approaches such as direct instruction, demonstration, group work, play activities, rote learning and recall, drawing and singing are overly engaged in teaching of environmental conservation lessons in Kenyan classrooms (Bitok, 2020). Akala (2021) argues that early childhood education should follow a child-centred approach that prioritizes play, participation, theme-based learning, multimodality, the use of

tangible manipulative materials, early stimulation, and holistic learning. However, there lies a paradox as to which instructional approach produces the best results for environmental conservation especially with grade three learners. The nexus of environmental problems experienced in Kenya and especially in Tharaka Nithi County is a matter of concern. The drying of mainstream rivers, scattered solid waste, and water pollution are issues of concern for the citizenry of Tharaka Nithi County (Kaua, Mutheu & Thenya, 2019). Probably, the persistence in environmental problems in Kenya and by extension in Tharaka Nithi County is due to non-use of appropriate instructional approaches in environmental activities with children at the early years' education level. Therefore, the study examined the influence of multimodal instructional method on learners' skills competence for environmental conservation in Tharaka Nithi County, Kenya.

1.2 Statement of the Problem

In an ideal educational landscape, learners engaged in multimodal instructional methods for environmental education would possess a comprehensive understanding of environmental conservation core competencies. Such learners would demonstrate critical awareness of sustainability practices, actively engage in environmental stewardship, and collaborate effectively with their peers and communities to implement resource-efficient solutions. Consequently, a generation that is equipped with green skills required to address urgent environmental challenges, such as pollution, biodiversity loss, and climate change, would arise. However, significant gaps exist between this ideal and the current reality, particularly in Tharaka Nithi County. Unlike more resource-endowed regions of Kenya, where multimodal instructional strategies are effectively integrated into curricula and widely adopted, Tharaka Nithi struggles with limitations in educational resources, teacher training, and pedagogical challenges. Data indicates that while auditory methods are predominant in the region, visual, tactile and digital modes of instruction are underutilized, hampering the development of a robust understanding of environmental conservation among learners.

Efforts by stakeholders in the education sector, including government agencies and non-governmental organizations, have aimed to enhance environmental education through workshops, seminars and curriculum reforms. However, these initiatives often prioritize direct actions over pedagogical innovations, neglecting the crucial role that

instructional methodologies play in shaping learners' environmental competencies. To bridge the gap between the current state and the ideal, a more strategic focus on the implementation of multimodal instructional methods was necessary. However, little is known about how multimodal instructional activities can enhance sustainable environmental conservation. Therefore, it was imperative to for this study to address this lacuna by examining the influence of multimodal instructional method on learners' environmental conservation core-competencies in lower primary schools

1.3 Purpose of the Study

This study examined the influence of multimodal instructional method on the core-competencies of environmental conservation (creativity and innovation, communication and collaboration, and critical thinking and problem solving) exhibited by learners in lower primary schools in Tharaka Nithi County, Kenya.

1.4 Research Objectives

The following specific objectives guided the study:

i. To assess the multimodal instructional activities used in presenting environmental conservation lessons in lower primary schools in Tharaka Nithi County, Kenya.
ii. To examine the frequency of utilization of multimodal instructional activities in delivering environmental conservation lessons in lower primary schools in Tharaka Nithi County, Kenya.
iii. To determine the influence of multimodal instructional method on learners' acquisition of environmental conservation core-competencies in lower primary schools in Tharaka Nithi County, Kenya.
iv. To analyze pedagogical challenges associated with implementation of multimodal instructional methods in delivering environmental activities lessons in lower primary schools Tharaka Nithi County, Kenya.
v. To determine the effectiveness of utilizing multimodal instructional model guidelines in enhancing acquisition of environmental conservation core-competencies among learners in lower primary schools in Tharaka Nithi County, Kenya.

1.5 Research Questions

The study sought to answer the following research questions:

i. What multimodal instructional activities are teachers utilizing to deliver environmental conservation lessons in lower primary schools in Tharaka Nithi County, Kenya?
ii. To what extent are multimodal instructional activities being utilized to present environmental conservation lessons in lower primary schools in Tharaka Nithi County, Kenya?
iii. What pedagogical challenges are associated with delivering environmental conservation lessons in lower primary schools in Tharaka Nithi County, Kenya using multimodal instructional method?

1.6 Hypotheses

The following null hypotheses were tested at 0.05 level of significance:

$H_0$1: There is no statistically significant influence of multimodal instructional activities on learners' acquisition of environmental conservation core-competencies in in lower primary schools in Tharaka Nithi County, Kenya

$H_0$2: There is no statistically significant effectiveness in applying multimodal instructional model guidelines to enhance learner acquisition of environmental conservation core-competencies in lower primary schools in Tharaka Nithi County, Kenya.

1.7 Significance of the Study

The Ministry of Education can make informed decisions form the findings of this study that enhance the quality and effectiveness of environmental education, ultimately contributing to the development of a more environmentally conscious and competent generation. The Ministry may also use the findings of this study to raise awareness among parents and communities about the importance of environmental education and how they can support it at home and in the community. The Ministry may use the findings to allocate resources more effectively, investing in the necessary materials and technologies to support multimodal instruction.

Findings may be helpful to curriculum developers at Kenya Institute of Curriculum Development. Specifically, the study will provide evidence on the effectiveness of

multimodal instructional learning activities, guiding the development of a more engaging and effective curriculum that integrates these methods to enhance environmental conservation education. Evidence from the study may support the formulation of policies that promote the use of multimodal instructional methods in teaching environmental conservation and other subjects.

The findings of the study may also give teachers insights into selection of multimodal instructional resources ultimately contributing to the development of a more environmentally conscious and competent generation. Effective multimodal instructional methods identified in the study can be scaled up and replicated in other regions, promoting widespread improvement in environmental education. The results of the current research may contribute to guiding teachers to the necessity of diversifying teaching methods, experiences, and educational activities that correspond to the preferred learning styles of learners. Teachers, who are curriculum implementers may incorporate or adopt multimodal instructional methods in teaching various environmental conservation topics. The information obtained from the study may also provide a platform for dialogue for advancing multimodal research.

1.8 Scope of the Study

The study aimed to identify the multimodal instructional methods utilized in environmental activities, assess the extent of their utilization and explore the challenges associated with their implementation. Additionally, the research involved designing, testing, evaluating and reflecting on the effectiveness of a multimodal instructional model guidelines in enhancing learners' acquisition of environmental conservation core-competencies. The study was conducted in lower primary schools, focusing primarily on Grade Three learners. This group was chosen because, in comparison to their colleagues in Grades One and Two, they are already engaging with environmental conservation themes more thoroughly and are becoming more adept at complex problem-solving activities. Data were collected from both learners and teachers using questionnaires, observation checklists, interview schedules, and pre-and post-tests. The data collection process took three months ensuring sufficient information was gathered to address the study's objectives.

1.9 Limitations of the Study

This study's limitations included:

i. Minimal implementation of multimodal instructions in early years' classrooms which necessitated additional training of teachers leading to extended data collection period with increased implications. External funding was sought from TransNation Sacco Society Limited which mitigated this challenge and made the research feasible.

ii. Inherent biases arising from teachers self-reported data. Self-reported data is limited by the fact that it rarely can be independently verified. However, the iteration aspect of the design-based research approach adopted for this study helped mitigate this challenge. Instead of relying solely on teachers' self-reported data, this study incorporated other sources of data, such as observations of teaching and learners work samples. Triangulating data from different sources further helped corroborate findings and provided a more comprehensive understanding of the research phenomenon, ultimately enhancing the validity, reliability and credibility of the responses.

iii. The observation method used for data collection introduced posed inherent reporting biases. However, the iterative design approach employed in this study helped minimize these biases, as repeated observations allowed for more reliable inferences to be drawn.

1.10 Assumptions of the Study

This study was based on the assumptions that:

i. Multimodal instructional approaches were identified as the preferred method for teaching environmental conservation to Grade Three learners in Tharaka Nithi County.

ii. Various modes of instruction were integral in meaning-making and competency formation.

1.11 Operational Definition of Terms

The following terms were operationalized as follows in this study:

Auditory Learning Strategies:	In this study means learning processes that are best accomplished via listening or using the sense of hearing such as speech or verbal explanations, open discussions, audio, music, sound, among others.
Core Competences:	Are skills that are necessary for one to be able to do a particular activity or job. They entail the abilities and skills that make up an individual's competitive advantage. In this study core competences refers to critical thinking and problem solving, imagination and creativity, communication and collaboration, cooperation, systemic thinking, and cognitive adaptability.
Environmental Activities:	Is a learning area in lower primary level of education in Kenya that entails the study of the relationship between man and his environment. It is an integrated learning area comprising science, social and agriculture activities. It comprises; the local natural environment and its care, social relationships, health practices and safety. This provides opportunities for the learner to explore, experiment and interact with the immediate environment. This enables the learner to acquire skills to; enjoy learning, promote good health, safety, environmental conservation and appreciate rich cultural diversity.
Environmental Conservation Knowledge:	In this study was applied to mean knowledge, general ideas or understanding of how the natural environment can be protected from destructive human habits.
Environmental Conservation:	In this study means practices adopted to protect environment from destruction and loss of species so that every living thing in it can have an improved quality of life.
General Competencies:	General competencies refer to broad, transferable skills and abilities that are not specific to a particular job or field but are valuable across various contexts. In this study, these

	competencies included knowledge, skills, attitude and behavior.
Instructional Methods:	Are a systematic way of teaching that involves specific steps and techniques to deliver content. In this study they will refer to activities within the multimodal instructional method which include visual, auditory, read/write and kinesthetic.
Kinesthetic Learning Strategy:	In this study means learning processes that are best accomplished through physical manipulation, touching and feeling (experiments and demonstration), movement (field trips).
Multimodal Instructional Method:	Refers to a teaching strategy that uses multiple ways or modes of presenting information to engage learners. This approach leverages various sensory channels such as visual, auditory, read/write and kinesthetic activities.
Multimodality:	Multimodality refers to communication by means of different modes. In this study the term will be used to describe visual, auditory, linguistic and kinesthetic modes.
Pedagogy:	The method and practice of teaching and concerns the study and practice of how best to teach. In this study the word will be used to refer to traditional and multimodal teaching and learning instructional methods.
Scientific Inquiry Skills:	Scientific inquiry skills in this study means science process skills such observation over time, pattern seeking, identifying, grouping and classifying, critical thinking, problem solving, inferring, predicting, experimenting, and communicating that children may use to find out answers to investigable issues.
Teacher Practices:	Teacher practices in this study refers to the various strategies, behaviors, and actions that teachers employ in the classroom to facilitate student learning and development. These practices encompass a wide range of instructional techniques, pedagogical approaches, classroom management strategies and assessment methods aimed at fostering student engagement, understanding and achievement.

Visual Learning Strategies: In this study means learning processes that are best accomplished via visual aids such as pictures, flashcards, video, video clips, diagrams, charts and pictorials.

CHAPTER TWO
LITERATURE REVIEW

2.1 Environmental Conservation Core-Competencies

In a broad scope, competencies can be defined as, context-specific cognitive dispositions that are acquired by learning and needed to successfully cope with certain situations or tasks in specific domains (Kiesler, 2023). In a narrow scope the notion of competencies in the context of education, refers to what a learner will be more capable of doing after completing the learning activity (Pereira, Amaral & Mendes, 2022). It is a common way of describing desired educational outcomes, which includes cognitive, functional, ethical and personal dimensions. Lozano, Merrill, Sammalisto, Ceulemans and Lozano (2017) introduced twelve competencies connected to pedagogical approaches. These are systems thinking; interdisciplinary work; anticipatory thinking; justice, responsibility and ethics; critical thinking and analysis; interpersonal relations and collaboration; empathy and change of perspective; communication and use of media; strategic action; personal involvement; assessment and evaluation; and tolerance for ambiguity and uncertainty.

Core-competencies are essential skills, abilities and attributes that are critical for success in various fields and life situations. They form the foundation for effective performance and adaptability, enabling individuals to navigate complex environments and achieve their goals (Marulanda-Grisales & Vera-Acevedo, 2023; Škrinjarić, 2022). Key core competencies that are essential in life for the 21st century learner include 1) critical thinking and problem-solving which entails the ability to analyze information, evaluate evidence, and develop solutions to complex problems, 2) creativity and innovation that pertains the capacity to generate new ideas, think outside the box and apply creative solutions to challenges, 3) communication that entails proficiency in expressing ideas clearly and effectively through various modes, including verbal, written, and digital communication, 4) collaboration and teamwork which implies the ability to work well with others, leveraging diverse perspectives and skills to achieve common objectives, and 5) digital literacy that pertains to the competence in using digital tools and technologies to access, manage and communicate information. Other vital core competencies for the 21st century learner according to Sommier and Vasques (2022) include adaptability and flexibility which means the capability to adjust to changing circumstances, learn new skills, and embrace new approaches, ethical and

responsible decision-making that entail making choices based on ethical principles, social responsibility and sustainability considerations and self-management and independence which implies the ability to set goals, manage time and resources effectively, and work independently with self-discipline.

According to Wang, Sommier and Vasques (2022), core-competencies can be developed through pedagogical approaches. According to the CBC curriculum design for grade three environmental activities in Kenya, the following core competences needs to be developed among learners: 1) communication and collaboration; 2) analytical and critical thinking; 3) problem-solving; 4) cooperation and collaboration (team-work); 5) imagination and creativity; and 6) learning to learn. It is therefore expected that learners shall apply these competences in solving environmental challenges for sustainable development, develop appropriate organizational, practical and technological skills for problem solving in conserving the environment and communicate environmental friendly messages through technological, verbal and non-verbal modes for conservation, improvement and protection of the environment.

The current study seeks to examine the influence of multimodal instructional method in aiding learners acquisition of communication and collaboration, critical thinking and problem solving, and creativity and innovation core competencies. This is important for several reasons. First, modern environmental conservation initiatives increasingly rely on team-based projects and collaborative efforts. Thus, effective communication and the ability to work well with others are crucial for success in this aspect. Second, Critical thinking and problem solving competencies are essential for making informed and logical decisions. This involves analyzing information, evaluating options, and considering potential outcomes. Further, these skills are also foundational for academic success, enabling learners to engage deeply with content, understand complex concepts, and perform well in assessments. Creativity and innovation are key drivers of competitive advantage in today's economy. Organizations seek individuals who can think outside the box and develop new ideas and products, services and processes that can drive economic growth and improve quality of life.

The rationale for comparing learning outcomes in terms of competences for environmental conservation using multimodal pedagogies first stems from the

recognition that different instructional methods can have varying impacts on learners' understanding, engagement, and retention of environmental concepts and skills. Secondly, by comparing the influence of multimodal pedagogies on learners' environmental conservation core-competencies, educators and researchers can assess which method is more effective in enhancing environmental conservation core-competencies among learners in lower primary schools. Understanding the relative strengths and weaknesses of each multimodal instructional method can inform instructional decisions and improve teaching practices. Thirdly, comparing learning outcomes of multimodal methods can help determine which method better sustains learners' interest and enthusiasm for environmental conservation topics.

Relevant literature from the global to the local context is presented in this section to provide a foundation for understanding the existing knowledge, theories and findings related to the research topic. This has helped situate the current study within the broader scholarly discourse and delineation of gaps requiring further investigation. Additionally, the literature offers insights into methodological approaches used in the related studies hence helping the current study to design robust methodologies avoiding potential pitfalls of the previous studies. Thus, by engaging with existing scholarly works, the current study will contribute meaningfully to the advancement of knowledge in the field and inform evidence-based educational practices in lower primary education level.

The impact of various instructional strategies on the learning outcomes of young children have been a topic of discussion among educators and developmental psychologists for many years. Policymakers are now focusing again on early childhood education to raise the educational attainment of minority children who are disadvantaged (Mukagihana, Nsanganwimana & Aurah, 2022). Very little research has been done to determine how well different pedagogical approaches work for teaching environmental education in lower primary school curricula, despite the fact that education is one of the most effective ways to mitigate the effects of environmental deterioration. The current study investigates how different pedagogical approaches can affect selected children's environmental conservation core competencies distinctively.

Previous studies have demonstrated the impact of instructional methods on learners' environmental conservation core-competencies, such as environmental attitudes and behaviors. In a study conducted by Shammas (2022) in Singapore that compared the effect direct and indirect learning approaches on learner competences for environmental conservation, it was established that direct instruction strategy was among the most commonly used. This strategy includes methods such as lecture, didactic questioning, explicit teaching, practice and drill, and demonstrations. The strategy was found to be ineffective in building learner competences for environmental conservation and effective in providing information that would easily be recalled and reproduced. That is, knowledge construction. Therefore, it can be argued that expository methods are only appropriate when content memorization and immediate recall is desired and not when life-long learning capability is desired.

The empirical evidence supporting the differences between child-centered and didactic instructional approaches for young children has not been strong enough to support the debate, even when it comes to achievement outcomes. In addition, research on the prerequisite knowledge, skills, attitudes, values, and experiences that are an essential component of a competency-based curriculum is currently scarce. In the context of the current study, advancing knowledge in the relationship of different pedagogical approaches and learners' competences for environmental conservation will not only contribute to the literature of sustainability education but also sheds light on how to develop useful pedagogical tools in purpose of empowering children to address environmental challenges. Hence, to fill this void, the current study sought to answer the question "what environmental conservation core-competences are demonstrated by lower primary school learners after interaction with multimodal instructional methods during environmental activity lessons in Tharaka Nithi County, Kenya?"

In Thailand, Wanchana, Inprom, Rawang and Ayudhya (2020) carried out a study focusing on the environmental education competency of secondary school teachers. The survey employed mixed research methods and data collected using questionnaires and structured interview. Findings of this study revealed that most respondents had a moderate level of environmental education competency that involved six aspects: knowledge of the environment, basic understanding of the environment, responsibility for the environmental education of professional teachers, planning and practice with

regard to the environmental education, promoting learning about the environmental education and evaluation of the environmental education.

Wanchana et al. (2020) suggest that approaches to enhance the environmental education competency of secondary school teachers should involve multidisciplinary instruction learning, community-based learning, project-based learning, happy teaching and learning, and holistic learning management. While the Wanchana et al. (2020) study provides valuable insights into environmental education competency and pedagogical approaches in secondary education, there are gaps in understanding how these findings translate to early years' education. Addressing these gaps through targeted research and professional development efforts can contribute to the enhancement of environmental education initiatives in early childhood settings. The current study will depart from Wanchana et al. (2020) study that explored teacher competences and focus on learners' core-competences. Understanding the competency levels of learners can inform efforts to strengthen environmental education initiatives in early years. In addition to collecting data using questionnaires and structured interview employed by Wanchana et al. (2020), the current study enhance triangulation by adding learners pre-and-post-tests as well as observation of classroom teaching.

In a study that involved 333 fourth-grade learners at primary schools in Croatia, Letina (2020) interrogated development of learners' learning to learn competence in primary science. The results of this research show that through inquiry-based teaching learners developed a higher level of the learning to learn competence than by using traditional teaching methods. Therefore, it is recommended to use inquiry-based learning as often as possible, because by developing the learners' learning to learn competence, learners will be empowered for the process of lifelong learning. In related studies experts at Stanford University systematically searched the academic literature and analyzed 119 peer-reviewed studies published over a 20-year period that measured the impacts of instructional methods in environmental education for K-12 learners. The review found clear evidence that environmental education programs provide a variety of benefits. Not surprisingly, the studies clearly showed that learners taking part in environmental education programming using varied instructional modes gained systems thinking, problem-finding, adapting, creative problem solving, visualizing and improving competences.

Mastery of environmental conservation core competencies is significant to a developing country like Kenya. Despite the fact that many studies in science process skills have been done in general, few studies have been specific on mastery of environmental conservation core competencies particularly in Kenya. One of the objectives of lower primary environmental activities curriculum in Kenya is to teach through the philosophy of interactive learning in which core competences are an integral part. In recognition of this pedagogical philosophy, it is important to investigate the level of mastery of environmental conservation core competencies which are relevant for the development of learners who are imaginative, creative, critical thinkers and problem solvers. There is a growing demand for flexibility in learning, innovations in teaching and mentoring and investments in coming up with a new breed of conservation learners, who are responsive and technically. Despite multimodal learning approach being touted to be among the most effective means of mitigating the effects of environmental degradation there has been very little investigation into the extent this pedagogical approach is being applied for teaching environmental education at lower primary education level in Kenya. This gap gives impetus to the proposed study. The results of this investigation offer insights into the extent of utilization of multimodal instructional methods in enhancing environmental conservation core- competencies among learners in lower primary schools in Tharaka Nithi County, Kenya.

A study carried out in South Africa focusing on learners' skills and knowledge of environmental education in selected primary schools of the Tshwane North District, Gauteng Province, Mashaba, Maileand Manaka (2022) found that learners in primary school were provided with adequate environmental educational knowledge and were able to contribute towards maintaining a clean environment and conservation in their communities. The study further established that teachers incorporated technology in their lessons thereby empowering learners to acquire skills and knowledge they can tap to expand their knowledge, talents, skills, and knowhow. Mashaba et al (2022) findings imply that competences for sustainable environmental conservation can be promoted in educational contexts through technology-enhanced learning which a multimodal learning strategy is. However, due to the complexity and intensive investment of time and resources, the accurate evaluation and reporting on the outcomes of instructional pedagogies on environmental conservation have been limited. It is important that proper

evaluations are conducted even though they require creative, careful, human-resource-heavy efforts to document.

In a study exploring the adequacy of environmental education techniques and strategies employed to instill environmental conservation competences in Uluguru Mountains Hotspot, Tanzania, (Manase, 2016) noted that, environmental education methods implemented in Uluguru Mountains are not satisfactory enough to improve learners' competences for action on the current environmental conditions. In addition, Manase (2016) avers that indigenous knowledge has been less integrated into environmental education and recommends that different environmental education methods need to be improved and integrated to create sustainable learning outcomes within environmental education. Manase (2016) findings suggest that the environmental education techniques and strategies employed in the Uluguru Mountains Hotspot in Tanzania may not be sufficient to effectively instill environmental conservation competences in learners. This implies that a critical assessment of the environmental education methods used in early years' education in Kenya is necessary to ensure they are adequate and impactful. In the context of early years' education in Kenya, there is a need to prioritize the development of environmental conservation core-competencies that empower young learners to become environmentally responsible citizens capable of addressing current and future environmental challenges.

Manase (2016) findings further highlights the underutilization of indigenous knowledge in environmental education. This finding suggests the importance of incorporating indigenous perspectives, practices, and traditional ecological knowledge into early years' environmental education curricula in Kenya. Recognizing and valuing indigenous knowledge can enrich environmental education experiences and enhance learners' connection to their cultural and environmental heritage. Overall, Manase's (2016) findings underscore the importance of critically evaluating and improving environmental education methods, integrating indigenous knowledge, and fostering sustainable learning outcomes in early years' environmental education in Kenya. Addressing these implications can contribute to the development of environmentally literate and empowered young citizens capable of contributing to environmental conservation efforts in their communities and beyond. To respond to the purpose of this study, a research-based design shall be adopted to explore teachers' multimodal

teaching experiences and find out how correct blending of multimodal approaches could improve learners' core-competencies for environmental conservation.

Studies carried out in Kenya by Kariuki, Kathambi and Inyega (2023); Ndonye (2022); Lilian (2022). Nyika and Mwema (2021) and Burer (2014), indicate that project-based learning, problem-based, inquiry-based and reflective learning in environmental activities curriculum, encourages creativity, critical thinking and respect for cultural diversity and creation of a sustainable society. For instance, the study by Burer (2014) that surveyed the influence of environmental education on conserving natural environment in Moiben constituency in Uasin Gishu County, established that experiential education involving field trips, nature walks, and conservation projects not only help learners gain firsthand knowledge but also cultivate a sense of responsibility and stewardship in them. Conservation projects, such as tree planting initiatives or environmental clean-ups, allow learners to actively contribute to environmental conservation and witness the positive impact of their actions. These experiences foster a lasting appreciation for nature and motivate learners to take action to protect and conserve their surroundings. This outcome is rooted in systemic thinking, communication, teamwork, problem solving, civic engagement and critical thinking competencies. The current study examined the communication and collaboration, critical thinking and problem solving as well as imagination and creativity core-competencies.

Nyika and Mwema (2021) established that, instructions in formal education cannot provide a platform for better conservation of natural resources because of its target population. This is because it does not give opportunity for the learner to have contact with the environment and make environmental conservation more practical. Thus it is not flexible enough but improves learners' knowledge and attitudes toward the environment. The study further established that experiential pedagogies help learners to know about their environment, identify problems concerning the use of natural resources, seek alternative solutions to environmental problems, and instills commitment action taking to alleviate environmental problems. These are rooted in problem-solving competencies which is one of the selected competence that the current study seeks to examine.

Nyika and Mwema (2021) therefore argue that teaching and studying environmental studies should include relevant pedagogies adequate to give learners opportunity to master cognitive flexibility and problem-solving skills. By fostering critical thinking, problem-solving skills, and a deep understanding of environmental systems, education equips individuals with the tools to navigate and contribute to the sustainable solutions needed for the future. Instructions in education also develops resilience, creativity, and teamwork among learners, preparing them to be future leaders with the know-how to handle challenging environmental issues. Therefore, in an attempt to fill in the knowledge gap in lower primary education level, the current study poses the following question: "Which environmental conservation core competences are observable in learners after engagement with multimodal instructional methods?" Because of this, the study aims to evaluate three selected environmental conservation core-competencies (communication and collaboration, critical thinking and problem solving, imagination and creativity) that learners in lower primary schools in Tharaka Nithi County, Kenya display after interacting with multimodal instructional methodologies.

2.2 Lower Primary Environmental Conservation Education and Multimodal Learning Activities

A comprehensive discourse of environmental activities for lower primary level grades in Kenya is given in section 2.2.1. To enhance the effectiveness of environmental conservation lessons, multimodal learning activities have emerged as a valuable pedagogical approach. These activities integrate various teaching methods such as visual, auditory, kinesthetic and digital tools catering to diverse learning styles and promoting active engagement. A comprehensive review of literature on multimodal learning activities is provided in section 2.2.2.

2.2.1 Lower Primary Environmental Conservation Education

Environmental conservation education is an integrated learning area in lower primary education in Kenya comprising both environmental, hygiene and nutrition concepts. The learning area endeavours to nurture an engaged and environmentally aware citizen through acquisition of green skills that encompass a broad range of knowledge, skills, attitudes, values and competencies that contribute to the development of sustainable environmental (Chisika & Yeom, 2024).

Green skills are increasingly important as the world shifts towards more sustainable economic models and strives to meet global environmental goals such as those outlined in the Paris Agreement and the United Nations Sustainable Development Goals (SDGs) (Lieponienė, Micevičienė & Sargūnas, 2023). Educational instruction plays a crucial role in developing green skills by integrating sustainability concepts into curricula and fostering the necessary competencies for a sustainable future. Environmental education, according to United Nations Educational, Scientific and Cultural Organization (UNESCO) is a well-established field that focuses on how humans interact with the natural environment, how to conserve and preserve it, and how to manage its resources responsibly (Yadav, Banerjee, Jhariya, Meena, Raj, Khan & Sheoran, 2022). It is defined by scholars like Saber Garekani, Tajik, and Etemad Ahari (2022) as the type of education that incorporates the infusion of knowledge, skills, and attitudes related to environmental awareness and practices. It covers all facets of training, including field trips, excursions, and environmental symposiums at all educational levels. Learners are exposed to information about their surroundings and the appropriate behaviors that are connected with them through environmental education. While there are many ways to promote environmental education, including conferences, media education, online, and advocacy work, it is generally agreed that schools are the primary forum for doing so. The school is one of the powerful agents through which knowledge, practices and conventions are transferred from one generation to the other. Undoubtedly, the school's role in ensuring best practices towards the environment cannot be questioned.

The components of environmental education according to Saber Garekani, Tajik and Etemad Ahari (2022) are: awareness and sensitivity to the environment and environmental challenges, knowledge and understanding of the environment and environmental challenges, attitudes of concern for the environment and motivation to improve or maintain environmental quality, skills to identify and help resolve environmental challenges and participation in activities that lead to the resolution of environmental challenges. Thus, early exposure to environmentally conscious education influences how learners will perceive and engage with the environment as future citizens, and this influence will continue throughout adulthood. According to Ramírez et al. (2023), it teaches people how to maintain ecological balance and the connection between environmental protection and humankind.

Environmentally responsive education has been identified as a major way through which knowledge about the environment is imparted to learners so as its desirable behaviours (Ajaps & Forh-Mbah, 2022). Teaching learners to act for the environment is essential. Its aim is to develop an informed citizenry that is environmentally conscious and motivated to actively participate in managing and sustainable use of its environment (Gani, Razali & Burhansyah, 2023). Environmental education helps to foster a sense of responsibility and ownership among learners. Learners learn about the importance of biodiversity, the impact of climate change, and the role that humans play in shaping the environment. This knowledge can motivate action to reduce the impact on the environment and advocate for more sustainable practices in communities. Environmental education is vital to the survival of mankind. Without educating the masses, they will continue to mismanage and destroy the environment on which their existence depends. Considering the profound roles of teachers in the formation of environmentally literate citizenry, the study analyzed teacher practices in the teaching of environmental activities in lower primary schools in Kenya with reference to Tharaka Nithi County.

Environmental education however does not advocate for a particular viewpoint, practice or course of action. Rather, environmental education teaches individuals how to weigh various sides of an issue through critical thinking and it enhances their own problem-solving and decision-making skills (Gale, Chapman, White, Ahluwalia, Williamson, Peacock & Cooke, 2022). Through environmental education, people can learn about environmental challenges, find solutions to problems, and take action to safeguard the environment. By teaching learners about the importance of protecting the environment, educators can inspire behavior changes that will help protect the planet for future generations. In pondering the profundity of research which promotes the effectiveness of an environmentally based education, the question becomes, what instructional practices are teachers engaging in while teaching environmental activities in lower primary schools?

The growing concern with environmental issues and their impact on general awareness is one of the most noticeable phenomena of the 21st century (Marques & Xavier, 2020). In this vein, UNESCO-UNEP suggested that learners at all learning levels, in particular, require new environmental attitudes, skills, expertise, understanding, and behaviors

(Nyika & Mwema, 2021). The UN Agenda 2030 Sustainable Development Goal (SDG) 13 take urgent action to combat climate change and its impacts includes a target to improve education processes, although how the target might be met is not specified. Mónus (2022) posits that education is the most effective means that society possesses for confronting the challenges of the future. Thus, educating the citizenry is the best way to cope with environmental problems and challenges facing the world. Van de Wetering, Leijten, Spitzer and Thomaes (2022) believe that the teaching of environmental studies will help learners develop knowledge, skills and positive attitudes towards the environment from a very early stage. Van de Wetering et al. (2022) further asserts that environmental education would create environmentally conscious individuals since it would provide them information, skills, concern, and favorable attitudes toward the environment. Environmental education is, therefore, necessary to teach and learn.

Over the years, there has been a growing recognition that education should be more than the traditional transmission of knowledge and skills but should also emphasize the development of critical thinking skills, problem-solving abilities, creativity, and social and emotional skills (Kim & Lee, 2022). To achieve this, many innovative educational approaches have emerged, such as project-based learning, inquiry-based learning and experiential learning which aim to engage learners' actively in learning and provide opportunities to apply knowledge and skills in real-world contexts (Piotrowska, Cichoń, Sypniewski & Abramowicz, 2022). Overall, adoption of innovative pedagogical processes in education is a crucial intervention that will play a critical role in shaping individuals, societies and the world at large towards taking an active part in seeking and implementing solutions to the problems facing them in their environment.

Environmental education has been delivered in a variety of ways. In Kenya, environmental education is an essential part of the lower primary school (grade 1, 2 and 3) curriculum nested in environmental activities (that includes hygiene and nutrition activities) under the rationalized learning areas in CBC (Matere, 2024). To inform current debate around the rapid depletion of earth's natural resources and the fast degrading environment with adverse effects such as droughts, floods, drying of water sources and other environmental phenomena in Kenya and Tharaka Nithi County in particular, the proposed study aims at establishing current teacher practices in the

teaching of environmental activities in lower primary schools. Reflecting on examples of success and failure within the field from a diverse range of empirical studies will provide voices that will be useful both in theory and practice. Some scholars have suggested that curriculum reforms designed to improve environmental quality have been more rhetorical than substantive in their impact in classrooms and schools, thus exposing the misalignment between policy aims and practice.

In America, Teddlie, Stringfield, Wimpelberg and Kirby (2022) established that teachers employed contextual approaches such as field trips to local ecosystems, conservation areas, or even industrial sites can provide children with a firsthand understanding of environmental concepts and issues. These experiences allow children to directly observe the impact of human activities on the environment and understand the importance of sustainable practices. Zhang and Ma (2023) and de Oliveira Biazus, and Mahtari (2022) also found that teachers used the project-based learning which is an approach that encourages learners to undertake projects related to real-world environmental issues. For example, children can develop a recycling program for their school or community or create a local biodiversity map. This enhances children's understanding of the issue and develops problem-solving and critical thinking skills. In support of field trips and project-based learning as vital instructional approaches in lower primary schools, Wulansari, Oktariani and Pulungan (2023) points that contextual learning has a profound impact on learners' outcomes, particularly in the field of environmental studies. It enhances learners' understanding of environmental concepts and issues and contributes to their personal and social development. Wulansari et al. (2023) advises that educators can make environmental studies more engaging and relevant for learners, ultimately fostering a deeper understanding of the subject and empowering learners to contribute to environmental conservation efforts.

In United Kingdom (UK) schools are required to deliver a broad and balanced environmental education curriculum that is considered precursors of education for sustainable development. According to Dunlop and Rushton (2022) environmental education topics are incorporated within the core subjects, notably geography and science and citizenship allowing learners to understand the interconnectedness of human actions and environmental outcomes. The findings of a related study in England by Hallam, Gallagher and Owen (2022) reveal that children in stages 1 and

2 of their primary level schooling are encouraged to learn about the environment through local, national and international events, observing things that had changed people's lives through the years and cross-curricular approach. Cross curricular learning is a way of organizing the curriculum so that subjects are taught in an integrated way rather than as discrete, stand-alone areas (Sharma, 2023). The benefits of a cross-curricular approach to teaching according to Sharma (2023) include: supporting learners' overall achievement, classroom organization, lesson planning, and educator confidence. When a lesson or activity integrates two or more subjects, educators can teach and practice more quickly than in two back-to-back single subject lessons. Learners also benefit from these time-saving, multifaceted learning opportunities by being exposed to the interconnectedness of different subjects which provide a new perspective on learning (Sharma, 2023).

While studying cross-curricular teaching within the learning outcomes framework: The experiences of primary teachers in two state schools in Malta, Europe, Hili and Schembri (2022) found that cross-curricular integration is a powerful approach that motivates learners, strengthens their understanding and allows more learning in limited class time. As educators, we know the importance of providing learners with a well-rounded education that prepares them for success in the real world. However, according to Sharma (2023), implementing the cross-curricular approach in teaching environmental education is difficult due to challenges for the relevance of sustainability for each subject involved. To help tackle the awareness gap between subjects and a lack of resources and promote school-wide sustainability of cross-curricular approach, the current study will explore a way to integrate cross-curricular key competencies into classroom teaching practices in lower primary school to promote children's learning of environmental activities with particular emphasis to multimodality.

In a study of the current state of environmental education in primary and secondary (K-12) schools in Boyacá, Colombia, Ramírez Suárez, Acosta-Castellanos, Castro Ortegon and Queiruga-Dios (2023) established that educators used hands-on outdoor learning and field trips and encouraged the planting of trees, recycling, greening schoolyards, to deliver environmental education lessons. The findings also reflected that the majority of the teachers did not discuss the different perspectives of environmental issues. When they discussed, they did not encourage learners to form their views and ideas on

different environmental issues. Along this line, the study advocated for the development of instructional materials and training for teachers in the teaching and integration of environmental education in the different subject areas. Using this conceptualization, the current study intended to develop an instructional model that would assist teachers in lower primary schools in using multimodal instructional approaches when teaching environmental activities.

In Africa, the initiatives of introducing environmental education at the primary school levels were developed by Science Education Programme for Africa (SEPA). In 1971 SEPA produced A Guide to the Study of the Environment which deals with broad man-made and natural environmental concerns. Educators in Africa have since been active in the development of SEPA and its activities in organizing, disseminating and teaching of environmental science. Hitherto, environmental education processes in Africa have been adopted to address issues such as poverty, equity, biodiversity, health, sanitation, water and food security (Hassan & Umar, 2024). New emerging areas of environmental education praxis include a focus on climate change. Many countries in Africa have adopted a formal environmental education curriculum designed as part of program to combat impacts of climate change sustainably (Yadav et al., 2022). In Ethiopia for example, the general education curriculum framework places strong emphasis on fostering environmental care and protection in primary schools and creating civically engaged learners (Gugssa, 2023). The framework stipulates that cultivating environmentally active learners will only be achieved if opportunities are provided for learners to take active roles in their learning through exploring, observing, having first-hand experiences, and acting.

In a study characterizing environmental education practices in Ethiopian primary schools, Gugssa (2023) established that teachers were delivering environmental education content using hands-on and place-based activities as well as taking local actions. The findings however indicate that despite the teachers favoring these learner-centered and experience-based strategies, their self-reported teaching approach tended to be teacher-dominated and classroom-based. Large class size, training and capacity, and safety issues were identified as barriers to teaching environmental topics. This leads to the assumption that in most schools in Ethiopia, environmental education initiatives are limited in their effect on children's behaviour. Lessons that are based on the

transmission of knowledge cannot generally be transformed into environmental behaviors and action competence (Krasny, 2020). Devising teaching strategies that can empower learners and enable them to engage willingly in environmental actions is crucial. The current study sought to establish whether multimodal instructional approaches were part of the current teaching practices of early childhood teachers in Kenya, with reference to Tharaka Nithi County.

Environmental education continues to be a crucial component of curricula at all levels of education in the East African countries such Rwanda, Uganda and Tanzania. In these countries, teacher practices in teaching environmental education is largely informed by developments and trends in the international environmental education arena and promoted through formal curricula instructions (Nalumenya, Rubinato, Kennedy, Catterson, Bakamwesiga & Blackett, 2023). Findings obtained from a study conducted in Tanzania by Mugabe, Mbah and Apollo (2022) reveal that teachers were delivering environmental education lessons through a wide range of teaching approaches such as projects or inquiry, integrative teaching, as well as using cooperative and problem-based learning approaches. The study by Mugabe et al (2022) further elucidates that teachers have also engaged learning activities such as play and drama to nurture, creativity, imagination and thinking that would ultimately result in enhanced learner competences for environmental conservation, outdoor-based learning activities such as collecting scrap paper, sorting waste, and taking care of plants to instill positive values and raise awareness about ecology and direct instruction that involves the teacher explaining the concept or skill to be learned, modeling the correct behavior or procedure, guiding learners through the learning process, and providing feedback and support as needed. This took many forms, including lectures, demonstrations and guided practice activities.

Banamwana, Musoke, Ntakirutimana, Buregyeya, Ssempebwa, Maina, and Tumwesigye (2022) laments that, very little research has been done to determine how effective the various instructional approaches used to teach environmental education in pre-primary school curricula are at mitigating the effects of environmental degradation. The goal of the proposed study is to fill in this gap. The environment is a subject of global discussion and concern and it is important that any aim to improve the vehicle (schooling) of capacity building in environmental issues be investigated. This provides

the basis of additional studies in the sense that such studies will locate the changing practices of teachers as per understanding of policy, personal beliefs and other factors which exist in developing countries like Kenya. Thus, this study contributes towards the development of teachers' pedagogic knowledge and practice, by serving as a reflection of their practice specifically in environmental education.

In an attempt to address environmental challenges, education for sustainability has become an imperative in many countries (Kariuki-Githinji, Boyo, Bowen & Kiambi, 2022). Kenya is one of the leading countries in the implementation of environmental education and training programmes at all levels of education (Osuntuyi & Lean, 2023). In Kenya environmental education is carried out in two dimensions (Chisika & Yeom, 2023). One dimension is geared towards teaching about nature and ecology, in subjects like biology, natural science and geography. This approach is used in the classroom situation where the teachers have to follow a given curriculum. The second dimension involves creating awareness, developing skills and active participation. This method is used in school to a small degree in the extra curriculum activities schools have clubs such as environment clubs, young farmers' clubs, geography clubs and wildlife clubs, in which learners' members take part in various environment awareness and conservation activities. But their existence and operations is a matter of concern.

The lower primary school environmental activities learning area in Kenya aims to help learners acquire appropriate practical skills and values for problem solving in conserving the environment, communicate appropriate messages for conserving the environment, demonstrate appropriate values, attitudes and practices for sustainable interactions, explore the natural resources in the immediate environment for learning and enjoyment, practice proper hygiene and good health habits to promote the well-being of self, others and the environment, apply acquired competences in solving environmental challenges for sustainable development, participate in community service learning to promote environmental and social well-being, observe safety precautions to limit risks to self and others while exploring the environment and appreciate the country's rich and diverse cultural heritage for harmonious living in the community (Osuntuyi & Lean, 2023).

In a study assessing the status of pedagogical approaches for environmental education in Kenya, Kariuki, Kathambi and Inyega (2023) found KICD had developed three approaches for environmental education as follows: a) teaching from the environment, b) teaching about the environment, and c) teaching for the environment. In addition, Lilian (2022) also established that KICD in conjunction with UNESCO had devised twelve broad instructional methods to be applied in the teaching of environmental education in primary schools. These teaching processes take the form of inquiry, experiential learning, project-based learning, service-learning among other critical pedagogies.

Environmental education is vital to promote knowledge, skills, attitudes, and practices to solve environmental problems, in the long run building a sustainable environment for current and future generations. This study aims at determining the current teacher practices in the teaching of environmental activities in lower primary schools in Tharaka Nithi County. In Kenya, educators utilize largely behaviorist teaching approaches that tend to be teacher-centered rather than student-centered (Otachi, 2023). According to Martínez, Ruíz-Munzón and Buil-Fabregá (2022), these behaviorist teaching approaches are not ideal for teaching skills, knowledge and dispositions essential to globalization, although they play a crucial role in the processes of teaching and learning.

A study carried out by Otachi (2023) in Nyamira County found that teachers in lower primary schools in Kenya have been teaching environmental studies using themes that have been mainstreamed in the school curriculum with a major objective of reducing the negative impact of human activities on the environment using exclusively teacher-centered teaching strategies. Otachi's (2023) findings also reveal that teachers are using a range of teaching methods that include: direct instruction or speaking, group work, rote learning, games, play, projects, textbook reading, modelling and experiments among other methods. It should be noted that teachers employ a given method depending on the topic of study and the level of the learners (Domenici, 2022). Lately, the emphasis on science teaching methods is on those methods that are more practical and experiential, for instance, experimentation, engagement in real activities, play and games. Rather, the use of learner-centered instructional approaches is preferred.

According to Sinakou, Donche and Van Petegem (2022), poor teaching results when the teacher employs an inappropriate instructional method in teaching. An inappropriate method makes the learners lose the motivation and interest to learn and creates a negative attitude in the learners about the topic and consequently leads to low learning outcomes. Thus, arguments about teachers' classroom pedagogical practices makes it imperative to ascertain what pedagogical methods teachers are employing in their regular interactions with grade three learners. It is for this reason that the current study seeks to explore current pedagogical practices in the teaching of environmental activities in lower primary schools in Tharaka Nithi County, Kenya. Previous researches have not sufficiently focused on upcoming instructional approaches such as multimodal instructions. In addition, some of the reviewed studies have focused on higher levels of education mainly secondary schools while the current study focused on lower primary school level which is the foundational stage at which basic literacy skills should be acquired and strengthened.

Kenya's education curriculum falls short in addressing the unique characteristics of learners, such as interests, competencies, and regional differences in environmental conservation behaviours (Walker, Bruyere, Zarestky, Yasin, Lenaiyasa, Lolemu & Pickering, 2022). Experts have raised concerns over the lower primary school curriculum, saying it could be defective in this front (Chisika & Yeom, 2023; Kariuki et al., 2023). This implies that inadequate environmental conservation competencies among learners that could be rooted in the kind of instruction they receive right from early childhood (Bendini & Devercelli, 2022). It is possible children are only being taught to pass examinations at the expense of their holistic educational development. It has been a common practice that teachers only concentrate on aspects that are to be examined and skip the aspects of developing of core competences (communication and collaboration, critical thinking and problem solving, imagination and creativity, citizenship, digital literacy, learning to learn and self-efficacy) (Kirimi, 2016).

According to Kinuthia (2023) the current lower primary school curriculum does not adequately equip learners with competencies to meet Kenya's aspirations for environmental conservation as enshrined in article 42 of Kenya constitution 2010. The result is that learners transit to primary schools with lack of practical skills, competences and desired attitudes for environmental conservation due to over

concentration on theoretical skills. Sufficient instructional efforts should be committed to learning activities and experiences that make children have a sense of personal responsibility to environmental degradation. Thus, an important focus of this study was the multimodal instructional methods currently being utilized to present environmental conservation lessons in order delineate gaps that needed to be addressed through an empirical study.

2.3 Multimodal Instructional Learning Activities

Extant studies focusing on multimodal instructional methods have defined multimodal instruction as a teaching method that incorporates multiple sensory channels (such as visual, auditory, kinesthetic, and tactile) to deliver content and engage learners (Firmansyah, 2021; Jiang, Yu & Zhao, 2022). Key components of multimodal instruction include 1) visual learning activities that incorporating images, diagrams, charts, videos, and other visual aids to help students understand and retain information, 2) auditory learning activities that involve use of spoken language, music, sound recordings, and other auditory elements to reinforce learning, 3) reading/writing that involves engaging learners through reading and writing activities, including textbooks, articles, essays, and digital texts, 4) kinesthetic or tactile which entails engaging leaners in hands-on activities, physical movement, experiments, and real-world applications to help them learn by doing, 5) technology integration which entails utilizing technology such as interactive whiteboards, educational software, online resources, and multimedia presentations, 6) collaborative learning that incorporates group work, discussions, peer teaching, and cooperative learning to enhance understanding and teamwork and experiential learning that entail providing opportunities for students to learn through direct experience, such as field trips, simulations, and role-playing.

The foundation of multimodality lies upon the idea that different modes have different affordances for meaning making. Thus, multimodal learning recognizes that learners have different learning styles and preferences, and aims to cater to these diverse needs by presenting information in various formats simultaneously. Multimodal instructions have become increasingly popular in science education (Lu, Mishra, Xia, Qiu, Chang, Zhu & Kalyan, 2022). This approach recognizes that individuals learn in different ways, and by incorporating multiple modes of instruction, teachers can enhance the learning experience for their learners. Multimodal instruction enhances learning in two ways:

first, by allowing learners to experience learning in the way they are most comfortable, and second, by challenging students to experience and learn in other ways (Lian, 2022; Lilian, 2022). There are mainly four multimodal instructional strategies that teachers can use to deliver environmental activities lesson. These include visual, auditory reading and writing and kinesthetic commonly known as VARK (Chaudhry Ashar & Ahmad, 2020). Trends in contemporary education has added some other three that include interactive technology, collaborative and experiential typologies.

2.3.1 Visual Learning Activities

In visual learning, the learner relies on visual perception and visual memory and learns better by seeing the educational material, such as drawings, charts, videos, illustrations, shapes, graphic and graphic representations, artwork and other visual techniques (Simons, McHugh, Appling, Harris & Burgoon, 2022). In the process of absorbing information, learners often try to visualize the information they receive. It is therefore crucial for teachers to use incorporate images, diagrams, charts, videos, and other visual aids to help students understand and retain information.

2.3.2 Auditory Learning Activities

Auditory learning activities refers to a method where learning takes place through oral conversations, listening to lectures, discussions, audio recordings and other oral and audio practices (Abdelkader & Qashoush, 2019). Teachers often use group discussion and presentation learning methods to improve learners' communication skills and self-confidence. Auditory instructional methods stimulate learners to convey their knowledge and listen to new information. According to Kirchhoff and Mision (2022), auditory learners get information by listening and prefer to listen rather than read or write. They can reproduce symbols, letters or words by hearing them. Getting information from written texts is more difficult to them than spoken. They enjoy dialogue, drama, dictation and love music. Auditory instructional methods enhance the learners' ability to listen and learn better in the material, as this pattern works on the breadth of auditory perception and auditory memory through which the educational material is better learned.

2.3.3 Reading and Writing Activities

Reading and writing learning activities entails learning through texts, notes and written explanations (Walldén, 2022). Learners that thrive in this learning style like being in a quiet place to read and process information obtained from books and other text media. The learner draws new knowledge from the ideas and meanings read and written. In order to facilitate learning, learners require books, references, dictionaries, articles, pamphlets and worksheets, in addition to written works and notes taken and their summaries. This multimodal instructional method has the ability to develop learners' expression in writing and communication skills as it works to broaden the comprehension of the ideas and meanings read and written.

2.3.4 Kinesthetic or Tactile Activities

Kinesthetic learning activities entails learning through hands-on experiences and manipulative activities (Carr, Schoephoerster & Riegel, 2024). Kinesthetic learners highly favour practicums and learning involving other physical activities. They like learning that engages them in activities accompanied by hand and body gestures (Carr et al., 2024). Because they prefer hands-on activities, these learners want learning accompanied by a practicum, games and other physical activities. They tend to be able to receive information maximally by movement rather than sound, writing or pictures. In science learning, kinesthetic learners tend to be more active in trying and asking questions and have a very high curiosity which encourages them to be engaged in learning. In this method, the learner relies on his tactile perception to learn ideas and meanings. Learner that prefer the kinesthetic style learns better through manual work, conducting experiments and movement activities. According to Carr et al. (2024) kinesthetic learning method has a great impact on learners' acquisition of critical thinking, problem solving and innovation skills. This information is significant to teachers in the sense that insights gained can help them to implement learning activities that will enable learners acquire sustainable environmental conservation core-competencies.

2.3.5 Interactive Technology Learning Activities

Interactive technology, as a multimodal instructional strategy, leverages digital tools and resources to create engaging, dynamic learning experiences that cater to diverse learning styles (Lasaiba, 2024). Resources for this strategy may include use of

interactive whiteboard and smartboards, tablets, educational apps, virtual reality, online collaborative platforms and multimedia presentations. This instructional mode not only captures learners' attention but also allows them to explore and manipulate content in ways that enhance understanding and retention. Moreover, interactive technology supports differentiated instruction, providing personalized learning pathways that meet individual needs and promote active, student-centered learning (Lasaiba, 2024). By fostering greater engagement and collaboration, interactive technology helps develop critical 21st-century skills such as digital literacy, problem-solving, and teamwork, preparing students for future challenges in a technology-driven world.

2.3.7 Collaborative Learning Activities

The collaborative approach, as a multimodal instructional strategy, emphasizes learning through interaction and teamwork, leveraging the collective knowledge and skills of students to enhance understanding and problem-solving (VanderHoeven, Bradford, Jung, Khebour, Lai, Pustejovsky & Blanchard, 2024). By engaging in group projects, discussions, peer teaching and cooperative learning activities, learners can articulate their ideas, challenge each other's thinking, and build on one another's contributions. This instructional strategy fosters a deeper comprehension of subject matter as students explain concepts to peers and receive diverse perspectives (VanderHoeven, et al., 2024). According to Firmannandya (2023), collaboration develops essential skills such as communication, teamwork, and conflict resolution, which are crucial for success in both academic and professional settings. By creating a supportive and interactive learning environment, the collaborative approach not only increases learners' engagement and motivation but also prepares them to effectively navigate complex, real-world challenges through cooperative efforts.

2.3.6 Experiential Learning Activities

Experiential learning, as a multimodal instructional strategy, involves learners engaging directly with real-world experiences to deepen their understanding and retention of subject matter (Yao, 2023). By participating in field trips, simulations, experiments, internships, and role-playing activities, learners can connect theoretical knowledge to practical applications, enhancing their critical thinking and problem-solving abilities. This hands-on approach caters to kinesthetic learners and fosters active participation, making learning more relevant and memorable. Experiential

learning also encourages reflection, as students analyze their experiences and draw meaningful conclusions, promoting self-awareness and personal growth (Yao, 2023). This strategy not only enriches academic learning but also prepares learners for real-life challenges and professional environments, making education more dynamic and impactful.

The benefits of multimodal instructional method are rooted in evidence from empirical studies. In a study focusing on the relationship between learning style preferences and critical thinking skills in natural science learning among elementary school learners in, Indonesia, Leasa, Corebima and Batlolona (2020) found that there was a positive correlation between the learning style preferences of learners and their critical thinking skills in natural science learning. The study further established that learners with a preference for the visual learning method had the highest critical thinking skills, followed by those with a preference for the auditory method. Additionally, studies highlight that skills, such as critical thinking, communication, collaboration and creativity, which are developed by learners while engaging in multimodal learning, are essential for 21st-century education (Kaimara et al., 2020; Kaimara & Deliyannis, 2019). Based on these findings, the authors suggest that the VARK model may be useful for identifying the learning preferences of learners in lower levels of primary schooling and for informing teaching practices in order to optimize learning outcomes in natural science. This provides vital pedagogical implications and lessons for educationists and education stakeholders in Kenya.

Hussain (2017) discusses the pedagogical implications of the VARK model. These implications include the idea that teachers can use a variety of teaching methods and materials to accommodate different learning styles, and that learners can use their knowledge of their own learning style to select learning activities and materials that are most effective for them. Knowledge of learning styles will influence teachers in selecting learning tools. The quality of learning outcomes for environmental activities in Kenya will depend on the quality of the teaching provided. Overall, the current study conceptualizes that the multimodal instructional model that will be developed will provide a framework for teachers to understand individual differences in learning preferences to inform environmental activity teaching and learning practices in order to

optimize learning outcomes and enhance learners' environmental conservation core-competencies.

Research indicates that multimodal approaches outperform traditional methods in improving learning outcomes (Das & Singh, 2023; Padios et al., 2023). According to Das and Singh (2023), multimodal learning creates an exciting learning environment, which leads to increased engagement from the learners. This is because learners are not required to conform to a particular learning style that doesn't suit them. This highlights the potential of multimodal instructions in enhancing learner engagement and fostering better learning outcomes in educational settings. In a similar vein, Padios et al. (2023), posits that multimodal instruction can be highly effective for developing core competencies among learners. The lower primary environmental activities curriculum in Kenya has clearly identified core competences to be acquired by learners as they engage in activities in different learning areas. These core competences include: communication and collaboration, critical thinking and problem solving, imagination and creativity, citizenship, digital literacy, learning to learn and self-efficacy.

According to Bassachs, Serra, Bubnys, Cañabate and Colomer (2022), multimodal instruction can be a powerful tool for enhancing environmental conservation core competencies among learners by providing diverse learning experiences that engage multiple senses and perspectives. For example, Mangaroska, Sharma, Gašević and Giannakos (2022) argue that multimodal instructions can enhance critical thinking and problem-solving skills. By presenting information differently, teachers can encourage learners to approach problems from different angles and develop a more nuanced understanding of the material. This can lead to deeper insights and a more thorough understanding of the subject matter.

Porte, Boucheix, Rapet, Drai-Zerbib and Martinez (2024) provides that use multimodal instructions such as interactive simulations or virtual reality experiences to allow students to explore different ecosystems and understand the impact of human activities on the environment. This hands-on approach can help students develop communication and collaboration competencies that enable them to visualize complex concepts and make connections between cause and effect. In addition, engaging learners in hands-on projects such as creating sustainable gardens, building birdhouses, or designing

recycling programs for their school or community. These projects allow students to apply their knowledge, creativity and innovations in real-world contexts and develop practical skills for environmental conservation.

Chang, Wang, Haynes, Song, Lai and Hsieh, (2022) as well as Piotrowska, Cichoń, Sypniewski and Abramowicz (2022) proposes adoption of project-based learning activities that challenge learners to address real-world environmental problems and propose innovative solutions. Encourage collaborative teamwork, critical thinking, and creativity as students work together to develop and implement their conservation projects. Therefore, by incorporating multimodal instruction strategies into environmental education programs, teachers can effectively enhance learners' core competencies in environmental conservation and empower them to become informed and engaged stewards of the planet.

Chango, Lara, Cerezo and Romero (2022) roots for further research in order to gain a comprehensive understanding of the influence of multimodal instructional methods on learners' environmental conservation core-competencies at the lower primary level of schooling. The findings from such an investigation presents opportunity for a paradigm shift in the way that environmental activities lessons are delivered. There is no study according to the researchers' knowledge dealing with development of a multimodal instructional model for environmental activities and demonstrating its effect on the acquisition of environmental conservation core-competencies among lower-grade primary learners in Kenya, which justifies why the current study is proffered.

From the foregoing, it can be deduced that there are several benefits to incorporating multimodal learning strategies in science education. First, it allows educators to cater to the different learning styles of their learners. Some learners may learn better through visual aids like diagrams or videos, while others may prefer auditory cues, such as lectures or podcasts. By using multiple modes of instruction, teachers can reach a broader range of learners and help them engage more deeply with the material. Additionally, multimodal instructions can improve retention and recall of information. Learners are more likely to remember and understand the material when they receive information through multiple channels, such as text, images, and audio. This is because the brain processes information differently depending on the input modality (Padios,

Pascua & Orleans, 2023). By engaging multiple sensory channels, teachers can activate more parts of the learners' brain and create stronger neural connections, leading to better retention and recall.

2.4 Frequency of Multimodal Instructional Use

Early child education is one of the most vital stages of learning because children are intrigued by what they see in their environment and are enthusiastic about learning (Cade, Wardle & Otter, 2022). According to Cade et al. (2022), the key objective of early childhood education is to provide activities and experiences that integrate all the major domains of development, thereby catering to the needs of each child individually, as well as in groups. Additionally, the early stage of child development sets the pace for children's future intellectual abilities and adaptability. Hence, it is necessary to maximize the potential outcomes of teaching and learning during the early stages of child development to ensure proper growth and advancement. Early childhood education best practices also use developmentally appropriate instruction strategies, an ideology that focuses on engaging learners based on their developmental stage (Guerrero, 2022). For example, teaching five-year-olds will require a different approach than teaching fifteen-year-olds. Children always exhibit loads of enthusiasm to explore, experience and learn new things almost every single day. That's why it becomes important that both educators and administrators are aware that learning can effectively happen only when the teaching approaches for early childhood education address all the developmental needs of children. For this reason, developmentally appropriate instructional strategies have been created to tailor learning to children stages of development.

Teaching is a complex and multifaceted profession that requires a combination of knowledge, skills, and dispositions to effectively support student learning and development (Banga, 2023). Therefore, teachers must be able to adapt their instructional strategies to meet the individual needs of each learner and have a deep understanding of the subject matter they are teaching. This includes not only factual knowledge but also an understanding of the underlying concepts, theories, and principles within their field. In this context, teachers must engage instructional strategies and techniques that facilitate learning. In order to achieve this, teachers must possess pedagogical knowledge, including knowledge of instructional methods,

classroom management techniques, assessment strategies, and the ability to create engaging learning experiences.

The CBC demands that environmental activities be taught using various approaches aimed at fostering skill development, promote health, safety, environmental conservation competences, and an appreciation for cultural diversity of children (Ndungu, 2021). According to Setiawati, Purnawarman and Sukyadi (2021), one of these vital approaches is multimodal learning that is credited with fostering creative thinking, developing cognitive structures, and improving career decision making. The theories of cognitive learning and social interdependence lend support to the pedagogical practice of learning. Multimodal learning has become popular in recent years as education moves away from outdated traditional methods. In the past, education from kindergarten through the university level featured a teacher at the front of the room lecturing and telling learners what to do. Even professional development learning focused on lectures, reading texts, and answering questions. Multimodal learning transforms classrooms and learning environments into dynamic, engaging spaces.

The CBC curriculum has clearly identified core competences to be acquired by learners as they engage in activities in different learning areas. These core competences include: communication and collaboration, critical thinking and problem solving, imagination and creativity, citizenship, digital literacy, learning to learn and self-efficacy (Muchira, Morris, Wawire & Oh, 2023). For this reason, all children need these important tools to enhance productivity based on their abilities so that, in the long run, they can make contributions to environmental conservation. The curriculum emphasizes holistic development of the learner. This can be achieved by embracing learning approaches that are ideal for teaching learners in their formative stage of development. Even though various approaches exist that educators are using to implement environmental education, education experts in the 21st century are rooting for multimodal instructions to cater to the diverse learning styles of children.

The CBC in Kenya further proposes that with the unique endowment of counties with different resources, teaching instructional methods are supposed to equip learners with competences that address the unique needs of each county (Ndungu, 2021). The current

study seeks to philosophically analyze and explore the viability of mainstreaming multimodal instructional approach in the teaching of environmental activities in the early years of education in Tharaka Nithi County. To achieve this, the current study will first survey current teacher practices in delivering environmental activities curriculum in Tharaka Nithi County as a case study. The county of Tharaka Nithi is selected for this study not because of its unique pedagogies, but rather because it is a symbol of Kenyan national approaches that are used in the lower primary schools. In this section, the current study contextualizes the research presented in publications in terms of multimodal learning and draws on the different levels of multimodality research to explicate the research gaps. In addition, the reader will have the intellectual pleasure of delving into new areas of thought and nuances that the current study considers avenues for expansion of research on multimodal learning.

In a study of teachers' integration of multimodality into 21st Century English as a Foreign Language (EFL) classrooms in Thailand, Sakulprasertsri (2020) established that English teachers at the university level in Thailand utilized multiple semiotic modes (visuals, texts, animated images or digital graphics) in their classroom practices which contributed to enhancing learners' English skills enabling them to apply their knowledge and skills to real life situations. Additionally, the findings reveal that English teachers utilized online that enabled learners to engage in the lessons, achieve their learning outcomes, and enhance 21st century skills. While Sakulprasertsri (2020) study findings are useful to the current study in that it focused on multimodal instruction that typically involves combining visual, auditory, kinesthetic, and tactile modalities, the study focused on its use in English learning classrooms at University level. The proposed study focuses on environmental activity at the lower primary education level in Kenya because there is limited research on the optimal combinations of modalities for teaching specific environmental concepts. Further investigation is needed to determine which modalities are most effective for conveying different types of environmental information and fostering deep understanding and engagement among ECDE learners. Addressing this research gap will contribute to a deeper understanding of the current status multimodal instructional use in enhancing environmental education to foster sustainable attitudes and behaviors among children.

In a study assessing the extent of multimodal science teaching and learning in Asia, Yeo and Nielsen (2020) established that science teachers use pictures, symbols and physical models to present scientific ideas, as well as other instructional materials including textbooks with photos, text and other modes of representations to support learners in making meaning. Beyond, Padios, Pascua and Orleans (2023) contend that teachers use educational media such as the classroom whiteboard and a range of technology-enabled modes such as animation, simulations, videos, virtual reality and augmented reality for supporting science learning. The extent of multimodal instructional use comes under investigation in the current study.

Researchers working in multimodality studies in South Africa have established a great tendency of teachers to employ multimodal teaching and learning strategies. Matarirano, Gqokonqana and Yeboah (2021) posit that education in South Africa has moved increasingly to multimodal environments as access to technology has increased and contexts such as the COVID-19 pandemic have meant increased use of learning technologies. The focus in South Africa has been on multimodality and access due to the social and political imperatives of our context. Olivier (2020) found that self-directed multimodal learning that entail learners being self-directed in selecting modes of learning and communication appropriate to an individual was a common practice for educators in higher institutions of learning. In support of Oliver's (2020) findings, Mathee (2023) notes that self-directed multimodal learning allows for the mastery of the rules of the system as well as the freedom to break the rules and to see beyond the systems.

Cope and Kalantzis (2022) averred that self-directed multimodal learning is commonly utilized by educators in South Africa because it is a reflexive pedagogy where the learner is immersed in his or her own learning and brings their experience, interests and voices to the learning. Consequently, in analyzing teachers' appropriation of multimodal learning, the current study shall examine the extent teachers in Kenya with reference to Tharaka Nithi County are exploiting the many approaches available for multimodal instruction to engage in teaching environmental activities. Based on the practices around which the approach is conceptualized and implemented, the current study will develop an instructional model that will assist teachers in lower primary

schools in using multimodal instructional approaches when teaching environmental activities.

In Uganda, Jones (2022) established that preschools are full of multimodal learning. Children sing songs, play, experiment at water and sand tables, look at pictures in storybooks, watch short videos, field trips, drawing, experiments and many more. Surveys show that children feel more engaged in classes when they have access to flexible and interactive tools in or out of the classroom. This may be related to the fact that multimodal learning gives learners the chance to work in their preferred, most comfortable learning style, but also pushes them to improve their skills in other modes. The aim of the current study is to find out the extent of utilization of multimodal instructional approaches and whether multimodal instruction is an effective strategy to develop the children's' retention skills on the important concepts of environmental conservation. This is predicated on the psycho-pedagogical theories of early childhood development that emphatically stress the importance of organizing a multimodal learning environment in which children use their own semiotic resources or signs to create an image of themselves and construct their own theories of the world (Sofiq & Nikolay, 2023; Gardner, 2020). The modes of communication used while using multimodality and the various resources are an implicit component of forming cognition because in the process of mediated interaction meanings are specified or actualized in the minds of the learners.

In a study of multimodal approaches use in the competency of listening and speaking skills among Grade 1 learners in Kenya, Masinde, Mandillah and Barasa (2023) found that teachers handling English lessons in Kenya have shown less engagement in the identification and usage of multimodal approaches while teaching listening and speaking skills. As a result, studies show that over 70% of learners in lower primary schools in Kenya cannot dully express themselves in English. The current study draws several insights from Masinde et al. (2023) findings. One, the inability of Grade 1 learners in Kenya to express themselves fully in English due to limited engagement with multimodal approaches suggests that they may face challenges in effectively communicating about environmental conservation.

Environmental conservation often involves discussing complex concepts, expressing opinions, and collaborating with others, all of which require strong language skills. Two, effective environmental conservation efforts rely on education and awareness-raising among young learners. However, if a significant portion of Grade 1 learners in Kenya cannot fully express themselves in English, they may have limited access to environmental education resources and information delivered in English. This could hinder their understanding of environmental issues and their ability to engage in conservation efforts. Three, Children who struggle with English language skills may feel less confident participating in environmental activities that require verbal communication, such as group discussions, presentations, or debates. Limited engagement in these activities could diminish their overall involvement in environmental conservation initiatives both within and outside the classroom.

The findings from Masinde et al. (2023) study suggest a potential disconnect between the linguistic backgrounds of learners and the language of instruction in English-focused environmental education initiatives. Incorporating multimodal approaches that accommodate linguistic diversity and cultural relevance could enhance children's engagement and understanding of environmental conservation. The findings further highlight a need for teacher training and professional development focused on integrating multimodal approaches into English language instruction, particularly for teaching listening and speaking skills. Equipping teachers with effective strategies for incorporating visual aids, hands-on activities, role-playing, and other multimodal techniques can enhance children's language proficiency and their ability to communicate about environmental issues. The findings underscore the importance of educational policies that prioritize the use of effective pedagogical practices, including multimodal approaches, in early childhood education. Therefore, incorporating effective pedagogical techniques and assisting teachers in promoting language development and environmental education will be crucial to raising children’s capacity to discuss environmental conservation issues and take an active role in it. The current study sought to elucidate how effective choice of multimodal approaches can aid in the teaching of environmental activities.

2.5 Challenges of Implementing Multimodal Instructional Method

According to Djalilova (2023), the practice of teaching using multimodality encompasses engagement in multiple learning activities simultaneously. Pedagogical constraints refer to limitations or obstacles within the educational process that hinder effective teaching and learning (Choriev, Khujakeldiev, Kucharov, Khayitova, Abdiev & Amirqulov, 2022). These constraints can manifest in various forms and impact different aspects of pedagogy, including instructional methods, curriculum design, classroom management, and assessment practices. The goal of the current study is to identify the particular difficulties that teachers in Kenya handling environmental activities curriculum in lower primary schools with a focus on Tharaka Nithi County face when implementing multimodal instructional strategies. A worldview that is contextualized is provided by drawing on information from both theory and practice.

A study in Norway focusing on teachers' use of multimodal ensembles in the Norwegian English as an additional language classroom, Veiesund (2023) established three factors influencing teachers' use of multimodal instructions. These included time, resources available and curriculum restrictions. Veiesund (2023) notes that time limitations within the school day or academic calendar can constrain educators' ability to cover curriculum content thoroughly, provide individualized support to learners, or engage in reflective practice. Time constraints may also impact educators' capacity for professional development and collaboration with colleagues. The current study contextualizes that insufficient resources, such as classroom materials, technology, funding, and support personnel, can impede effective teaching and learning. Further, resource constraints may limit educators' ability to provide hands-on experiences, access relevant instructional materials, or integrate technology into their lessons. According to Veiesund (2023) constraints in the curriculum can restrict educators' ability to address diverse learning needs, interests, and abilities. This may include rigid or overcrowded curricula, prescribed textbooks, and standardized assessments that prioritize coverage of content over depth of understanding. Based on the Veiesund (2023) study findings, the current study sought to unearth pedagogical constraints and opportunities for enhancing multimodal instructional practices in the Kenyan context.

In Bosnia and Herzegovina, Guthrie, Santos, Henderson, Norfolk-Beadle, Fordham and Baucal (2022) examined teachers' pedagogical practices in detail and posited that the greatest impediments to implementing multimodal instructions in science classrooms pertains to policy mandates, limitations in teaching methods, assessment practices, classroom environment and limited professional development opportunities. According to Guthrie, pedagogical constraints may stem from external policies, mandates, and regulations that dictate instructional practices, curriculum standards, and accountability measures. Policy constraints may limit educators' autonomy and flexibility in tailoring instruction to meet the diverse needs of learners. Further, Guthrie et al. (2022) argue that pedagogical constraints may arise from a lack of flexibility or innovation in teaching methods. For example, educators may face constraints in implementing active learning strategies, project-based approaches, or inquiry-based learning due to curriculum mandates, standardized testing requirements, or limited resources.

Empirical studies and anecdotal evidence indicate that many teachers are hesitant to include multimodal pedagogies into their classrooms due to their absorbed rigidity to didactic methods. Teachers believe they lack the necessary knowledge and experience to implement this approach. According to Tan, Zammit, D'warte and Gearside (2020), constraints in assessment practices, such as reliance on high-stakes testing limits teachers' ability to accurately measure and promote learning through multimodality. Assessment constraints may also contribute to a culture of teaching to the test rather than fostering holistic student development.

Tan et al. (2020) also found that pedagogical constraints may arise from challenges in managing classroom dynamics, maintaining learners' engagement and addressing behavioral issues. Factors such as class size, diversity, classroom layout and disciplinary policies can influence educators' effectiveness in creating a conducive multimodal learning environment. Lastly, Tan et al. (2020) contend that limited access to quality professional development opportunities, training and support networks can constrain educators' capacity to enhance their pedagogical content knowledge and skills to stay abreast with emerging best practices. Based on this discourse, it was important to recognize this multifaceted nature of challenges impeding utilization of multimodal instructional in the Kenyan context and in particular, lower primary education level so that policymakers, stakeholders, school administrators and managers

can work collaboratively to create more supportive, inclusive and effective learning environments that promotes the development of essential competencies in learners for addressing complex environmental challenges.

Teachers have expressed concerns about inability to effectively integrate multimodal practices due to lack of technological skills. Megagianni and Kakana (2021) examined teachers' pedagogical practices in detail and posited that one of the biggest impediments is in the use of technology devices and educational software. Megagianni and Kakana discovered that some teachers were hesitant to participate in multimodal activities because of lack of expertise in applying new methodologies. Teachers' concerns, problems, and negative attitudes about multimodal practices appear to be at the basis of inadequate technical skills for handling digital instructional platforms. In this context, Tomczyk, Jáuregui, de La Higuera Amato, Muñoz, Arteaga, Oyelere and Porta (2021) identified four categories of teachers' attitudes towards new technology: techno-optimist, techno-realist, techno-pessimist, and techno-ignorant. Techno-optimist teachers are enthusiastic and realize that new technology could positively affect the quality and effectiveness of education. Techno-realists react with careful and critical thinking to the new possibilities presented by the new technology, without this attitude implying a reluctance to adapt to technological progress. Techno-pessimists believe that new technologies are useless or even unfavourable for human development. Finally, the techno-ignorant is characterized by a lack of participation in the learning process by using new technology.

Additional challenges brought to the fore by Megagianni and Kakana (2021) include the incompatibility between digitally-mediated curriculum and the conventional curriculum. The emphasis on high stakes dominant summative assessment and the tacit hierarchy of engaging multimodal practices remain incompatible thus presents as a serious deterrent. The current study will seek to consolidate primary data on teachers' perceptions with regard to the challenges they are encountering with multimodal pedagogies in environmental activity classrooms. This will serve as a heuristic for understanding how teachers utilized multimodal learning in the context of such challenges so as to enable the study develop an instructional model that will assist teachers in lower primary schools in using multimodal instructional methods when teaching environmental activities.

In a study investigating teachers' perceived opportunities and challenges in the use of multimodal instruction, Fokides and Kostas (2020) observed that teachers are finding it challenging to use multimodal instructional approaches without clear guidelines or support from the curriculum documents. Additionally, the many teachers report having superficial comprehension of the approach which is further complicated by lack of support and collegiality in their schools. This implies that teachers' perception was influenced by external factors such as policies and curriculum and internal factors such as their views and attitudes towards the approach based on their pedagogical beliefs. Therefore, this study aimed at gaining further understanding on barriers impeding use of multimodal instructional pedagogies in Tharaka Nithi County. This was predicated on the rationale that differences in institutional capacities, resources endowment, socio-economic, cultural as well as political dictates have an effect on the pedagogical constraints reported from region to region. Overall, these challenges and concerns highlight the importance of considering pedagogical effectiveness, technical proficiency, and audience engagement when implementing multimodal instructional methods in delivering environmental activities lessons in Kenya.

2.6 Model Guidelines for Lower Primary Environmental Conservation Lessons

Instructional design refers to the systematic method for designing, testing, evaluating and reflecting on an instructional model based on the knowledge and experiences of learning and instructional theories so that it will improve the quality of instruction and ensure effective and retentive learning (Dousay & Branch, 2023; Spatioti, Kazanidis, & Pange, 2023; 2022). An instructional design model (IDM) provides procedural framework for the systematic production of instruction. Instructional design models provide conceptual tools to visualize, direct, and manage processes for creating high-quality teaching and learning materials. The proper selection of instructional design models assists us in appropriately matching the right process with the right situation. Thus, instructional design models serve as a valuable source for matching the right creative process to the right design situation as well as an effective framework for conducting instructional design research. The overarching objective of the literature reviewed in this section was to present the theoretical evidence for designing an instructional model that would assist teachers in lower primary schools implement multimodal instructional method in environmental activities lessons.

2.6.1 Learning Under the Multimodal Instructional Method

Learning is the process of acquiring new knowledge, skills, behaviors, attitudes, or values through experience, study, instruction, or observation (Tawfik, Gatewood, Gish-Lieberman, & Hampton, 2022). It involves the transformation of information into understanding and the ability to apply that understanding in different contexts. Learning is typically characterized by changes in behavior, cognition, or affect, which may result from various forms of stimuli, feedback, practice, and reflection (Ginsburg & Jablonka, 2021). It is a fundamental aspect of human development and adaptation, enabling individuals to adapt to their environment, solve problems, and engage in meaningful interactions with the world around them (Benvenuti, Cangelosi, Weinberger, Mazzoni, Benassi, Barbaresi & Orsoni, 2023). The science of learning is an interdisciplinary field that combines research from cognitive psychology, neuroscience, education, and other related disciplines to understand how people learn and retain information (Nasir, Lee, Pea & McKinney de Royston, 2021). It aims to uncover the underlying mechanisms of learning, memory, and skill acquisition, and apply this knowledge to enhance educational practices and improve learning outcomes.

Learning involves memory systems of encoding information into memory and later retrieving it when needed. It includes three types of memory (sensory, working, and long-term memory) that interact to encode incoming information. All information perceived by sensory memory will pass to working memory when the learner pays attention to it (Gresch, Boettcher, van Ede & Nobre, 2024). To be learned, materials must be processed in working memory, which reflects our consciousness, where mental activities take place. Working memory is very limited in duration and capacity (Gresch et al., 2024). The limitation in working memory is considered a critical factor when designing instruction (Gresch et al., 2024). Figure 1 illustrates the Information Processing Model (IPM).

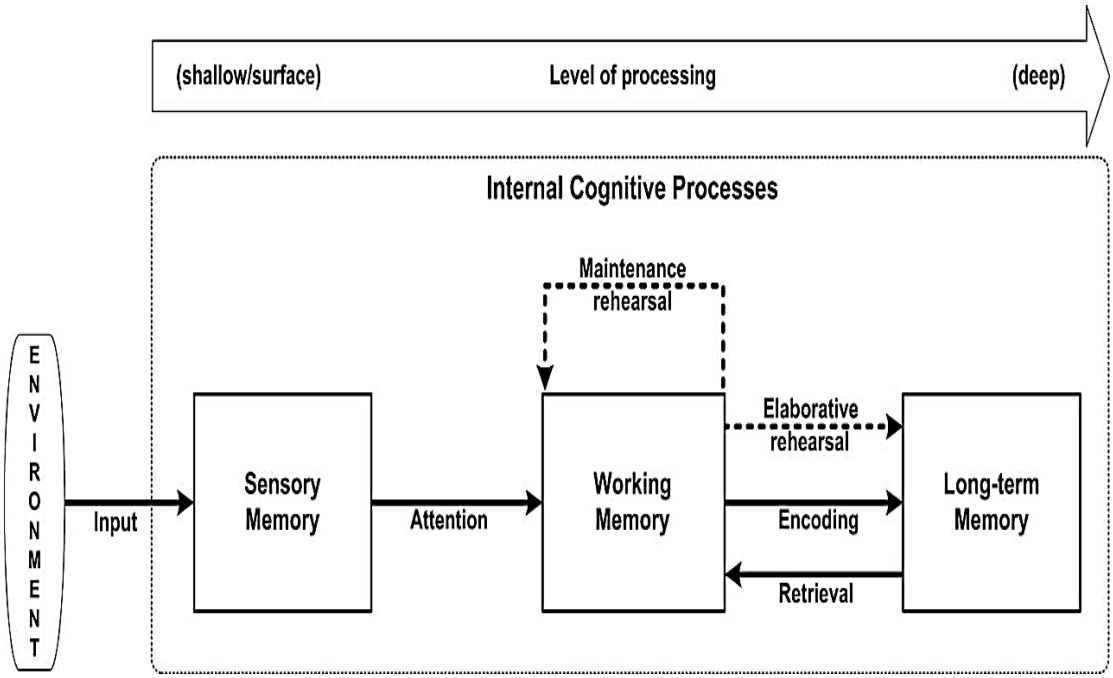


Figure 1: Relationship between Memory Types, Internal Cognitive Processes and Information-Encoding Rehearsal Methods.
Source: Zedeck (1977)

The Information Processing Model is a theoretical framework that describes how individuals perceive, process, store, and retrieve information, often used in psychology and education to understand cognitive functions and learning processes. The model emphasizes the role of memory and cognitive processes in how people learn and remember information. The model provides a framework for understanding cognitive processes involved in learning, memory, problem-solving, decision-making, and other aspects of human cognition. By analyzing how information is processed at each stage, researchers and educators can develop strategies to enhance learning, optimize memory performance, and improve cognitive skills.

Leveraging on IPM model, Gagné (1995) identified five domains of learning that affect the learning process: 1) motor skills, 2) verbal information, 3) intellectual skills, 4) cognitive strategies, and 5) attitudes. Motor skills require repetitive practice to master and include such examples as taking a pulse, the introduction of a nasal tube, and performing dissection in the laboratory. Verbal information refers to the factual knowledge and principles in the curriculum, and their learning requires organized presentation and meaningful context. Intellectual skills are the elaboration of basic concepts and rules, the learning of which is based on prior assimilation of prerequisite

skills. Cognitive strategies are internally organized skills that control learning behaviors, remembering, and thinking, which are learned by practice. Learners develop these strategies by reflecting on their own experiences or they may be taught effective learning strategies. Attitudes are considered to be in the affective domain and are not learned by practice. Changing attitudes requires human modeling with reinforcement and feedback. Attitudes affect a student's motivation to learn. For example, a student with a positive attitude and interest in physiology will regularly attend physiology classes.

The main message in recognizing the different domains of learning is that different concepts require the selection of different instructional strategies. In this case, instruction includes both teaching and learning. Since the first appearance of instructional design models in the 1960s there has been an ever-increasing number of models published in both the instructional technology and other education literature based on the assumptions that instruction includes both teaching and learning. While there are hundreds of instructional design models, there have been only a few major distinctions among them. Based on an understanding of how people learn, the science of instruction is concerned with the rational development of instructional design strategies. Effective development of instructional models elicits appropriate cognitive processes in the learner and mediates more successful learning outcomes. Hendry, Ford, Williams and Hodges (2015) identified five principles of instruction that promote learning: 1) learners are engaged in solving real-world problems, 2) existing knowledge is activated as a foundation for new knowledge, 3) new knowledge is demonstrated to the learner, 4) new knowledge is applied by the learner, and 5) new knowledge is integrated into the learner's world. These principles can be implemented using different delivery or teaching methods to create effective learning environments.

According to Hendry et al. (2015), an instructional model indicates the existing plan and processes for any instruction regardless of the field of study and it works as a guide indicating how to implement an instruction. Thus, instructional design professionals typically employ models that guide their practice. However, it is unclear how a specific model is selected for an instructional situation. Edmonds, Branch and Mukherjee (1994) provided a valuable procedure for comparing instructional models, but because of the proliferation of variations in applications, there has emerged a need for new

frameworks that assesses the potential success of any instructional model. By leveraging Andrews and Goodson's procedure for comparing instructional models, the current study seeks to systematically develop an effective and evidence-based instructional model for multimodal learning that enhances learning outcomes and engages learners across diverse sensory modalities. Several instructional models have been developed to facilitate learning (Fu, 2022). These include the Dick and Carey's model (Dick, 1996), ASSURE and Kemp model (Bajracharya, 2019).

2.6.2 The ADDIE Model

To produce effective instruction, all instructional design models require the following phases: analysis, design, development, implementation, and evaluation. These instructional design phases are summarized by the acronym ADDIE. The ADDIE model is simpler and easier to use than other models which elaborates on instructional design phases hence was borrowed to guide in the development of the model guidelines to assist teachers in lower primary schools deliver frequent and quality environmental conservation lessons using multimodal method. The ADDIE model (Figure 2) provides systematic approach for designing and developing a learning experience. The outcome of each ADDIE phase informs the subsequent phase.

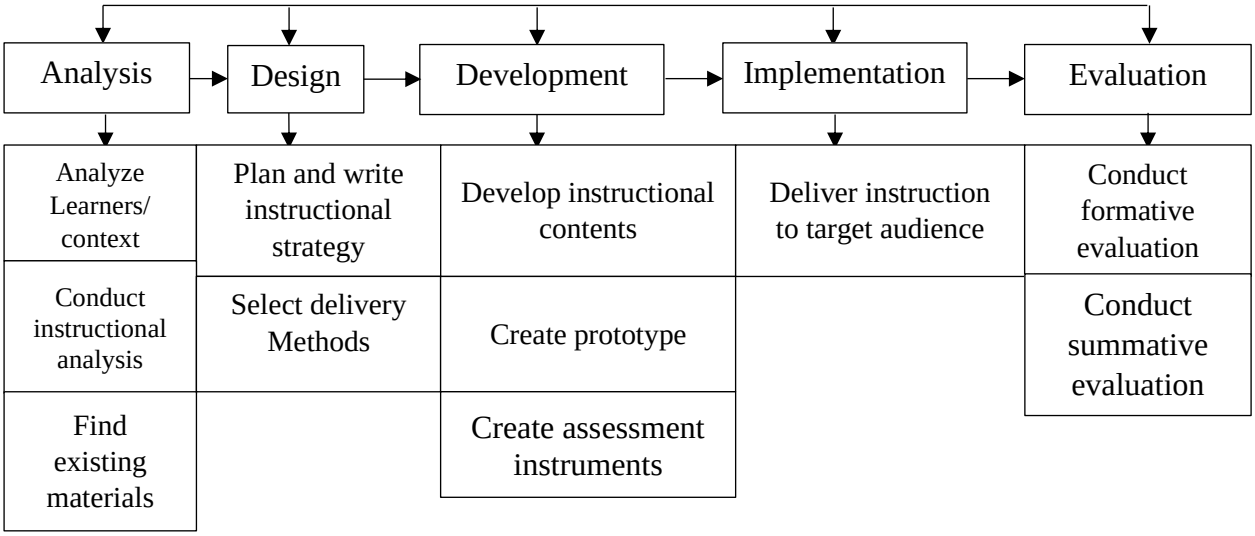


Figure 2: ADDIE Model Phases and the Steps during each Phase
Source: Muruganantham (2015).

Leveraging on ADDIE model, the current study will develop an instructional model that will assist teachers in lower primary schools in using multimodal instructions for environmental activities through identification of the specific environmental activities and concepts that are relevant and appropriate for lower primary school students,

conducting a needs assessment to understand the current teaching practices, resources, and challenges faced by teachers in incorporating multimodal instructions for environmental education, mapping the learning objectives, desired outcomes and target audience characteristics. Based on the analysis, design the instructional model, outlining the overall structure, content and instructional strategies, the multimodal elements to be incorporated, such as visual aids, hands-on activities, videos, storytelling, outdoor experiences, and interactive games and design learning activities and assessments that promote active engagement, communication and collaboration, critical thinking, problem solving, creativity and imagination and among other core competencies of environmental conservation.

The study adapted instructional materials and resources that supported multimodal learning, including lesson plans, worksheets, multimedia presentations and interactive tools, develop guidelines and procedures for teachers on how to implement multimodal instructions effectively in their classroom settings and collaborate with subject matter experts, instructional designers and multimedia specialists to ensure the quality and effectiveness of the instructional materials. Further, borrowing from the ADDIE model, the current study provided training for teachers on the use of multimodal instructions for environmental activities, support teachers in integrating the instructional model into their teaching practices through workshops, coaching and mentoring to facilitate implementation.

A variety of evaluation methods to assess the effectiveness of the instructional model and its impact on learning outcomes were engaged. Feedback from teachers, learners, and other stakeholders through surveys, interviews and observations were gathered. The study analyzed learners' performance data and assess whether learning objectives were being met. This was necessary to identify areas for improvement and enable revisions to the instructional model based on evaluation findings. It is important to note that the ADDIE model is iterative, meaning that feedback and insights gathered during the evaluation stage can inform revisions and improvements to the instructional materials, which can then be implemented in subsequent iterations of the design and development process.

This study engaged the following iteration steps typically involved in DBR design: 1) Development of an initial design (prototype) for the educational intervention based on existing theory, literature and best practices specifying key components, instructional strategies and resources, 2) Sought experts opinion on the predictive effectiveness of the model, 3) Gathered empirical data from teachers and learners to identify current multimodal instructional practices, 4) Trained teachers on the intervention and allow them to refine it, 5) Pilot tested the model in a small controlled setting and collect data on its performance being flexible and responsive to new information and insights that emerge, 6) Gathered data throughout the implementation phase using a variety of data collection methods, such as observations, interviews, surveys, learners work samples, and assessments to assess the efficacy of the intervention, 7) Analyzed data and feedback to identify strengths, weaknesses and areas that needs improvement, 8) Conducted a stakeholder workshop to reflect on the findings from data analysis and consider how they align with the initial goals and objectives of the research, identify areas where the intervention could be improved or refined based on the data and feedback collected during implementation and revise the intervention design as needed, making adjustments to the instructional strategies, resources, or implementation procedures, 9) Implemented the revised model and repeat the process of data collection, analysis, reflection, and revision through multiple iterations, gradually refining the intervention and increasing its effectiveness, 10) Continuously monitored and evaluated the model's effectiveness, repeating the iteration process as necessary. The findings were shared with the broader educational community through publications, presentations and conferences and recommendations for practice and policy provided based on the insights gained from the research.

The current study, aimed at developing model guidelines for teachers to use in presenting environmental conservation lessons in lower primary schools. The development of the model guidelines was informed by a synthesis of recent empirical Design-Based Research (DBR) studies. For example, Monte and Reis (2021) developed a pedagogical model focused on education for environmental citizenship among primary school learners. The DBR approach adopted included a systematic review and empirical testing, resulted in the creation of a prototype model tailored to enhance environmental values and skills in children. Monte and Reis (2021) study's emphasis was on fostering active participation, collaboration and critical thinking which aligns

with the objectives of the model guidelines for environmental conservation lessons developed in the current study. However, Monte and Reis noted the absence of well-established models that are specifically designed for primary-level learners, suggesting a gap in scalable frameworks for integrating environmental citizenship into early education. This gap informed the development of the model captured on page 144.

A study by Rickinson, Cirkony, Walsh, Gleeson, Cutler and Salisbury (2022) explored the effects of nature-based learning in enhancing ecological literacy and fostering connections to nature in primary education settings. The researchers found that nature-based learning, particularly when integrated into school grounds, significantly improved learners' engagement and environmental awareness. This finding reinforces the importance of using natural environments as a core element of environmental conservation education. However, the study identified challenges in urban settings, where access to nature is limited. This highlights a gap that the current study could address by proposing adaptable strategies for both rural and urban schools. The development of the model guidelines for environmental conservation education was anchored on this premise.

In their study, Kim, Suh and Song (2015) aimed to develop a design-based learning curriculum for a technology-enabled science classroom. Using the DBR methodology, they crafted a curriculum that incorporates technology tools to enhance students' engagement and learning outcomes in science education. The study’s findings highlighted the benefits of integrating design-based learning with technological resources, showing that it significantly improved students' problem-solving skills, scientific inquiry abilities, and motivation to learn. The curriculum was iteratively tested and refined through cycles of design, implementation, analysis, and revision, allowing the researchers to adapt the program based on feedback from both students and teachers. Key outcomes included a deeper understanding of scientific concepts and an increased capacity for collaboration among students. The study also emphasized the importance of providing continuous teacher support and training to maximize the effectiveness of technology in the classroom. The results suggest that design-based learning, when integrated with appropriate technological tools, can transform the traditional science classroom into a dynamic, interactive learning environment. However, the authors noted challenges related to resource limitations and teacher

preparedness, which are critical areas for future research and development. The model guidelines developed in the current study incorporated Kim, et al. (2015) findings to include digital tools such as nearpod, quizlet and storybird in the designed model guidelines as part of the multimodal instructional resources.

Rickinson, et al. (2022) study as well as that of Smith and Matthews (2020) provided a strong foundation for the development of the proposed model guidelines for teaching environmental conservation. Monte and Reis (2021) focus on environmental citizenship informed the need for a model that encourages active learner participation in solving real-world environmental problems. Rickinson et al.'s (2022) findings underscore the importance of integrating natural settings into the learning process, a critical element that can be adapted even in resource-limited schools through creative use of school spaces or community resources. Smith and Matthews's (2020) insights into the differing impacts of inquiry-based learning across urban and rural schools suggested the need for adaptable, context-specific guidelines that ensure equitable environmental education opportunities for all learners. By integrating the pedagogical strategies from these DBR studies, the current study addressed the identified gaps and developed a robust model guideline that is adaptable across various settings, supports active engagement and fosters environmental stewardship from an early age.

In the Kenyan context, one significant DBR study that informed the current work is the Eco-Schools Kenya initiative, researched by Otieno, Wandabi, and Dixon (2021). This program integrates education for sustainable development into primary school curricula, engaging learners in practical environmental management projects like waste management, tree planting, and energy conservation. The program focuses on hands-on activities where learners apply theoretical knowledge in real-life conservation projects, thus fostering responsible environmental behavior early on (Otieno et al., 2021). This aligned well with the current study’s aim of developing a model guideline for teaching environmental conservation, which emphasizes experiential learning as a key pedagogical tool. The Eco-Schools initiative provided a useful framework by illustrating how hands-on environmental projects can significantly improve learners' understanding of environmental issues. However, a gap identified by Otieno et al. (2021) was the lack of scalable models adaptable to different school environments especially between rural and urban areas where resource availability differs. This gap

informed the current study's approach of creating a flexible model that can be tailored to both rural and urban schools to ensure equitable access to environmental education.

The Eco-Schools Kenya program influenced the current study by demonstrating the importance of integrating active, project-based learning into environmental education. However, unlike the Eco-Schools initiative, which largely focuses on school-based projects, the current study aimed to extend these efforts by developing a more structured and adaptable guideline that can be applied consistently across different learning environments. Furthermore, while the Eco-Schools program has been successful in fostering environmental awareness, it does not provide a robust framework for scaling up such programs in under-resourced areas, which the model designed in the current study seeks to address. Therefore, the current study not only builds on the Eco-Schools' success but also fills the gap by offering solutions for context-specific challenges in both resource-rich and resource-limited settings. By incorporating the learnings from Otieno et al. (2021), this study proposes a guideline that is adaptable, scalable, and addresses the diverse challenges faced by schools in different contexts across Kenya.

Based on the insights from the reviewed DBR studied and conventional processes for DBR, this study was conceptualized as shown in Figure 3.

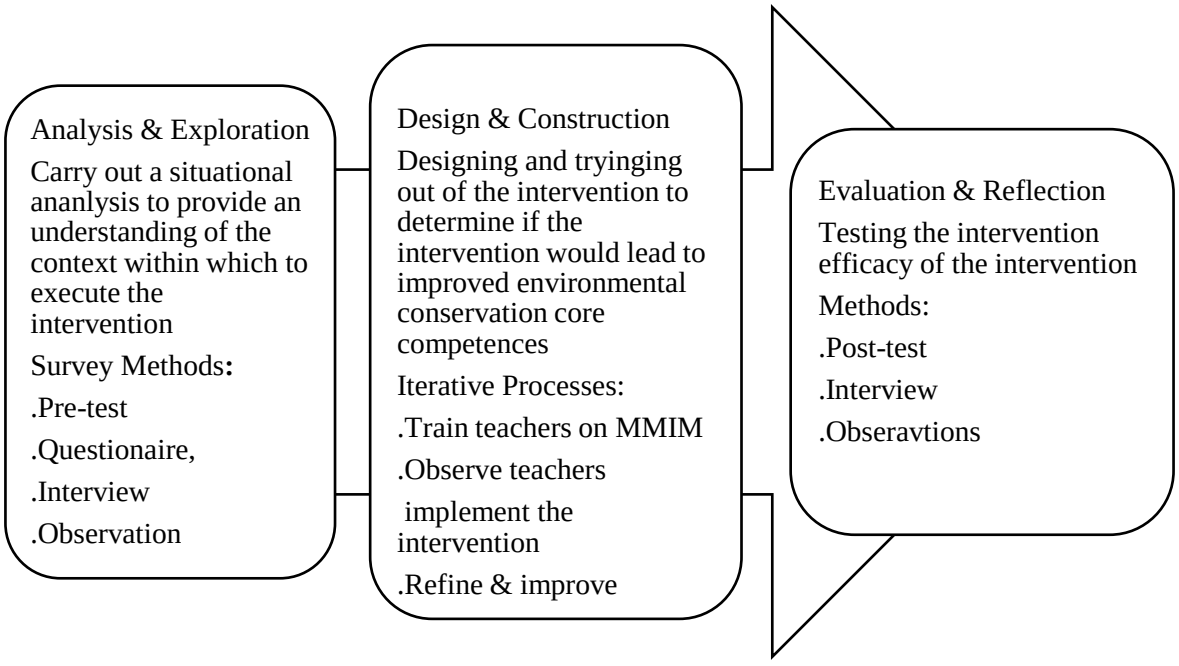


Figure 3: Conceptual Process of the Study

Source: Author

Overall, the ADDIE model provides a simpler and more intuitive framework for instructional design, with its five-step process being easier to understand and implement. By using elements of ADDIE, this study developed a multimodal instructional model (pg 150) for environmental activities and made it accessible to education practitioners.

2.7 Theoretical Framework

The theory used to frame this study was the Kearsley and Shneiderman (1998) Engagement Theory of Learning (ETL) that proposes that comprehension comes as a result of the learners' prolonged engagement in connecting new ideas and explanations to their prior beliefs. The fundamental idea underlying engagement theory is that learners must be meaningfully engaged in learning activities through interaction with others and worthwhile tasks. By engaged learning, Gardner (2020) avers that all learning activities involve active cognitive processes such as creating, problem-solving, reasoning, decision-making, and evaluation. In addition, learners are intrinsically motivated to learn due to the meaningful nature of the learning environment and activities.

The theory provides three primary means to accomplish engagement: (1) an emphasis on collaborative efforts, (2) project-based assignments, and (3) non-academic focus. It is suggested that these three methods result in learning that is creative, meaningful, and authentic. The theory further states that teachers can combine multiple pedagogical methods in the course of a lesson. Engagement Theory of Learning emphasizes cooperation, creativity and contribution, and the importance of learner engagement as a critical factor in the learning process. This approach makes learning a personal, action and self-directed effort by creating learning environments that permits learners to assume responsibility for their learning (Leong, 2020). Kearsley and Shneiderman (1998) are known for their work in instructional design and technology, with a focus on learner engagement and motivation.

According to Hiver (2022), the Engagement Theory of Learning is built on several key tenets and propositions. First tenet entails engagement which is seen as a fundamental component of effective learning. Learner engagement involves active participation, emotional involvement, and cognitive investment in the learning process. According to

engagement theory, there are three main types of engagement. Behavioural, emotional, and cognitive. Behavioural engagement refers to the actions that learners take in the classroom, such as attending class, participating in discussions, and completing assignments. Emotional engagement refers to the feelings that learners have about their learning experiences, such as interest, enjoyment, and excitement. Cognitive engagement refers to the level of mental effort that learners invest in their learning, such as thinking critically, analysing information, and making connections between concepts. Further, the principles upon which ETL is based include; relate (learning through collaboration with others), create (adopting a project-based approach towards learning) and donate (learning using an outside focus). The end goal of each of these three principles is to develop intrinsic motivation in the learner's mind. While each dimension of engagement is important in its own right, engagement theory suggests that they are interdependent and that enhancing one dimension can lead to improvements in the others. For example, when learners are emotionally engaged in their learning, they are more likely to invest cognitive effort, which in turn can lead to better performance on academic tasks. Similarly, when learners are behaviorally engaged, they are more likely to experience positive emotions and invest cognitive effort, leading to deeper and more meaningful learning.

Second tenet entails motivation and Interest. Motivation and interest play crucial roles in fostering engagement. Student motivation is a critical factor in promoting engagement. When learners are motivated to learn, they are more likely to invest cognitive effort, participate in class, and experience positive emotions. There are several types of motivation, including intrinsic motivation (the capability to learn for the sake of learning), extrinsic motivation (the capability to learn for external rewards), and achievement motivation (the capability to succeed academically). While all types of motivation can promote engagement, intrinsic motivation is generally considered to be the most powerful, as it is associated with deeper and more enduring learning. Learners are more likely to engage with learning activities that are personally meaningful, relevant, and interesting to them.

Third tenet of ETL is multimodal learning environments. Engagement Theory of Learning recognizes the importance of multimodal learning environments that incorporate various modes of representation, such as visual, auditory, and kinesthetic

modalities. Multimodal instruction can enhance engagement by catering to different learning preferences and providing multiple entry points for understanding. The fourth tenet entails scaffolding and support which proffers that providing appropriate scaffolding and support is essential for maintaining learner engagement. Scaffolding refers to the guidance and support provided to learners as they work towards achieving learning goals. Effective scaffolding helps learners stay engaged and motivated by providing just the right amount of challenge and support. Interactive and Collaborative Learning constitutes ETL's fourth tenet which by implication advocates for interactive and collaborative learning experiences that promote active engagement and social interaction among learners. Collaborative activities can enhance engagement by fostering a sense of community, promoting peer interaction, and providing opportunities for cooperative problem-solving.

The relevance of ETL to the current study is that it offers a lens through which to examine the design, methodology, data analysis and specific objectives of the study, ultimately contributing to the development of effective instructional practices for teaching environmental activities in lower primary schools. The suppositions of ETL will inform each aspect of the current study in the following ways: First, it will inform understanding of effective instructional strategies for environmental activities and how they are currently being implemented in lower primary schools. Engagement Theory of Learning emphasizes the importance of offering diverse learning experiences to engage learners. This study utilized this conception to assess how effectively multimodal instructions were being utilized and their impact on learner engagement and learning outcomes. The theory informed the selection of assessment methods that captured not only factual knowledge but also deeper conceptual understanding and application of environmental concepts. The theory also provided useful framework for comprehending barriers to effective implementation of multimodal instructional approaches. The theory further provided insights into strategies for designing an instructional model that promotes active engagement and facilitates environmental learning using multimodal pedagogies (for instance, visual, auditory, kinesthetic) to cater to different learning preferences and enhance engagement in lower primary schools.

Engagement Theory of Learning offered valuable insights and guidance in selection of the DBR design for this study. Design based research and ETL are closely interconnected, as DBR emphasizes the iterative process of designing, implementing, and refining educational interventions within authentic learning environments, while ETL focuses on creating learning experiences that captivate learners' interest, promote active participation, and facilitate deep understanding. Engagement learning theory emphasizes the importance of adapting instructional approaches to meet the diverse needs and interests of learners. Design based research provided a structured framework for iteratively refining instructional designs based on feedback from learners, teachers, and other stakeholders to enhance engagement. Therefore, by using DBR the current study included methods that allowed for the observation and measurement of learner engagement during environmental activities lessons. This involved qualitative observations, surveys, interviews and quantitative measures such as tracking participation rates or assessing changes in attitudes and competences towards environmental conservation. It was further conceptualized that mixed-methods approaches can be applied to gain a comprehensive understanding of both the qualitative experiences of learners and the quantitative outcomes of different instructional approaches.

Engagement Theory of Learning suggests that engaged learners are more likely to demonstrate deeper learning outcomes. This study leveraged on this conception to examine how engagement with different instructional approaches relates to learners' acquisition of core competences for environmental conservation. Data analysis involved comparing the attitudes and core-competences of learners exposed to different instructional methods, identifying patterns of engagement, and exploring correlations between engagement levels and learning outcomes.

2.8 Conceptual Framework

A conceptual framework for this study as presented in Figure 4 provided a conceptual foundation for this research, allowing a clear and concise understanding of the key concepts, variables, relationships and assumptions that underlie this research study.

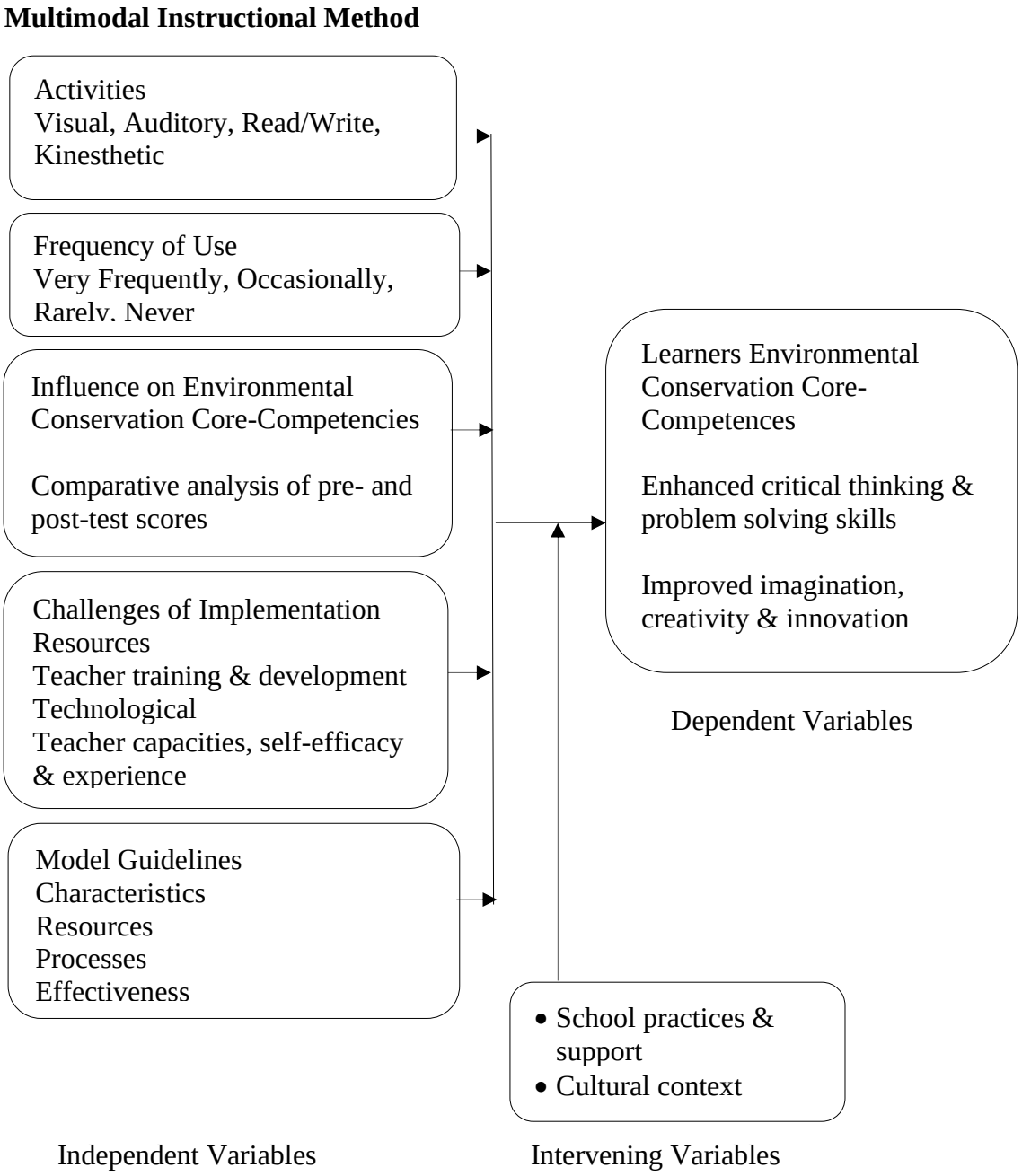


Figure 4: Conceptual Framework Showing the Relationship between the Study Variables

The independent variable was multimodal instructional method while the dependent variable pertained to learners' environmental conservation core competences. The dependent variable was assessed using knowledge acquisition, skill development, attitude disposition and behaviors indicative of competency mastery indicators that were measured using pre-and-posttest scores and observation checklist scores on environmental conservation core-competencies demonstrated during engagement in environmental conservation activities in school before and after the intervention.

CHAPTER THREE
METHODOLOGY

3.1 Location of the Study

The study was carried out in Tharaka Nithi County in Kenya. Appendix P shows the location of Tharaka Nithi County within the map of Kenya. Tharaka Nithi County was selected for this study because it is facing significant environmental degradation, which has contributed to the drying up of rivers, particularly in the lower regions of the county more than any other county in Kenya. Tharaka Nithi County stands out due to its location along below Mount Kenya region, where numerous main rivers, including the Nithi, Thuci, Mutonga, Thingithu, Kathita, Thanantu, Thangatha, Ura and Tana rivers traverse through. The drying up of rivers in Tharaka Nithi County has significant socioeconomic implications, particularly for people in the lower regions of the County. The urgency of addressing the environmental degradation issues in Tharaka Nithi County highlights the critical need for sustainable management practices to restore water resources and support the communities impacted by these changes. The CBC in Kenya proposes that with the unique differences in resource endowment of counties, pedagogical methods are supposed to equip learners with competences that address the unique needs of each county. Leveraging on this, the study sought to analyze and explore appropriate instructional methods that can be used during environmental activity lessons in the early years of education to achieve long term sustainable environmental conservation.

3.2 Research Design

This study adopted a Design-Based Research (DBR) design approach. Design-Based Research design is an innovative approach in educational research that integrates the development and testing of educational interventions within real-world contexts (Hoadley & Campos, 2022). Design-Based Research design is used in educational research to develop and refine interventions, instructional techniques, or tools. It emphasizes pedagogical processes and evidence-based claims derived from naturalistic investigations that result in knowledge about how people learn. This new knowledge about learning then drives future research and practice.

Design-Based Research design was adopted for this study because it emphasizes the iterative process of designing, implementing, and refining educational interventions in collaboration with practitioners to address complex educational problems. Hoadley et al. (2022), Greenhow, Graham and Koehler (2022), Love, Cook and Cook (2022) assert that common research designs such as descriptive survey, experimental and correlational have failed to improve classroom practice.

3.3 Study Population

According to Tharaka-Nithi County Devolution Hub (2023), Tharaka Nithi County has 479 public primary schools with a total gross enrolment of 93,939 learners (46,460 females and 47,479 male). Included in this population are 23,939 learners in lower primary school (11,960 females and 11,979 male) aged between 6-9 years. There were 3,323 teachers in the county hence the teacher learner ratio is 1: 28. Thus, the study population comprised 3323 teachers and 43900 learners totaling to 47223 respondents.

3.4 Sampling Procedure and Sample Size

This study integrated the development and testing of an education intervention according to the requirements of DBR. Therefore, sampling was carried out in two phases. Different sample sizes were applied depending on the nature of the study at each phase.

3.4.1 Survey Phase

Krejcie and Morgan (1970) table for determining the desired sample size based on different population sizes and desired levels of precision was used to determine the desired sample size. According to the table, for a population of 47,223 at a confidence level of 95%, the precise desired sample size is arrived at through interpolation. From the table (Appendix K) the recommended sample size for a population of 43,900 is 381. Therefore, a proportionate sample of 322 learners and 59 teachers was randomly selected as follows:

1. Selection of Schools: A total of 14 schools will be selected for the study, with 2 schools randomly chosen from each sub-county within Tharaka Nithi County. This ensures that the sample is geographically representative across the county.
2. Selection of Learners: From each of the 14 selected schools, 23 learners will be randomly sampled. The total number of learners to be sampled across all schools is

322. This means each of the selected schools will contribute 23 learners to the sample, ensuring proportional representation.

3. Selection of Teachers: Alongside the learners, approximately 4 or 5 teachers will be randomly sampled from each selected school, resulting in a total of 59 teachers across the 14 schools.

This approach ensured that a sample of 322 learners and 59 teachers was randomly and representatively drawn from across the county, allowing for robust data collection and analysis. The sample for the survey is described in the Table 1.

Table 1: Survey Phase Population and Sample

Category	Population	Sample
Teachers	3,323	59
Learners	43,900	322
Total	47,223	381

Source: Field Data (2024)

3.4.2 Intervention Phase

In this phase, a smaller population of grade three teachers was used because of the rigor involved in data collection. With 479 grade three teachers and 23,939 learners proportionate sampling lead to 372 (Appendix K). Learners and 8 teachers. Teachers were selected depending on their willingness to participate and accessibility of their schools for the purpose of lesson organization and observations. Since there were seven sub counties (Tharaka North, Tharaka South, Chuka, Igambango'mbe, Maara, Chiakariga and Muthambi) in the study site, one teacher from each Sub County was selected with the exception of Chuka that had two because of population density. While larger sample sizes are often desirable in quantitative research for statistical power and generalizability, Glaser and Strauss (2017) argue that in an in-depth study, it may not necessarily require a large number of participants. Instead, they emphasize smaller sample typically around 8 to 12.

This provided the rationale for using 8 teachers in this phase of the study. Table 2 provides the sample for phase two of the study.

Table 2: Intervention Phase Population and Sample

Sub County	Teacher Population	Sample	Learners Population	Sample	Total
Tharaka North	43	1	1975	30	31
Tharaka South	78	1	3654	57	58
Chiakariga	48	1	2355	36	37
Chuka	104	2	4860	76	78
Igamba Ng'ombe	58	1	2780	43	44
Maara	85	1	3835	60	61
Muthambi	63	1	4480	70	71
Total	479	8	23 939	372	380

Source: Field Data (2024)

3.5 Research Instruments

The instruments for data collection for this study included questionnaire, interview guide for teachers, observation of teaching guide, pre and post-tests for children and post survey checklist for teachers to evaluate the effectiveness of the instructional model. According to Dzwigol (2022) utilizing multiple research methods (triangulation) allows for a comprehensive collection of data from various sources, providing a holistic understanding of the topic under investigation.

3.5.1 Questionnaire for Teachers

A researcher made questionnaire for teachers 1 (QFT1) (Appendix C) was used to collect data in phase one of the study. This questionnaire consisted of three sections. First section had items seeking teachers' responses on the teaching approaches, methods, strategies and practices they are using to deliver environmental activities lessons for grade three level. Second section had questions aimed at examining the extent of multimodal instruction use in teaching environmental activities to enhance grade three learners' environmental conservation core competences. Third section sought general information and demographics about teachers that included, length of teaching in the current school, experience in teaching using multimodality, age, level of education, and gender.

In phase two, a second set of questionnaires 2 (QFT 2) for teachers (Appendix D) comprising of one section was used to gathering teachers' views on pedagogical challenges associated with implementation of multimodal instructional methods. Relevant and appropriate questions were developed taking into consideration the perspective of the respondents, their language proficiency and available time. According to Taherdoost (2022), well-crafted survey questions reduces ambiguity and potential misunderstandings enabling participants to provide accurate and relevant responses.

3.5.2 Interview Guide for Teachers

An interview guide for teachers (Appendix I) had four sections that were used to gather primary data. Section A comprised of preliminaries, section B had questions focusing on teaching methods and strategies used to deliver environmental activities lessons, section C had questions aimed at gathering comprehensive and actionable information on the characteristics of instructional models for teaching environmental education. Section D had questions focusing on pedagogical constraints associated with implementation of multimodal instructional approaches. Generally, questions were typically open-ended, allowing teachers to provide detailed responses, explanations, examples, or opinions and insights into their experiences, perspectives and practices.

Interviews were executed in the participants known environment, that is, in their respective schools after implementing the intervention. This was necessary to avoid putting teachers on pressure to move away from their working stations. Additionally, all interviews were carried out in private. This was meant to make the interviewee feel comfortable and stay interested and motivated during the whole interview process. Each teacher was contacted in person and explained the purpose of the interview, the types of questions to be addressed and the duration of the interviews. Interviews lasted 30 to 45 minutes and were conducted in English. Sources of data included verbatim transcription, as well as notes taken during interviews.

3.5.3 Observation Schedule of Teaching

In a study, lesson observation is a process where an observer, often a researcher, systematically watches a teacher's lesson to gather data on instructional practices,

classroom dynamics and learner engagement. The purpose is to gather useful data to enhance teaching and learning processes.

Observation schedule of Teaching (Appendix E) was used in phase two of the study. This tool was used to gather data on the frequency of utilization of multimodal instructional methods in delivering environmental activities lessons and document any challenges encountered. Additionally, the tool enabled the study to document practices that were effective, replicable and adaptable, relevant, sustainable, sensitive to children's learning styles and technically feasible. Practices refers to a particular way of doing things, methodology, process, strategy, activity, technique or tactic employed during teaching. Such observations provided firsthand, authentic data (Sølvik & Glenna, 2022). In the context of this study, observation of classroom teaching provided direct insight into how multimodal instructional approaches were implemented in practice.

The lesson observation schedule ensured that the observation process was systematic, objective and focused. It helped the observer to collect data that was relevant to the study's objectives, allowing for consistent and comparable results across different observations. Overall, observations provided empirical evidence for the effectiveness of the instructional model, directly contributing to the realization of the study objectives.

3.5.4 Observation of Learners Core-Competencies

The observation of learners' environmental conservation core-competencies (Appendix F) was used to establish core-competencies demonstrated by learners during engagement in three environmental conservation activities in the school through the assistant of the teacher. The tool comprised observation protocols focusing on three core-competency domain and 5-point Likert scale criterion. A criterion-based observation guide provided a systematic and objective framework for assessing learner performance, promoting consistency and reliability in observations. Unlike traditional observation methods that may focus on general behaviors or anecdotal notes, a criterion-based observation guide was designed with predefined criteria or standards against which learner performance is evaluated.

3.5.5 Pre-and Post-Tests for Learners

Assessment of learners' environmental conservation core competences before and after the intervention was done using pre- and post-tests (Appendix G). Pre-tests enabled the study to establish baseline measurements before the intervention, while post-tests were vital to measure outcomes or changes following the intervention. By comparing pre-test and post-test data, it was possible for the study to assess the effectiveness of the intervention and draw conclusions about its impact.

3.5.5 Post Survey Teachers Evaluation Checklist on Model Effectiveness

An evaluation checklist became an invaluable tool in the assessment and evaluation of the effectiveness of the instructional model in supporting learning. It provided a structured framework for observing and assessing various aspects of the model. The Teachers Evaluation Checklist (Appendix J) included key domains and indicators of the model, such as learner engagement and learning outcomes.

3.6 Pilot Study

A pilot study was carried out in two public primary schools in Tharaka Nithi County. Two teachers and 37 grade three children totaling to 39 respondents were engaged in the pilot study. Teijlingen and Hundley (2001) recommend piloting of instruments on a 10% of the sample. During this phase schools were visited to recruit and familiarize with the respondents and book appointments to administer the pilot instruments after permission to conduct the study was granted. The pilot study enabled assessment of reliability of the research tools. Different reliability methods were applied to ensure consistency and accuracy across the data collection tools. Cronbach's Alpha was used to assess internal consistency reliability of questionnaire, because it contained Likert-scale items. This enabled measurement of how well the items in the questionnaire were correlated with each other. Intra-Rater reliability was used to check the consistency of observation data from same observer over multiple observations. Test-Retest reliability was applied because same participants were interviewed at different times to assess the stability of their responses. Split-Half reliability was used for pre- and post-tests where the test items were divided into two halves (odd vs. even items) to check the consistency of the test.

In practice, pilot studies are carried out to establish whether the research procedures are unfeasible or susceptible to bias and facilitates making changes in time. Grammatical errors, question clarity and proper sequencing were ascertained during the pilot study before launching the full survey. The rationale for carrying out the pilot study lies in its ability to test research procedures, assess measurement tools, determine sample size, refine research design, test interventions, identify unforeseen issues, and build research team competency.

3.6.1 Validity

Testing validity in a study is crucial for ensuring that the research accurately measures what it intends to measure (Bell, Bryman & Harley, 2022). Validity testing in this study involved evaluating content, construct and face validity. Content validity assesses the extent to which the items or elements of a measurement tool represent the entire domain of the construct being measured. Procedures for establishing content validity include expert judgment, literature review and pilot testing to ensure that the measurement tool adequately samples relevant content. In this context, subject-matter experts' in Early Childhood Education and Development, Curriculum Instruction and Pedagogy in the Department of Education at Chuka University as well as supervisors of this study were provided with the research tools and requested to provide feedback on how well each tool was poised to measure the desired constructs of interest. Feedback given was critically analyzed and informed decisions made to improve the research tools.

Construct validity evaluates whether a measurement tool accurately measures the underlying theoretical construct it is intended to assess. Procedures for establishing construct validity include factor analysis, convergent and discriminant validity analysis, and hypothesis testing to examine relationships between the measure and other variables. Face validity refers to the extent to which a measurement tool appears to measure what it claims to measure. While not a rigorous form of validity, face validity in this study was assessed through informal feedback from the supervisors, other experts in the Department of Education and faculty and target participants to ensure that the measure is perceived as relevant and meaningful.

3.6.2 Reliability

Reliability of the research instruments (questionnaire, pre-and-posttests, observation schedule of teaching and learners core-competencies) was evaluated using Cronbach Alpha Coefficient. This was done by estimating the internal consistency of the responses so as to examine the reliability of the scales. Cronbach's alpha is appropriate for dichotomous variables coded 0 or 1 (Lina & Desnita, 2022). Zero means that there is no internal consistency between items in the instruments while 0ne means that internal consistency is perfect (Cronbach & Hedge, 2001). Thresholds for acceptable reliability depends on the specific context of the study and the type of measurement being used. According to Toma and Lederman (2022), the choice of threshold for acceptable reliability depends on factors such as the study's objectives, the nature of the measurement tool and disciplinary norms. Fraenkel, Wallen and Hyun (1993) recommends that a reliability coefficient $\alpha = 0.70$ and above is acceptable for descriptive research surveys. In the context of this study, a Cronbach's Alpha Coefficient of 0.72 and 0.76 was obtained with the questionnaire and standardized tests. The tools were deemed reliable.

3.7 Data Collection Procedures

Generally, the data collection procedures for this study involved the following critical steps and instruments: 1) Pre-field preparation (establishing contacts, rapport and obtaining the necessary permissions); 2) Baseline survey that provided crucial initial data that ensured the intervention was appropriately tailored and measured. Pre-test (Appendix G) and Questionnaire for teachers (QFT 1, Appendix C) was used to collect survey data; 3) Teacher training on the intervention. Teacher training equipped them with the necessary knowledge, skills and strategies to effectively implement the intervention in their classrooms. This ensured teachers understood the goal of the intervention, the instructional activities involved, and how to apply them in real-world educational settings. This training fostered teacher confidence and consistency, ultimately improving the success and sustainability of the intervention.; 4) Observation of teaching. This involved systematically watching and recording teachers' instructional methods, classroom interactions and learner engagement to assess the effectiveness of their practices. This provided valuable insights into how teaching strategies were being implemented, allowing for the identification of strengths and areas for improvement. This process was crucial for informing professional development, improving teaching

quality and enhancing learning outcomes. An observation schedule (Appendix E) was used.; 5) A post-test (Appendix G) was administered after the completion of the instructional period with the intervention to evaluate the knowledge, skills and competencies gained by learners. It served as a comparison point to pre-test results, measuring the effectiveness of the intervention or teaching methods.

The post-test helped determine whether learning objectives were met and provided data to assess the overall impact of the multimodal instruction model guidelines.; 6) Data on pedagogical challenges of implementing multimodal instructional method was collected using pedagogical challenges questionnaire for teachers (QFT 2), (Appendix D). Data to collaborate information gathered using questionnaires and observations was generated using a structured interview guide for teachers (Appendix I).; 5) Stakeholder evaluation and feedback. The rationale for stakeholder evaluation and feedback ensured that diverse perspectives were considered, leading to more comprehensive and relevant outcomes. Stakeholders brought critical insights regarding the practicality, effectiveness and sustainability of the intervention. A final validation workshop engaged stakeholders in a review of the findings, to confirm the accuracy of conclusions and collectively endorse the proposed actions, enhancing the credibility and acceptance of the study outcomes. These DBR iterative steps are briefly elaborated in the subsequent section.

3.7.1 Pre-field Preparation

An introductory letter (Appendix M) from Chuka University and Ethics Committee (Appendix N) and a research permit from the National Commission for Science Technology and Innovations (NACOSTI) (Appendix P) were sought. Obtaining an introductory letter from the Chuka University ethics committee and a research permit from the NACOSTI ensured that the research adhered to ethical standards and guidelines. These approvals demonstrated the researcher's commitment to protecting the rights and welfare of participants and ensuring the integrity and validity of the research process. Tharaka Nithi County Director of Education was contacted to grant permission to conduct the study in the said areas. This step demonstrated respect for local authorities and ensured compliance with regulations governing educational research in the county.

The researcher visited the schools and explained the purpose for the study to the head teachers and other respondents. This step fosters transparency, builds rapport with school authorities, and addresses any concerns or questions arising from the research procedures. Appointments with the respondents were booked to administer the research tools. This ensured that the data collection activities were conducted at times convenient to the respondents which minimized disruptions to school activities.

3.7.2 Baseline Survey

The empirical survey involved 59 teachers using questionnaire for teachers (QFT1), (Appendix C) in order to describe approaches, methods and strategies educators seem to be utilizing to provide environmental education and map out their training needs with respect to multimodality, establish extent of utilization of MMIA and collect teachers' general information and demographics. A pre-test on 322 grade three learners was facilitated by the subject teachers in order to help the study understand learners' entry abilities in the aspect of environmental core-competences before exposure to multimodal instructional teaching approaches. Experts were engaged to appraise the proposed instructional model.

3.7.3 Development of the Model Prototype

The baseline survey data was utilized to create a multimodal instruction model prototype (pg 150), which underwent expert review before being implemented by teachers. Prototyping is an iterative process that involves creating rough, preliminary versions of a product or service, testing them, and using the feedback to make improvements. This cycle of creating, testing, and refining is crucial for ensuring that the final design meets the needs and expectations of the target audience.

The iteration steps typically included gathering and analyzing data that enabled the study identify user needs and expectations which informed the design process. This enabled creation of a basic version of the prototype incorporating the gathered information. The prototype was shared with users to collect feedback regarding its features and functionality. Usability testing entailed evaluating the product with real users to identify issues. The refinement process entailed analyzing feedback, making adjustments to features, User Interface (UI) and User Experience (UX) elements and overall functionality. The refined prototype was further subjected to further testing for

usability and performance. This iterative process was utilized until the prototype met the desired standards and user satisfaction.

3.7.4 Training of Teachers

A three days training (see training program, Appendix L) was organized to orient eight teachers sampled for this study on multimodality, help them to recognize, identify and use spaces and resources at their disposal to prepare and deliver environmental activity lessons using multimodal instructional approaches, and closely monitor and support their practices. Continuous training, closer follow-up and support of teachers was done to ensure compliance and collegiality. Teachers were allowed to refine the instructional model by bringing in their inputs.

3.7.5 Implementation of the Model

The model prototype (pg 150) was utilized by a sample of 8 teachers to evaluate its functionality and effectiveness. The 8 teachers were observed in three different lessons using unobtrusive techniques while implementing the intervention. A total of 24 observations were made. This enabled the study understand how training influenced teaching practices. Teachers were also interviewed thereafter to get their views on the effectiveness of the intervention. A pedagogical challenge questionnaire QFT 2, (Appendix D) was administered to generate teachers' responses on pedagogical challenges of implementing the intervention. Questionnaires were immediately collected after the respondents complete filling them. This reduced the risk of loss or tampering and ensured timely retrieval of data. This practice also minimized the chances of missing data or incomplete responses, enhancing the quality and completeness of the dataset.

In a span of one week after teaching children with MMIM, a post-test was administered that enabled the study to measure changes in learners' environmental conservation core-competencies. By comparing post-test scores with pre-test scores, this study was able to determine the extent of learning gains achieved as a result of engaging with multimodal instructional methods. Through their interactions with the prototype, teachers provided valuable feedback that informed the development process. This feedback led to continuous refinement of the model, ensuring that it evolved to better meet the needs of its users.

3.7.6 Evaluation of the Intervention

A one-day validation workshop was conducted at the end of the survey to engage teachers in an evaluation, refining and redesigning of the intervention. This was necessary to get their level of satisfaction with the outcomes of the intervention, document lessons learnt including best practices, challenges encountered and recommendations. Techniques such as plenary and focused group discussions were employed to gather feedback on teachers' experiences and perceptions. A checklist (Appendix J) to evaluate the effectiveness of the intervention was administered.

3.8 Ethical Considerations

Ethical considerations are integral to the design, conduct, and dissemination of research involving human participants. Upholding ethical principles ensures the protection of participants' rights and welfare, maintains the integrity and credibility of the research, and promotes trust and confidence in the scientific community (Sobočan, 2022). Key ethical considerations that were ensured in the current study included obtaining a written consent from the respondents. This was crucial to ensure that participants were fully aware of the study's purpose, procedures, risks, benefits, and their rights before agreeing to participate. Obtaining informed consent demonstrates respect for participants' autonomy and ensures that they can make voluntary and informed decisions about their involvement in the research. It was the responsibility of this study to protect the rights, privacy, confidentiality, and well-being of participants throughout the research process. This included safeguarding sensitive information given, maintaining confidentiality, minimizing risks of harm, and providing appropriate support and debriefing mechanisms for participants, especially when dealing with vulnerable populations.

The study further ensured the confidentiality of sensitive information obtained during the study. This included protecting participants' identities, ensuring that data was anonymized or de-identified whenever possible and securely storing and transmitting data to prevent unauthorized access or disclosure. This study took bold steps to minimize the risk of physical, psychological, emotional or social harm to participants. This entailed designing research protocols that minimized discomfort or distress, providing appropriate support and resources for participants who may experience adverse effects, and promptly addressing any unforeseen risks or adverse events that

would arise during the course of this study. The study also ensured fair and equitable treatment of all participants, regardless of their background, characteristics or status. This entailed avoiding discrimination, coercion or exploitation and ensuring that all participants were treated with dignity, respect and fairness throughout the research process. This study also adhered to ethical guidelines and regulations established by Institutional Review Boards (IRBs), that is, Chuka University Ethics Committee, funding agencies, professional associations and relevant regulatory bodies like NACOSTI. (Appendix P). Compliance with ethical standards ensures the integrity, credibility, and trustworthiness of the research and protects both participants and researchers from potential ethical violations or misconduct.

3.9 Diagnostic Tests

Before conducting data analysis, it was important to conduct quantitative and qualitative diagnostic tests to ensure the data gathered meets certain assumptions and criteria (Pek, Hoisington-Shaw & Wegener, 2022).

3.9.1 Normality Test

In statistics, conducting a normality test is vital in ensuring valid inferences and accurate predictions are made from the data generated (de Souza, Toebe, Mello & Bittencourt, 2023). Thus, normality test using the Shapiro-Wilk test or Kolmogorov-Smirnov test, were conducted to determine if the data generated was normally distributed.

3.9.2 Collinearity Test

This was conducted to assess whether the independent variables were highly correlated with each other. This was achieved by calculating the variance inflation factor (VIF) for each independent variable in the model. It is a measure of how much the variance of the estimated regression coefficient βk is "inflated" by the existence of correlation among the predictor variables in the model. A VIF of 1 means that there is no correlation among the kth predictor and the remaining predictor variables, and hence the variance of βk is not inflated at all. The general rule of thumb is that VIFs exceeding 4 warrant further investigation, while VIFs exceeding 10 are signs of serious multicollinearity requiring correction (Shrestha, 2020). Detecting and addressing multicollinearity is crucial for ensuring the reliability of regression results.

3.9.3 Autocorrelation Test

Autocorrelation refers to the degree of correlation of the same variables between two successive time intervals (Silva, Fleming, Noonan, Alston, Folta, Fagan & Calabrese, 2022). Thus, autocorrelation analysis measures the relationship of the observations between the different points in time, and thus seeks a pattern or trend over the time. Autocorrelation test was used to check if there was a relationship between same variables over a time interval. One common test for autocorrelation is the Durbin-Watson test, which was used to detect autocorrelation of the responses generated from teachers within the different grade levels. The test statistic ranges from 0 to 4, with a value close to 2 indicating no autocorrelation, a value less than 2 indicating positive autocorrelation, and a value greater than 2 indicating negative autocorrelation. The analysis of autocorrelation enabled the study to establish repeating periodic patterns in the data, which can be used as a tool for technical analysis.

3.9.4 Homoscedasticity Test

In statistics, homoscedasticity refers to homogeneity variance. That is, different samples or groups have the same variance (Emerson, 2022; Yi, Chen, Cheng, Wang, Nguyen & Kim, 2022). Homoscedasticity assumption implies that the variability of the dependent variable is consistent across different levels of the independent variables. Thus, homoscedasticity test was done using Levene's test to find out whether the variance of the dependent variable (environmental conservation core competences) are consistent across the levels of the independent variable(s) because was suspected that the independent variables (multimodal instructional methods) may cause heteroscedasticity and the consequences of violating homoscedasticity would lead to biased standard errors, invalid inferences and results that are not precise.

3.10 Data Analysis

After conducting the diagnostic tests, the raw data from the field was first be checked for completeness, usefulness and accuracy. After data cleaning, the quantitative data was coded and entered in the computer for analysis using Statistical Package for Social Sciences (SPSS) Version 29. This software was used because it accommodates a large number of variables at the same time and reduces detailed laborious calculations by hand. The quantitative data obtained from the questionnaires was analyzed quantitatively and descriptive statistics used to summarize the results. Qualitative data

from interviews and observations was analyzed using software NVivo 12 plus to uncover patterns, themes and meanings. According to Izza and Rusydiana (2022), NVivo 12 plus is used to manage data, create nodes and categorize themes. A two-cycle qualitative data analysis was used as described in Table 3.

Table 3: Two-Cycle Qualitative Data Analysis Strategies Utilized

Cycles	Coding Style	Methods
1	Structural Coding	Codes assigned to the participants associated with the semi-structured questions related to the research questions
2	Axial Coding	Recording the initial codes and condensing them into categories to identify meaningful themes

Adapted from the coding manual for Qualitative Researchers by Saldama (2021)

Survey responses were analyzed using descriptive statistics to make conclusions on the types and extent of multimodal instructional use. The study conducted one-way ANOVA to compare means across groups. Pre-and-posttest analysis were done to assess changes in learners' environmental conservation core competencies after exposure to different multimodal instructional methods. Test scores were analyzed using statistical methods such as t-tests or Analysis of Variance (ANOVA) to determine the efficacy of instructional intervention. A summary of data analysis methods is shown in Table 4.

Table 4: Summary of Data Analysis Methods

Research Question	Independent variable	Dependent variable	Level of Measurement	Analytical Methods
i) What multimodal instructional activities are teachers employing to deliver environmental conservation lessons in lower primary schools in Tharaka Nithi County, Kenya?	Instructional Methods	Environmental Activities	Nominal Likert Scale	Descriptive (frequencies, percentages, means and standard deviation)
ii) To what extent are multimodal instructional activities being utilized in delivering environmental conservation lessons in lower primary schools in Tharaka Nithi County, Kenya?	Extent of Utilization	Multimodal Instructional Approaches	Ordinal Likert Scale	Kruskal-Wallis H Test Shapiro-Wilk Test
iii) What pedagogical challenges are associated with delivering environmental activities lessons in lower primary schools in Tharaka Nithi County, Kenya using multimodal instructional methods?	Pedagogical Constraints	Multimodal Instructional methods	Nominal Likert Scale	Quantitative Thematic Analysis
$H_0$1: There is no statistically significant influence of multimodal instructional method on learners' acquisition of environmental conservation core competencies in lower primary schools in Tharaka Nithi County, Kenya	Multimodal Instructional methods	Environmental Conservation Core Competencies	Nominal Likert Scale	ANOVA and t-test
$H_0$2:There is no statistically significant effectiveness in applying multimodal instructional model guidelines to enhance learner acquisition of environmental conservation core-competencies in lower primary schools in Tharaka Nithi County, Kenya.	Effectiveness	Multimodal Instructional Model	Categorical	t-test

CHAPTER FOUR
RESULTS AND DISCUSSION

4.1 Response Rate

Response rate was worked out as a percentage of respondents who participated out of those who were invited to participate. It is an important indicator of the survey's success and reliability. Table 5 shows the response in phase one of the study involving empirical survey.

Table 5: Response Rate

Respondents	Sampled	Responded	Percentage Response
Teachers	59	59	100.0
Learners	322	322	100.0
Total	381	381	100.0

Source: Field Data (2024)

An aggregate response rate of 100% was achieved which according to Holtom, Baruch, Aguinis and Ballinger (2022) is sufficient for making accurate deductions from the samples. Holtom et al. (2022) asserts that high response rates generally contribute to higher data quality and reliability of the survey results. The high response rate was achieved through notifying of respondents ahead of time about the survey, its purpose and the time it was to be administered to prepare them mentally, administering the survey at a time when teachers and learners were least likely to be busy or stressed, such as during breaks or professional development sessions and providing respondents enough time to thoughtfully complete the survey without feeling rushed. The study also ensured that the survey questions were clear, concise and easy to complete to facilitate quick and accurate responses.

4.2 Demographic Information

Demographic data provides context about who the respondents are, enabling studies to see how different demographic groups responded to survey questions. By segmenting responses by demographic characteristics, studies can identify patterns and trends within specific groups. For example, age groups might have different preferences or opinions. This segmentation can reveal insights that are relevant for specific subgroups, which can be crucial for targeted interventions. In addition, knowing the demographic

profile of respondents helps in assessing whether the study's findings can be generalized to the broader population. For this study teachers provided information in respect of length of teaching in the current school, gender, age, highest education level and years of teaching experience.

4.2.1 Teaching Experience

The length of teaching provides critical context for understanding how effectively teachers can implement multimodal instructional methods. It helps to account for variations in teacher experience, stability and integration within the school environment, all of which can significantly impact the development of learners' environmental conservation core competencies. This study determined the duration teachers had taught in their current stations. Fifty-nine teachers were surveyed and the results are presents presented in Table 6.

Table 6: Teaching Experience

Variable	Year Interval	Frequency	Percentage
Years of Teaching	1-5	4	6.78
	6-10	5	8.47
	11-15	11	18.64
	16-20	18	30.51
	21-25	7	11.86
	26-30	8	13.56
	31-35	6	10.18
Total		59	100.0

Source: Field Data (2024)

The data show that teachers who had between 16 and 20 years of teaching in the current station had the highest percentage 18 (30.51%), representing nearly a third of the surveyed population. This indicates a significant retention rate for teachers with substantial experience at their current station. This was followed by 11(18.64%) teachers in the interval of 11-15 years suggesting yet another substantial group of teachers with over a decade of experience in the same work station. The data further indicate that a group of long-term teachers 8 (13.56%**)** of the sample and nearing retirement had 26-30 years of stay in the current work station. The data also show that 7(11.86%) of the teachers that took part in the survey had taught in their current schools between 21 and 25 years. This still represents a notable portion of retention beyond 20

years. From the dataset, it can also be seen that 6 (10.18%) of the teachers had a tenure of 31-35 years in their current work stations. This category still has a significant percentage, reflecting a core of highly experienced teachers about to exit the teaching profession. The results further reveals that 5 (8.47%) of the teachers had between 6 and10 years of teaching experience in the current school while 4 (6.78%) had between 1 and 5 years' length of stay in the current station. This category had the lowest representation among those surveyed indicating that relatively few teachers are in the early stages of their tenure at their current station.

The data obtained in this study is in tandem with what Hanushek, Rivkin and Schiman (2016) established while studying the dynamic effects of teacher turnover on the quality of instruction in an urban district in Texas. Hanushek et al. (2016) found that teacher turnover adversely affects the quality of instruction in most schools. The study contends that the stability of having the same teacher over several years can positively influence students' learning experiences and outcomes. Consistency in teaching methods can lead to better learning outcomes, as learners receive a coherent educational experience over time. Similar data was obtained in Arkansas by Keng (2018) in his study of tenure system and its impact on grading leniency, teaching effectiveness and student effort. Keng (2018) found that teachers who had been at the same school longer may have more experience with the school's specific implementation of multimodal instructional methods. Teachers with longer tenure are likely to have a deeper understanding of the school's curriculum, including how multimodal instructional methods are integrated into teaching environmental conservation. Their familiarity with these methods could affect how effectively they use them to teach environmental conservation. Newer teachers might still be adjusting to the school's culture and teaching methods, potentially influencing their ability to effectively implement multimodal instruction.

4.2.2 Gender

Teachers serve as role models and the gender of the teacher might influence how learners perceive and engage with the subject matter. Learners responses to instructional methods can vary based on the gender of the teacher. Understanding these dynamics can help in tailoring multimodal instructional methods to maximize their effectiveness for all learners. In some cultures, gender roles and expectations might

influence teaching practices and the reception of different instructional methods. This study therefore sought to determine the gender of the teachers handling environmental activities in lower primary school level. Studying the gender of teachers helps in identifying any biases or gaps in current teaching practices. Data obtained is summarized in Figure 5.

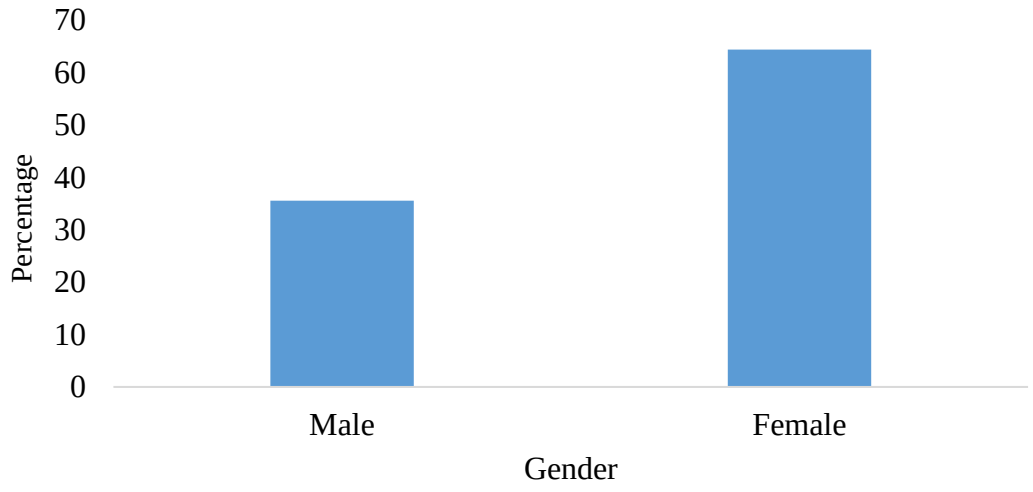


Figure 5: Distribution of Teachers by Gender
Source: Field Data (2024)

The data reveals a marked gender imbalance in the distribution of teachers handling environmental activities in lower primary schools. Specifically, female teachers significantly outnumber their male counterparts, with 64.41% of the teaching staff being women, compared to only 35.59% men. This translates to nearly two-thirds of the teachers being female, almost double the proportion of male teachers. Such a disparity highlights that women are predominantly represented in this teaching role, while men form a considerably smaller fraction of the group. This reflects the overall trend in many schools where female teachers are more prevalent in early childhood and primary education settings. Moraa, Thuba and Kithinji (2022) examined social-cultural factors influencing female under-representation in the management of public primary schools in Rigoma Sub-County, Nyamira County, Kenya. The findings indicated that cultural problems led to the underrepresentation of women in education management among teachers. The study concluded that The study concluded that cultural problems led to the underrepresentation of women in education management among teachers.

Sorhe (2024) focused on factors influencing gender disparities in professional development among early childhood education teachers in Kakamega East Sub-County, Kakamega County, Kenya. The study found that human resource factors such as recruitment and selection, workplace culture, diversity and inclusion collectively contributes to gender disparity in the early childhood education profession. Sorhe (2024) recommended that human resource factors be considered in the recruitment of early ECD teachers. Moraa et al. (2022) and Sorhe (2024) studies reinforce the observed trend that female teachers are more prevalent in the primary education sector in Kenya, particularly in subjects like environmental education. This has several implications for educational practices, professional development, recruitment strategies, curriculum development, and student perceptions.

4.2.3 Age

This study recognizes that the age of a teacher might influence their approach to learning and teaching. Teachers of different ages might have varying communication styles, classroom management skills, technological proficiency, professional development and work-life balance priorities which can affect the implementation of multimodal methods. Therefore, considering teachers' age in this study provided valuable insights into how multimodal instructional methods are perceived and implemented across the age continuums. Data obtained is shown in Figure 6.

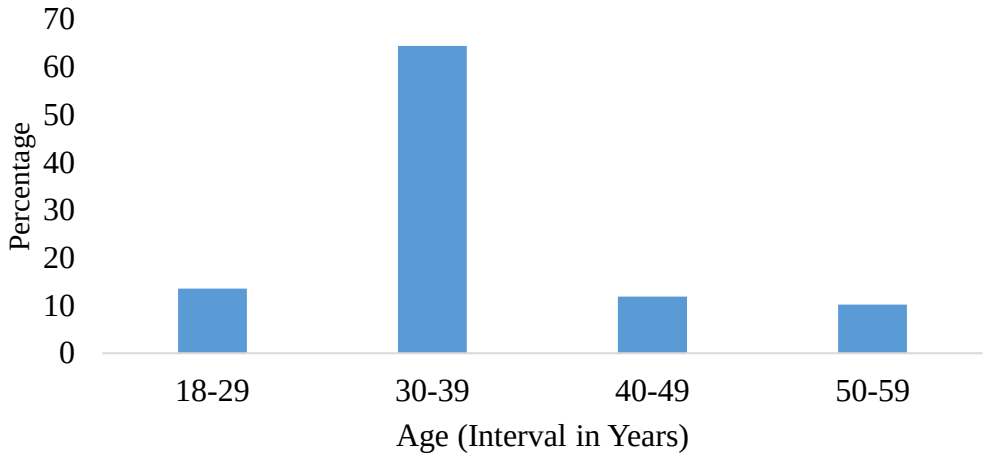


Figure 6: Distribution of Teachers by Age

Source: Field Data (2024)

The data show that majority (64.41%) of teachers handling environmental activities in Tharaka Nithi County were in the 30-39 age bracket. This indicates that most teachers are in their early to mid-career stages, likely possessing a combination of youthful energy and professional experience. Teachers in the 18-29 age group make up 13.56% of the workforce. This relatively smaller percentage might reflect the initial stages of their careers, where they are gaining experience and developing their teaching skills. The 40-49 age group represents 11.86% of the teachers. These individuals are likely to be highly experienced, potentially taking on mentoring roles and contributing significantly to the development of teaching methods and curricula. Teachers in the 50-59 age bracket comprise 10.18% of the total. This group is approaching retirement age and their wealth of experience can be invaluable, although their numbers are relatively small. The data presented in Figure 6 resonates with what Waigera, Mweru and Ngige (2020) found when they studied the demographic characteristics of primary school teachers in Kenya and their impact on teaching effectiveness. Waigera et al. (2020) findings revealed that age had no statistically significant relationship with the utilization of instructional materials in pre-primary schools.

4.2.4 Education Level

The level of education of teachers is an important variable because it significantly influences their pedagogical skills, content knowledge and ability to implement effective instructional methods. By collect detailed information on teachers' educational backgrounds, this study sought to understand the broader educational context, in respect of the significance of teachers' education level and instructional practices in analyzing the study's result. Data generated in summarized in Figure 7.

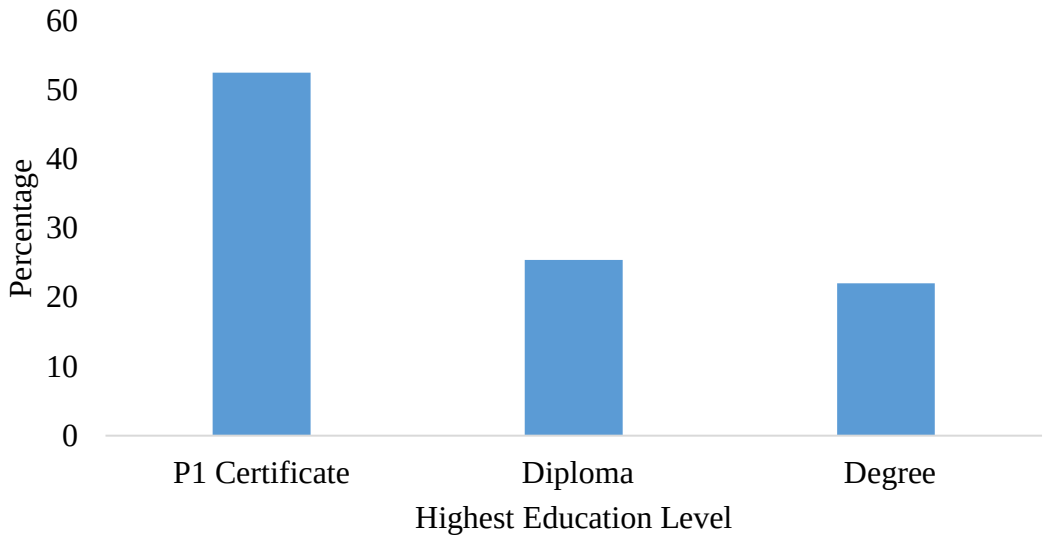


Figure 7: Teachers Highest Education Level

Source: Field Data (2024)

Data presented in Figure 7 show that majority 31(52.54%) of teachers hold a P1 certificate. This indicates that more than half of the teachers handling environmental activities have the minimum required qualification for primary school teaching. The data also indicate that, 25.42% of the teachers had a diploma in education. The data further show that, 22.04% of the teachers possess a first degree. This implies that the majority of teachers (52.54%) handling environmental activities in Kenyan primary schools possess a P1 certificate, the minimum required qualification. However, a significant portion (25.42%) holds a diploma, and 22.04% possess a first degree, indicating that a considerable number of teachers have pursued further education. This suggests that while most teachers meet the minimum qualification requirements, there is a notable proportion with higher academic credentials, which could potentially enhance their teaching effectiveness.

Ademola, Okebukola, Oladejo, Onowugbeda, Gbeleyi and Agbanimu (2021) investigated teachers' qualifications and teaching experience: impact on quality assurance in Nigeria Secondary Education. The study found that years of teaching experience and teachers' academic qualification with lack of deep content knowledge by the teacher will not have a significant difference in the academic achievement of students. Palardy and Rumberger (2008) study on teacher effectiveness in first grade:

the importance of background qualifications, attitudes, and instructional practices for Student Learning established that background qualifications have less robust associations with achievement gains. In line with the findings of these previous studies, it can be argued that qualifications alone may not guarantee improved learner achievement unless they are complemented by deep content knowledge and effective instructional practices.

4.2.5 Experience in Teaching Using Multimodality

Teachers' experience in using multimodal instructional methods is important because it significantly influences their proficiency, consistency and effectiveness in teaching. By investigating this variable, this study sheds more light on how multimodal instructional methods impact learners' environmental conservation core competencies so that more targeted interventions for improving educational practices in lower primary schools can be developed. This study gathered data on teachers' years of experience specifically with multimodal methods to differentiate between general teaching experience and specific experience with the instructional approach under study. Summarized in 8 is the data obtained during phase one of this study.

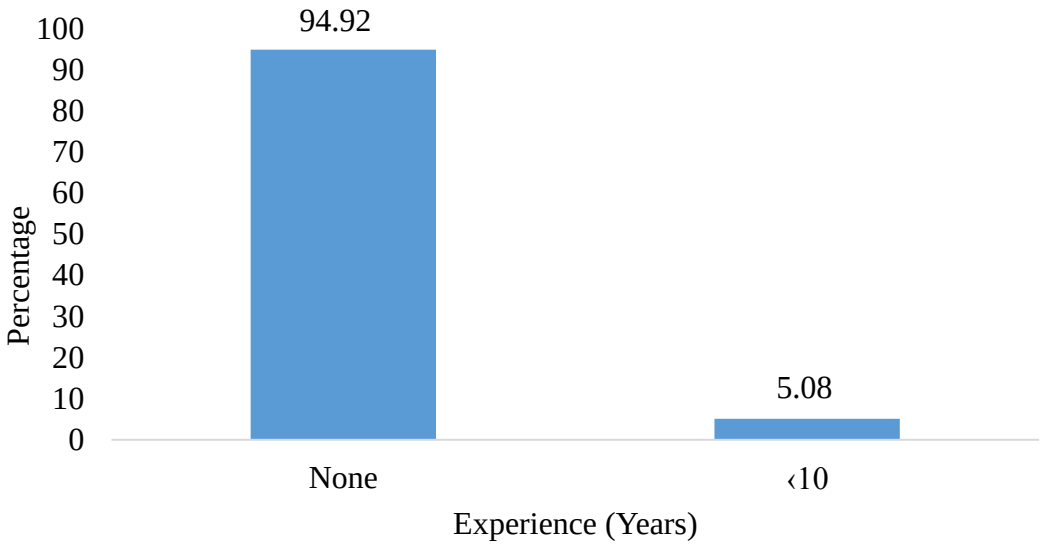


Figure 8: Experience in Teaching Using Multimodality

Source: Field Data (2024)

The findings indicate a glaring lack of experience among teachers in using multimodal instructional methods. An overwhelming majority of 56 teachers, representing 94.92%,

reported having no experience with multimodal instructional methods, while only a minority of 3 teachers (5.08%) had utilized the methods for less than 10 years. This significant contrast emphasizes that nearly all teachers are unacquainted with multimodal approaches, suggesting that the opportunity for professional development in this area is critically limited. The data underscores a substantial gap in instructional practices, indicating a pressing need for training and support in multimodal teaching strategies. This is consistent with the findings obtained by Masinde (2023) who investigated utilization of multimodal approaches in the teaching and learning of oral skills to grade one pupils in selected primary schools in Western Kenya. The study findings revealed that teachers of English had vast experience in using multimodal instructional methods but did not blend them during class interaction. The study identified lack of resources, large class size and work load among others as challenges hindering effective utilization of multimodal instructional method. Addressing these challenges will be crucial for improving the quality of environmental education implementation in schools.

4.3 Diagnostic Tests

Quantitative diagnostic tests were conducted to ensure the data gathered met certain assumptions and criteria before being subjected to hypothesis test. Diagnostic tests help researchers pinpoint the underlying problems or variables affecting the outcomes of their study. By identifying flaws or limitations in the research design or methodology, diagnostic tests enable researchers to refine their approaches and enhance the overall quality of the study. Insights gained from diagnostic tests guide researchers in making informed decisions about subsequent steps in their research, including adjustments to the study design. Ultimately, the following diagnostic tests performed in this study: normality, collinearity, autocorrelation and homoscedasticity.

4.3.1 Normality Test

Shapiro-Wilk tests was performed to help determine if the distribution of scores for each aspect were normally distributed. Results obtained are presented in Table 7.

Table 7: Results of Shapiro-Wilk Normality Test

	Shapiro-Wilk Test Values	
Variable	Statistic	p-value
Knowledge	0.966	0.847
Skills	0.952	0.755
Attitude	0.943	0.687
Behaviour	0.869	0.263
Communication and collaboration	0.847	0.184
Critical thinking and problem solving	0.907	0.451
Imagination and creativity	0.914	0.490

Interpretation:
p-value > 0.05: The data for the aspect does not significantly deviate from the normal distribution.
p-value ≤ 0.05: The data for the aspect significantly deviates from the normal distribution.

The p-values for all variables are greater than 0.05, indicating that the distributions of scores was consistent and did not significantly deviate from a normal distribution. Thus, it was concluded that the scores for each aspect follow a normal distribution.

4.3.2 Collinearity Test

Multiple regression analysis was conducted to evaluate the relationship between various multimodal instructional activities and the outcome variable, while checking for multicollinearity among the predictors. Results obtained are displayed in Table 8.

Table 8: Collinearity Statistics Summary

Predictor Variable	Unstandardized Coefficient	Standard Error	Standard Coefficient	t-test	p	95% Confidence Interval for the Unstandardized Coefficient		Collinearity Statistics	
						Lower Bound	Upper Bound	Tolerance	VIF
Intercept	232.797	29.542		7.880	<0.001	72.376	293.217		
Visual	0.221	0.642	0.050	0.344	0.733	-1.093	1.534	0.525	1.905
Auditory	-0.050	1.026	-0.011	-0.048	0.962	-2.148	2.049	0.202	1.948
Read/write	0.392	0.593	0.088	0.661	0.514	-0.817	1.601	0.599	1.670
Tactile	1.006	1.664	0.282	0.605	0.550	-2.388	4.401	0.575	1.738
Integrated Technology	4.083	1.411	0.396	2.893	0.007	1.197	6.970	0.585	1.709
Collaborative	-0.905	0.845	-0.305	-1.071	0.293	-2.633	0.823	0.135	1.823
Experiential	0.690	2.506	0.056	0.275	0.785	-4.435	5.816	0.261	3.834

The results indicate that integrated technology activities had a significant positive effect on the outcome variable (B = 4.083, p = 0.007), indicating that increased use of integrated technology in instructional methods is associated with a significant improvement in the outcome. The 95% confidence interval for this coefficient was [1.197, 6.970], providing further evidence of its robustness. Auditory instructional activities had a negative, though non-significant, effect on the outcome (B = -0.050, p = 0.962). This suggests that changes in the use of auditory methods do not significantly influence the outcome, as reflected by the wide confidence interval [-2.148, 2.049]. Visual instructional activities showed a positive, but non-significant, relationship with the outcome (B = 0.221, p = 0.733), with a confidence interval ranging from [-1.093 to 1.534]. The results imply that the use of visual methods does not have a meaningful effect on the dependent variable.

Read/Write instructional methods were also not significantly related to the outcome (B = 0.392, p = 0.514), despite having a small positive coefficient. The confidence interval for this predictor [-0.817, 1.601] suggests a degree of uncertainty around its influence. Kinesthetic or tactile methods had a positive coefficient (B = 1.006, p = 0.550), though it did not reach statistical significance. The confidence interval [-2.388, 4.401] was broad, indicating variability in the estimate. Collaborative learning activities produced a negative coefficient (B = -0.905, p = 0.293), although this effect was not statistically significant. The 95% confidence interval ranged from [-2.633, 0.823], suggesting that the effect could vary from a slight negative to no effect. Experiential learning activities had a small positive but non-significant effect (B = 0.690, p = 0.785), and the confidence interval [-4.435, 5.816] indicated that the estimate was highly variable and uncertain.

The collinearity diagnostics show that the Variance Inflation Factor (VIF) values for all predictor variables were within acceptable limits, with none exceeding 5. The highest VIF was 3.834 for experiential activities, while the lowest was 1.670 for read/write activities. These results suggest that multicollinearity was not problematic in this analysis, ensuring that the coefficients were not inflated due to the intercorrelation of predictors. Thus, the collinearity statistics show that multicollinearity was not a major issue, as all VIF values were below 5, suggesting that the predictor variables were

sufficiently independent which strengthens the reliability of the coefficient estimates for the individual predictors.

4.3.3 Autocorrelation Test

Autocorrelation shows the degree of correlation between variables over successive time intervals. Durbin-Watson statistic was computed to test for autocorrelation. The Durbin-Watson test statistic tests the null hypothesis that the residuals from an ordinary least-squares regression are not autocorrelated. Residuals are the differences between each score and the mean score. A value near 2 indicates no autocorrelation. The outcome of autocorrelation test resulting from the regression analysis, including the analysis of variance (ANOVA) table, model summary, and Durbin-Watson statistic are provided. A breakdown of ANOVA results is displayed in Table 9.

Table 9: ANOVA Test Results

Source	SS	df	MS	F
Regression	12,537.50	7	1,791.07	1.033
Residual	72,828.38	42	1,734.01	
Total	85,365.88	49		

The results show that the F-statistic is 1.033. Based on the F-statistic and the accompanying degrees of freedom, the p-value associated with this F-statistic greater than 0.05, indicating that the regression model as a whole is not statistically significant at the 0.05 level. This implies that the independent variables included in the model do not collectively predict the dependent variable effectively. Since the overall regression is not significant, it suggests that none of the predictor variables in the model (visual, auditory, read/write, tactile, integrated technology, collaborative, and experiential) are contributing significantly to explaining the variability in the dependent variable. Thus, the ANOVA results indicate that the predictors do not provide a statistically significant explanation for the variance in the outcome variable, which may prompt the need for further investigation, such as exploring additional predictors or modifying the model.

The presence of autocorrelation was tested using Durbin-Watson statistic test and the results are presented in Table 10.

Table 10: Autocorrelation Model Summary Table

Model	R	R-squared	Adjusted R-squared	Std. Error of the Estimate	Durbin-Watson
1	0.383	0.147	0.005	41.648	2.270

The R-squared of 0.147 means that 14.7% of the variance in the dependent variable is explained by the independent variables. Adjusted R-squared of 0.005 indicates that the model does not significantly improve after adjusting for the number of predictors. The Durbin-Watson statistic of 2.27 suggests that there is no significant autocorrelation in the residuals. Thus, the Durbin-Watson statistic of 2.27 falls within the acceptable range of 1.5 to 2.5, indicating that there is no significant autocorrelation in the residuals of the regression model. Hence, results of autocorrelation diagnostics suggest that the errors in the model are independent and not correlated with each other. This is a good sign for the validity of the regression model, as autocorrelation can distort the results and lead to biased estimates in time series or sequential data.

The regression analysis was conducted to examine the effects of various instructional methods (visual, auditory, read/write, tactile, integrated technology, collaborative, and experiential) on the dependent variable. The coefficients of the predictor variables were analyzed to determine their individual contributions and statistical significance. The regression analysis produced several coefficients that help to understand the impact of various instructional activities on the dependent variable. Each coefficient indicates the expected change in the dependent variable for a one-unit increase in the respective predictor variable, holding all other variables constant.

The results are summarized in Table 11.

Table 11: Coefficients of the Predictor Variables in the Regression Model

Variable	Coefficient	Std. Error	t-value	p-value	95% CI (Lower)	95% CI (Upper)
Constant	298.89	16.61	18.00	< 0.001	265.38	332.40
Visual	12.33	8.76	1.41	0.167	-5.35	30.00
Auditory	0.97	6.19	0.16	0.876	-11.53	13.47
Read/Write	-13.25	10.62	-1.25	0.219	-34.69	8.19
Tactile	2.95	4.06	0.73	0.471	-5.23	11.14
Integrated Technology	0.62	3.79	0.16	0.872	-7.03	8.27
Collaborative	-0.13	7.34	-0.02	0.986	-14.95	14.69
Experiential	3.34	2.11	1.58	0.121	-0.93	7.61

The results show that the intercept coefficient is 298.89 with a standard error of 16.61. This value is highly significant (t-value = 18.00, $p < 0.001$), indicating that when all predictors are at zero, the expected value of the dependent variable is 298.89. The 95% confidence interval ranges from 265.38 to 332.40, confirming a strong estimate for the intercept.

The coefficient for the visual instructional method is 12.33 with a standard error of 8.76. The t-value is 1.41, resulting in a p-value of 0.167, which indicates that this effect is not statistically significant. The 95% confidence interval ranges from -5.35 to 30.00, suggesting that the impact of Visual methods could vary widely and may include zero. The auditory method has a coefficient of 0.97 and a standard error of 6.19. The t-value is 0.16, with a p-value of 0.876, indicating no significant effect on the dependent variable. The confidence interval ranges from -11.53 to 13.47, which includes zero, reinforcing the lack of significant impact. The Read/Write instructional method displays a coefficient of -13.25 with a standard error of 10.62. The t-value of -1.25 results in a p-value of 0.219, indicating that this effect is not statistically significant. The 95% confidence interval ranges from -34.69 to 8.19, further suggesting considerable uncertainty about the impact of Read/Write methods. The Tactile method has a coefficient of 2.95 and a standard error of 4.06, with a t-value of 0.73 and a p-value of 0.471. This indicates no statistically significant effect. The confidence interval ranges from -5.23 to 11.14, indicating a potential for both positive and negative effects.

The coefficient for integrated technology is 0.62 with a standard error of 3.79. The t-value is 0.16, and the p-value is 0.872, signifying that this predictor does not have a significant effect. The confidence interval spans from -7.03 to 8.27, suggesting a wide range of possible effects. The collaborative method shows a coefficient of -0.13 with a standard error of 7.34. The t-value is -0.02, resulting in a p-value of 0.986, which indicates no significant effect on the dependent variable. The confidence interval ranges from -14.95 to 14.69, suggesting considerable uncertainty. The experiential method has a coefficient of 3.34 and a standard error of 2.11, with a t-value of 1.58 and a p-value of 0.121. This indicates that although there is a positive effect, it is not statistically significant. The confidence interval ranges from -0.93 to 7.61, further highlighting the uncertainty around the effect of experiential learning.

Overall, the coefficients obtained show that autocorrelation was not a problem based on the Durbin-Watson statistic as none of the instructional methods exhibited statistically significant effects on the dependent variable, as indicated by their respective p-values exceeding the conventional significance level of 0.05. This suggests that the instructional methods tested in this study did not have a substantial impact on the outcomes measured. Therefore, further research may be necessary to explore alternative methods or additional variables that could influence the dependent variable more significantly.

4.3.4 Homoscedasticity Test

Homoscedasticity refers to the assumption that different samples in an analysis have the same variance. It is often assessed using statistical tests such as Levene's test or Bartlett's test. To perform the test, data was appropriately transformed into a format where each row represented an observation and there were columns for each group. Levene's test was applied to assess the homogeneity of variances across the groups and the results generated are presented in Table 12.

Table 12: Levene's Test Results on Homogeneity of Variances Across the Groups

Test	Statistic	p-value
Levene's Test	0.395	0.876

Source: Field Data (2024)

The data indicate that the p-value is 0.876 and the test statistic is 0.395. It is not possible to reject the null hypothesis because the p-value (0.876) is significantly higher than the standard significance level of 0.05. This means there is no significant evidence to suggest that the variances are different across the groups, indicating that the assumption of homoscedasticity holds for this data.

4.4 Multimodal Instructional Activities Used to Present Environmental Conservation Lessons

The first objective sought to establish the multimodal instructional activities used in presenting environmental conservation lessons in lower primary schools in Tharaka Nithi County, Kenya. Results obtained are displayed in Table 13.

Table 13: Teachers' Self-Reported Multimodal Instructional Practices

Instructional Activities	Responses in % (n = 59)				
	SA	A	N	D	SD
Visual	0	0	0	83.0	17.0
Auditory	17.0	76.0	7.0	0	0
Reading and Writing	15.0	85.0	0	0	0
Kinesthetic	0	20.0	25.0	17.0	38.0
Interactive Technology	13.6	30.5	25.4	17.0	13.6
Collaborative	42.4	33.9	17.0	5.0	1.7
Experiential	25.4	50.8	17.0	5.1	1.7

Key: SA-Strongly Agree; A-Agree; N-Neutral; D-Disagree; SD-Strongly Disagree

Source: Field Data (2024)

Identification of the multimodal instructional methods used by teachers in delivering environmental conservation lessons in lower primary schools in Tharaka Nithi County was key for this study. Evidence from the data indicates a skewed practice in the use of multimodal instructional methods as discussed in the subsequent sections.

4.4.1 Visual Activities

The results show that the use of visual aids such as diagrams, photographs and videos is not commonly employed in delivering environmental activity lessons. The very low mean score of 1.830 reflects a predominant disagreement. The high standard deviation of 18.99 suggests significant variability in the responses, possibly due to differing interpretations or experiences among the respondents. This differs from the previous findings by Höllerer et al, (2018) where the findings established that teachers used

various photos in their presentations to get their point across. They displayed videos with sub-strands, speech, music, and gestures that deepen comprehension of a topic. Previous studies by Dar, Kudare, Dar, Ali and Mohammed (2022), have shown that while visual aids can be helpful in illustrating complex concepts, they are often less effective when used in isolation without accompanying interactive or hands-on activities. Therefore, educational strategies should integrate visual aids with more interactive methods to enhance their effectiveness. Teachers should be trained on how to use visual aids in conjunction with other teaching methods to maximize student engagement and understanding.

4.4.2 Auditory Activities

A considerable proportion of the respondents (93.0%) agreed that auditory instructional methods like lecture, oral presentation and recitations, storytelling, were commonly used in delivering environmental activity lessons. The high mean score (4.102) and low standard deviation (0.480) indicate strong agreement among teachers on the use of auditory aids in delivering environmental activity lessons. Auditory methods, such as storytelling and group discussions, are known to enhance comprehension and retention by engaging learners in active listening and verbal interaction. Previous research by Sihombing and Simanjuntak (2023) supports the use of auditory aids in education, highlighting their role in developing listening skills and fostering a collaborative learning environment.

The mean score of 4.102 indicates a high level of agreement, while the standard deviation of 18.08 indicates moderate variability in the responses, suggesting that while there is general consensus, some differences in opinion or experience exist. Kim and Kang (2019) showed that teachers in primary schools commonly use of auditory methods, particularly in the form of read-alouds. Teachers often read stories aloud, use songs and rhymes to teach concepts, and incorporate listening activities to develop language skills. The results of this study add to the mounting evidence that supports the widespread use of auditory instructional methods in most classrooms in Kenya. Storytelling, phonics songs, and read-aloud sessions are prevalent practices in early childhood and primary education at the expense of multimodality. Therefore, schools should encourage the use of auditory aids as part of a diverse teaching strategy.

Providing resources and training for teachers to effectively implement these methods can further enhance their impact on student learning.

4.4.3 Reading and Writing Activities

The engagement of learners in reading and writing activities was highly agreed upon, by all respondents (100.0%). The very high mean score (4.153) and minimal standard deviation (0.362) suggest a consensus on the use of reading and writing activities during environmental activity lessons. These activities are fundamental in education, promoting literacy, critical thinking and information retention. Results of the current study are similar to Mandilla (2021) findings that established that teachers have continued to use the top-down reading and writing instructional strategies in delivering content. Previous studies by Castells, Minguela and Nadal (2023) reveal that reading and writing are crucial for deep learning and comprehension, especially when integrated with other teaching methods. Therefore, educational programs should continue to emphasize reading and writing, ensuring these activities are central to the curriculum. Integrating reading and writing with other interactive and hands-on methods can further enhance their effectiveness.

4.4.4 Kinesthetic Activities

There was a mixed response to the use of hands-on and interactive methods, with a significant portion of respondents (55.0%) disagreeing that these methods are commonly used. The mean score of 2.288 indicates a general disagreement, while the standard deviation of 1.175 shows that there is some variability in responses, reflecting a lack of consensus on the use of kinesthetic methods. The mixed response could be due to logistical challenges, such as time, resources, and class size, which can make hands-on activities difficult to implement effectively. However, research supports the value of hands-on learning, showing it enhances learner engagement and understanding through experiential learning and practical application of knowledge. To address the challenges, schools should provide adequate resources and support for hands-on activities. Professional development programs can help teachers integrate these methods more effectively into their lessons, ensuring that students benefit from experiential learning opportunities. A study by Kimosop (2019) found that private schools in urban areas are more likely to implement hands-on and interactive methods

due to better resources and teacher training. Wambua (2018) indicates that schools in urban areas tend to utilize hands-on and interactive methods more frequently due to better access to educational materials and technology. Paul, Begi and Mwangi (2021) found that teachers who received specialized training in interactive teaching techniques were more likely to implement these methods effectively in their classrooms. Continuous efforts in teacher training, resource provision, and curriculum integration are essential to enhance the adoption of this multimodal instructional method across Kenya.

4.4.5 Interactive Technology Activities

The data indicates a mixed response to the use of interactive technology in delivering environmental activity lessons. The use of interactive modes such as whiteboards, educational software, online resources and multimedia presentations, scored a mean of 2.906 with a standard deviation of 1.307. This indicates a moderate level of agreement among teachers regarding its use in environmental activity lessons. This finding is in tandem with Lysenko, Abrami, Wade, Kiforo and Iminza (2022) findings that although the application of interactive digital presentations in the technology classes has positive impact on learning outcomes, its integration in learning in primary schools in Kenya is low. Previous study by Omonayajo, Al-Turjman and Cavus (2022) illuminates the value interactive technology arguing that for the successful structuring of learners' educational processes, the system of education necessitates the employment of new teaching technology. With smart gadgets, modern technologies are enhancing today's learning with increased teaching and learning. This technology enhances the classroom experience by transforming the education platform to allow sophisticated real-time search, sharing, collaboration, and communication.

Studies by Ullah and Anwar (2020) emphasize the effectiveness of interactive technology in enhancing learner engagement and learning outcomes despite its low adoption. For example, technology-based in-home reading and spelling programs have shown potential in compensating for traditional instruction gaps, especially highlighted during the COVID-19 pandemic. Such programs, utilizing artificial neural networks and linear regression, have demonstrated high accuracy in tailoring educational content to individual learning needs, which underscores the value of personalized learning

through technology. Therefore, integrating interactive technology in environmental activity lessons can provide personalized and engaging learning experiences and cater for the diverse learning needs of learners.

4.4.6 Collaborative Learning Activities

The data indicates agreement in application of collaborative learning methods, with a mean score of 3.932 and a lower standard deviation of 0.924, suggesting consistent positive responses. A significant majority of teachers (76.3%) agreed on engaging collaborative methods during environmental activity lessons. In a study of collaborative learning and student engagement in practical skills acquisition in Nigeria, Okolie, Mlanga, Oyerinde, Olaniyi and Chucks (2022) generated similar findings when they established that a good number of teachers were struggling with facilitating collaborative learning.

The positive response to collaborative learning highlights its perceived effectiveness in fostering student engagement and deeper understanding of environmental topics. Schools should continue to encourage and facilitate collaborative learning practices by providing the necessary resources and training. Incorporating group projects, peer teaching sessions, and cooperative learning activities can enhance student interaction and promote a more inclusive and dynamic learning environment. Collaborative learning strategies are widely supported in educational research for their ability to enhance understanding and retention of information. These strategies promote social interaction and collective problem-solving, which are critical for developing higher-order thinking skills. Teachers should therefore continue to foster collaborative learning environments, both in-person and online, to promote deeper understanding and engagement. Schools should provide resources and training to facilitate effective group work and cooperative learning strategies.

4.4.7 Experiential Learning Activities

The data shows a strong positive response towards use of experiential learning methods, with a mean score of 3.932 and a relatively low standard deviation of 0.961. A combined 76.2% of teachers agreed with the benefits of experiential learning, indicating its effectiveness in teaching environmental concepts. This implies that experiential

learning is highly valued for its ability to connect theoretical knowledge with real-world applications (Azeez & Aboobaker, 2024). Field trips, simulations, and role-playing provide immersive learning experiences that can significantly enhance understanding and retention. Educational scholars Mertayasa, Sumarni and Indraningsih (2024) highlight the importance of these experiential learning activities in developing critical thinking and problem-solving skills. Educational institutions should prioritize experiential learning opportunities, providing students with practical, real-world experiences that complement classroom instruction. This approach can be particularly effective in teaching environmental activities, where direct engagement with nature and environmental issues can inspire and educate students.

Collectively the data suggests that while auditory and reading/writing methods are commonly employed in delivering environmental activity lessons, visual aids and hands-on interactive methods are less frequently used in environmental activity lessons in Tharaka Nithi County, Kenya. These findings suggest a need for a balanced and integrated approach, combining various teaching methods to enhance the overall effectiveness of environmental activity lessons. Investing in teacher training and resources can help overcome the challenges associated with less favored methods, ensuring a comprehensive and engaging educational experience for learners. These insights can guide educational policy and resource allocation to enhance the effectiveness of environmental activity lessons.

4.5 Frequency of Multimodal Instructional Activities Utilization

The second objective sought to examine the frequency of utilization of multimodal instructional activities in delivering environmental conservation lessons in lower primary schools in Tharaka Nithi County, Kenya. The Kolmogorov-Smirnov (K-S) test was employed to assess the normality of the distribution of the data obtained.

The test results are shown in Table 14.

Table 14: Kolmogorov-Smirnov Test Results

Instructional Method	Min	Max	Mean ($\bar{x}$)	SD	K-S Statistic	p-value	Normality
Visual	1	4	1.797	0.839	0.0686	0.709	Yes
Auditory	1	4	2.525	0.620	0.0686	0.708	Yes
Read/Write	1	4	2.017	0.596	0.0668	0.739	Yes
Kinesthetic	1	4	2.119	0.555	0.0704	0.678	Yes
Interactive Technology	1	4	2.017	0.651	0.0720	0.651	Yes
Collaborative Learning	1	4	1.915	0.849	0.0473	0.971	Yes
Experiential Learning	1	4	1.847	0.605	0.0761	0.581	Yes

Source: Field Data (2024)

The K-S statistic indicates the maximum difference between the observed cumulative distribution and the expected cumulative distribution. p-value indicates the probability that the observed distribution is not different from the normal distribution. The results indicate that the K-S test results for all instructional methods show that the p-values are greater than the typical alpha level of 0.05. This indicates that the distributions of these instructional methods do not significantly deviate from a normal distribution. Based on the K-S test results, the distributions of the survey variables for the frequency of applying different instructional methods are not significantly different from a normal distribution and are considered normal. The frequency of multimodal instructional use means the individual's rate of usage, as recorded by the number of times they use a certain method. Descriptive statistics such as percentages were used to analyze the data measured on a four-point Likert scale. The frequency of use is indicated in Table 15.

Table 15: Frequency of Utilization of Multimodal Instructional Activities

Multimodal Instructional Activity	Frequency of Utilization in % (n=59)			
	Frequently	Occasionally	Rarely	Never
Visual	27.0	25.0	48.0	0
Auditory	59.0	34.0	7.0	0
Read/Write	19.0	64.0	17.0	0
Kinesthetic	22.0	68.0	10.0	0
Interactive Technology	11.9	25.4	33.9	28.8
Collaborative	16.9	15.3	23.7	44.1
Experiential	15.3	18.6	23.7	42.4

Source: Field Data (2024)

The results reveal significant variability in the frequency of use of different multimodal instructional methods for environmental activities.

4.5.1 Frequency of Utilizing Visual Activities

Results indicate that 27.0% of the respondents reported that they frequently used visual instructional aids, while 25.0% said they occasionally did and 48.0% rarely utilized the method. The mean score of 1.797, close to "Rarely" and a relatively high standard deviation indicate that visual methods are less frequently used and opinions on their use vary widely. This suggests that while some teachers find visual aids helpful, many others do not prioritize them in teaching environmental activities. A previous study by Mayer (2009) found that while visual aids can significantly enhance learning, they are often underutilized in classrooms due to a lack of resources or training.

4.5.2 Frequency of Utilizing Auditory Activities

The results indicate that auditory methods are highly favored, with majority (59.0%) reported frequently applying the method, 34.0% occasionally do and 7.0% rarely utilizing the method. With the highest mean of 2.525 and a lower standard deviation 0.620, auditory methods are frequently used and consistently preferred. This shows that lectures and discussions are well-integrated into environmental activity lessons. The frequent use of auditory instructional materials is consistent with findings from Gillis (2013) and Fadel et al. (2008) that highlighted that teachers often rely heavily on auditory methods, such as lectures and discussions, because they are easy to implement and do not require special materials.

4.5.3 Frequency of Utilizing Read-Write Activities

The results show that majority (64.0%) of the respondents said they frequently engaged learners in reading and writing activities compared to 19.0%, who occasionally did it and 17.0% who rarely did it. The mean score of 2.017 indicates that read/write methods are occasionally used. The relatively low standard deviation 0.596 suggests a consensus on its moderate usage. The occasional use of reading and writing methods aligns with research by Fleming (2001), who found that while reading and writing instructional methods are beneficial for some learners, they are often supplemented with other teaching methods to cater to diverse learning styles. This implies that reading and

writing activities are occasionally engaged but not as frequently as auditory methods, suggesting that while reading and writing are important, they might not be the primary methods for teaching environmental activities. They could be supplementary to more interactive methods.

4.5.4 Frequency of Utilizing Kinesthetic Activities

The results generally reveal that majority 68.0% reported occasional use of kinesthetic methods while 22.0% frequently used the method and 10.0% rarely utilized the method. A mean score of 2.119 indicates kinesthetic methods are occasionally used, with a lower standard deviation 0.555 showing consistency in this preference. This implies that kinesthetic methods, involving physical activities are occasionally used, indicating a moderate but not dominant preference for hands-on learning in environmental education. The findings regarding the use of kinesthetic methods are also supported by previous studies by Jensen (2005) and Sousa (2011) who suggested that although kinesthetic activities can greatly enhance learner engagement and learning, they are not used as frequently due to the perceived difficulty in managing hands-on activities and time constraints within the curriculum.

4.5.5 Frequency of Utilizing Interactive Technology

The use of digital tools in teaching environmental activities shows a relatively low frequent usage (11.9%) and a high percentage of teachers rarely (33.9%) or never (28.8%) using it. The mean of 2.017, along with a moderate standard deviation 0.651, suggests that interactive technology is occasionally used but with significant variation in its application. This means that while technology-enhanced learning is present, it's not universally integrated into teaching environmental activities. This indicates a need for increased integration of interactive technology to potentially enhance learning experiences. Tamim, Bernard, Borokhovski, Abrami, and Schmid (2011) found that interactive technology had low adoption and varied effects on learning outcomes depending on implementation quality and context. These findings are similar to the current findings of the study. The study conducted by Tamim et al. (2011) revealed that although interactive technology has the potential to enhance learning outcomes, its efficacy and range of applications rely on how well it is incorporated into the curriculum.

4.5.6 Frequency of Utilizing Collaborative Learning Activities

Collaborative learning methods are moderate in their frequency of usage (16.9%), but a significant portion of teachers (44.1%) never use the method. The mean score of 1.915, close to "Rarely," and a higher standard deviation 0.849 indicate less frequent use and varied opinions on collaborative methods. Despite the benefits of group work, it is underutilized. This indicates potential missed opportunities for cooperative learning in environmental activity lessons probably due to challenges in incorporating group work and cooperative learning, possibly due to classroom management issues or lack of training. In a study of collaborative learning: a review of research and practice by Gillies (2016), Laal and Ghodsi (2012), it was found that collaborative learning fosters critical thinking, enhances communication skills and promotes learner engagement. However, it also pointed out that many teachers underutilize collaborative methods due to lack of training and resources. This study aligns with the current findings showing that while collaborative methods have significant benefits, they are not frequently used, indicating potential gaps in teacher preparation and support for implementing these strategies.

4.5.7 Frequency of Utilizing Experiential Learning Activities

Experiential learning activities had a similar pattern, with 15.3% of teachers using them frequently and 42.4% never using them. This implies missed opportunities for engaging learners through direct experiences, which could enhance understanding and retention of environmental concepts. This method could enhance engagement and understanding in environmental activities if more frequently employed. Behrendt and Franklin (2014) studied the value of field trips in education while Kolb and Kolb (2005) studied experiential learning in higher education: implications for improvement. These studies noted that experiential learning is often underutilized due to logistical challenges and traditional curriculum structures. This finding mirrors the current findings, showing that while experiential learning is valuable, its rare use suggests a need for structural and logistical support to incorporate more hands-on learning experiences. In summary, the study established that auditory activities were the most frequently used. In contrast, visual, collaborative and experiential learning activities were less frequently used, with a significant number of teachers rarely or never using them. Reading-writing and kinesthetic learning activities were moderately utilized, with most teachers using them

occasionally. Interactive technology shows a balanced distribution, with a significant portion of teachers rarely or never using the method.

Further analysis was done to identify which grade level differed in the frequency of multimodal instructional activity utilization. Descriptive statistics are presented in Table 16.

Table 16: Frequency of Multimodal Instructional Activity Usage Across Different Grade Levels in Lower Primary Schools

Activity	Grade	N	Frequently	Occasionally	Rarely	Never
Visual	1	21	6	13	2	0
	2	19	3	13	3	0
	3	19	4	10	5	0
Auditory	1	21	10	6	5	0
	2	19	9	6	4	0
	3	19	8	5	6	0
Read/Write	1	21	11	8	2	0
	2	19	12	4	3	0
	3	19	13	3	3	0
Kinesthetic	1	21	7	10	4	0
	2	19	3	11	5	0
	3	19	5	12	2	0
Interactive	1	21	0	5	6	10
Technology	2	19	0	3	8	8
	3	19	0	2	7	10
Collaborative	1	21	8	9	4	0
	2	19	6	9	4	0
	3	19	9	6	4	0
Experiential	1	21	3	3	15	0
	2	19	2	5	12	0
	3	19	2	4	13	0

Source: Field Data (2024)

The data reveals distinct trends in the frequency of utilization of various multimodal instructional activities employed across different grade levels in lower primary schools in Tharaka Nithi County. Auditory instructional activities are predominantly favored, with a high number of teachers reporting frequent use in all grades, particularly in Grade 1, where 10 out of 21 teachers use this method frequently. In contrast, visual methods show a moderate level of use, while kinesthetic and interactive technology activities are less favored, indicating a potential underutilization of diverse teaching strategies that could enhance learning. Notably, experiential learning activities are rarely

implemented, as evidenced by the significant number of teachers reporting "Rarely" or "Never" using them.

The implications of these findings suggest that while auditory methods are prevalent, the limited engagement with visual, kinesthetic and experiential strategies may restrict pupils' learning experiences and limit the development of essential competencies. These findings underscore the need for professional development for teachers to embrace a more balanced and multimodal instructional approach that caters to diverse learning styles, thereby fostering an enriched learning environment that can promote better educational outcomes for students. Siraj, Taggart, Melhuish, Sammons and Sylva (2014) empirical study titled "Exploring Effective Pedagogy in Primary Schools" offers insights that aligns with the findings of the current study regarding utilization of instructional methods in lower primary education. Siraj et al. (2014) established that auditory methods were frequently utilized. While both studies report auditory methods as being frequently utilized, there is a need for a more balanced approach that includes diverse pedagogical strategies to optimize learning outcomes.

Further analysis to determine if there were statistically significant differences in utilization of the multimodal instructional activities between grade one, two and three level teachers was done using Kruskal-Wallis H test. Results of the test are shown in Table 17.

Table 17: Kruskal-Wallis H Test Results

Method	H statistic	p-value
Visual	0.588	0.745
Auditory	0.242	0.886
Read/Write	0.684	0.710
Kinesthetic	1.657	0.437
Interactive Technology	0.740	0.691
Collaborative Learning	0.525	0.769
Experiential Learning	0.151	0.927

Source: Field Data (2024)

The Kruskal-Wallis H test results show no significant differences in the frequency of applying different multimodal instructional methods between grade 1, 2, and 3 teachers for all the methods considered (all p-values > 0.05). This suggests that the use of these

instructional methods does not vary significantly across the different grade levels. The Wilcoxon signed-rank test was performed to compare two differences in utilization of multimodal instructional activities by matching teachers in different grade levels. Results obtained are presented in Table 18.

Table 18: Wilcoxon Signed-Rank Tests Results

Instructional Method	Grade Comparison	U Statistic	p-value	Significant Difference ($p < 0.05$)
Visual	Grade 1 vs Grade 2	4668.0	0.418	No
	Grade 1 vs Grade 3	5486.0	0.236	No
	Grade 2 vs Grade 3	5766.0	0.061	No
Auditory	Grade 1 vs Grade 2	4054.0	0.021	Yes
	Grade 1 vs Grade 3	5248.0	0.545	No
	Grade 2 vs Grade 3	6122.0	0.006	Yes
Read/Write	Grade 1 vs Grade 2	4719.0	0.493	No
	Grade 1 vs Grade 3	4918.0	0.842	No
	Grade 2 vs Grade 3	5227.0	0.580	No
Kinesthetic	Grade 1 vs Grade 2	5009.0	0.983	No
	Grade 1 vs Grade 3	5151.0	0.713	No
	Grade 2 vs Grade 3	5118.0	0.774	No
Interactive Technology	Grade 1 vs Grade 2	4659.0	0.405	No
	Grade 1 vs Grade 3	5344.0	0.401	No
	Grade 2 vs Grade 3	5724.0	0.077	No
Collaborative Learning	Grade 1 vs Grade 2	4666.0	0.415	No
	Grade 1 vs Grade 3	5588.0	0.151	No
	Grade 2 vs Grade 3	5891.0	0.030	Yes
Experiential Learning	Grade 1 vs Grade 2	4240.0	0.063	No
	Grade 1 vs Grade 3	4560.0	0.283	No
	Grade 2 vs Grade 3	5261.0	0.524	No

Source: Field Data (2024)

The results show that for visual methods no significant differences were found between the grades (p-values 0.418; 0.236 and 0.061). Significant differences were found between Grade 1 vs Grade 2 and Grade 2 vs Grade 3 with auditory method (p-values 0.021; 0.545 and 0.006). As for read and write, kinesthetic and experiential methods, no significant differences were found between the grades. For example, read/write instructional method (Grade 1 vs Grade 2: no significant difference $p = 0.493$); (Grade 1 vs Grade 3: no significant difference $p = 0.842$); and (Grade 2 vs Grade 3: no significant difference $p = 0.580$); kinesthetic instructional method (Grade 1 vs Grade 2: no significant difference $p = 0.983$); Grade 1 vs Grade 3: no significant difference $p =$

0.713); and Grade 2 vs Grade 3: no significant difference p = 0.774). Experiential learning instructional method (Grade 1 vs Grade 2: no significant difference p = 0.063); Grade 1 vs Grade 3: no significant difference p = 0.283) and Grade 2 vs Grade 3: no significant difference p = 0.524).

A significant difference was however, found between Grade 2 and Grade 3 with the collaborative method (p = 0.030). In summary, most instructional methods did not show significant differences in application frequency across grades, except for the auditory and collaborative learning methods, where some significant differences were noted. This suggests that the use of these methods may vary more across different grades compared to other methods. The significant difference found between Grade 2 and Grade 3 in the application of the collaborative method (p = 0.030) indicates that the use of collaborative learning techniques, such as group work, peer discussions, and cooperative activities, varies notably between these two grades. This could suggest that as learners progress from Grade 2 to Grade 3, teachers might be more inclined to implement collaborative methods, possibly because students in Grade 3 are generally more capable of engaging in group-based tasks, have developed better communication skills, or the curriculum for Grade 3 might emphasize more collaborative activities.

In contrast, the lack of significant differences in the application frequency of most other instructional methods across grades suggests that these methods are used consistently regardless of the grade level. This uniformity could imply that the instructional strategies for those methods, such as lectures or visual aids, are viewed as equally appropriate and effective across both Grade 2 and Grade 3, or that teachers maintain a consistent teaching style across different grade levels. However, the significant differences noted in the auditory and collaborative methods highlight that these methods might be more adaptable to the developmental stages or specific learning needs of students in different grades. For instance, auditory methods, such as storytelling or oral presentations, might be adjusted in complexity or frequency as learners' advance, reflecting their growing ability to process and engage with spoken information. Similarly, the variation in collaborative methods indicates a pedagogical shift that aligns with the increasing social and cognitive skills of older students.

Overall, these differences suggest that while most instructional methods are applied uniformly across grades, certain methods like collaborative and auditory learning are more sensitive to the developmental and educational needs of students at different grade levels. This could point to the importance of tailoring instructional approaches to better suit the specific capabilities and learning contexts of students as they progress through their educational journey.

The survey results derived from questionnaires were triangulated by assessed the frequency of utilization of multimodal instructions through lesson observations in classrooms to enhance collaboration of the findings. Three observation sessions for each of the eight teachers were done over a period of three weeks to capture the progression and consistency of teaching practices. An observation tool (Appendix E) was used. Inferences were made based on the mean scores aligned with the 4-point Likert scale as shown in Table 19.

Table 19: Frequency of Use Rating Scale

Rating	Description	Inference
3	Frequently Used	High frequency of use
2	Occasionally used	Moderate frequency of use
1	Rarely used	Low frequency of use
0	Never used	Not used at all

Results on teaching observations are displayed in Table 20.

Table 20: Frequency of Observations made for Each Multimodal Instructional Activity

Activity	Rating Scale/Observed Frequencies				Mean	Inference
	1	2	3	4		
Visual	7	7	6	4	1.71	Moderate frequency of use
Auditory	8	7	4	5	1.75	Moderate to high frequency of use
Read/Write	6	8	6	4	1.67	Moderate frequency of use
Kinesthetic	5	9	5	5	1.58	Moderate frequency of use
Interactive Technology	3	5	8	8	1.13	Low frequency of use
Collaborative	6	9	6	3	1.75	Moderate frequency of use
Experiential	0	3	8	8	0.58	Very low frequency of use

Key: 1. Frequently used (applied in all the 3 observed lessons scored-scored 3)
2. Occasionally used (applied in 2 of the 3 observed lessons-scored 2)
3. Rarely used (applied in only 1 of the 3 observed lessons-scored 1)
4. Never used (not utilized at all-scored 0)

Source: Field Data (2024)

The data indicates visual instructional activities were minimally implemented as evidenced by an average score of 1.71 across 14 observations (7 frequent and 7 occasional). This implies that in about half the lessons, visual methods were employed frequently, while in the other half, they were used occasionally or less. This inconsistency suggests that visual resources were being underutilized. Matusiak, Gendron, Heinbach and Taylor (2019) empirical study on visual literacy and underutilization of visual resources in academic work reported inconsistent or minimal application of visual methods, similar to the trends observed in the current study, where visual instructional activities were employed sporadically and often insufficiently.

Visual instructional activities are crucial for enhancing learner engagement, especially for students who are visual learners. Minimal implementation means that learners may not be benefiting fully from the potential of visual aids to simplify complex concepts, capture attention and enhance memory retention and understanding through imagery. Merritt, Stern, Powell and Frensley (2022) established that use of multiple modalities such social interactions and active involvement were promising in enhancing outcomes related to environmental literacy in online programs for K-12 learners. The occasional or minimal use of visuals may lead to reduced stimulation for learners who rely heavily on visual input to grasp new information. Furthermore, different learners have different

learning preferences (auditory, visual, kinesthetic). The minimal use of visual methods implies that those that are visual learners might not be receiving the kind of instructional support they need to fully engage with and understand the material. This could result in lower comprehension or retention of concepts for those who benefit from seeing rather than hearing or doing.

The fact that visual activities were frequent in some lessons but only occasional in others points to an inconsistency in teaching practices. Some teachers may be incorporating visuals effectively, while others may not, leading to uneven learning experiences for learners. This means that there could be practical barriers to the consistent utilization of visual instructional activities, such as limited access to visual teaching aids like projectors, charts, or other materials, time constraints and lack of adequate training in using visual aids effectively in their classrooms. The findings have implications for teacher professional development and resource allocation. Teachers may require additional training or support to better incorporate visual instructional activities, as this inconsistency could stem from a lack of skill or understanding of how to use visual aids effectively. Schools might need to invest more in resources that facilitate the use of visuals, such as posters, digital projectors, or classroom technology (Gonfa, Birhanu and Gendo (2024). Innovative use of educational technologies, according to Sankey, Birch, and Gardiner (2011), offers teachers significant potential to create a learning environment that is more engaging, inclusive, interactive and enriched.

The results also show that read-write methods were minimally used as indicated by a mean score of 1.79 across 14 observations (6 frequent and 8 occasional). This indicates that in about half of the lessons, these methods are used often, but in the other half, they are employed sporadically or minimally. It may also imply that learners are relying more on passive learning (listening or watching) rather than active engagement with the material through reading and writing, which can affect how deeply they internalize and apply knowledge. Quintero-Angel, Duque-Nivia and Molina-Gómez (2024) found that read-write teaching strategy is commonly applied in many learning settings in Colombia.

Read-write learning activities are typically vital for developing literacy skills, critical thinking and independent learning. Their minimal implementation could indicate that these skills are not being emphasized adequately in the learning process. Additionally, reading and writing are foundational skills that help learners process, organize, and retain information. By using these methods infrequently, learners may have fewer opportunities to practice and develop strong literacy skills, such as comprehension and writing. Minimal use may lead to weaker writing abilities and less mastery of subject matter. Frequent use of reading and writing methods improves learners' written communication skills, which are essential for effectively conveying environmental information and advocating for conservation efforts (Fang, Hassan & LePage, 2022). Writing essays and reports helps learners develop the ability to construct logical arguments, a key competency in environmental advocacy and policy-making. Therefore, reading and writing method of multimodality is essential in inculcating environmental conservation competencies.

Results of observation further reveal that kinesthetic methods were also minimally employed by teachers, as indicated by a mean score of 1.71 across 14 observations (5 frequent and 9 occasional). This imply that teachers were minimally incorporating hands-on or tactile activities into their environmental conservation lessons. Robles (2023) results indicate that in order to maximize learning and create an engaging Science, Technology, Engineering, and Mathematics environment for learners, educators must adapt their curriculum and instruction around their students' learning styles to tailor their different learning needs. Thus, Kinesthetic methods, such as experiments, field trips and hands-on projects, should be largely implemented to actively engage learners. Physical activities associated with kinesthetic learning enhances memory retention making learning more impactful. For example, when learners participate in activities like planting trees or conducting water quality tests, they are more likely to remember the underlying environmental principles. Physical engagement keeps learners motivated and interested, fostering a positive attitude towards environmental conservation. Regular use of kinesthetic methods underscores its utility in promoting active learning and enhancing students' engagement with environmental conservation concepts. To further enrich the learning experience, these

methods should be balanced with visual, auditory, and read-write instructional activities.

Interactive technology was also observed to be implemented at a low extent as evidenced by 3 frequent and 5 occasional observations, a significant number of teachers either rarely (8 observations) or never (8 observations) used interactive technology learning activities in their teaching. The inconsistent use of interactive technology where only a small number of teachers frequently use the method and the majority either rarely or never do, creates uneven learning experiences. This inconsistency could lead to disparities in learning outcomes, as students in technology-enhanced environments may develop better problem-solving, critical thinking, and collaboration skills compared to those in classrooms where technology is underutilized. A study from South Africa carried out by Lomos, Luyten and Tieck (2023) found that many teachers either rarely or never use interactive technologies due to constraints like lack of access to hardware and insufficient technological knowledge, resulting in uneven learning experiences across schools. Additionally, a study in Kenyan schools by Zenda and Dlamini (2023) also highlighted that teachers' inconsistent use of technology was linked to external limitations such as resource availability and internal barriers like teacher competence, causing disparities in student engagement and learning outcomes. These findings strongly align with the patterns observed in the current study, indicating that the challenges observed in your context are part of broader trends in education, especially in resource-limited settings.

Overall, the data indicate that interactive technology such as digital whiteboards, educational apps, online quizzes, or multimedia tools is not being widely or consistently used in the classroom. Interactive technology can facilitate innovative teaching methods, such as flipped classrooms, blended learning, and project-based learning. The minimal implementation observed suggests that teachers may be relying on more traditional instructional methods, missing opportunities to explore these more student-centered approaches that technology can support. Research has shown that the effective use of technology in education can lead to better learning outcomes, including improved understanding of complex concepts, greater engagement, and enhanced retention of information (Naik, Chitre, Bhalla, & Rajan, 2020). When technology is rarely or never

used, learners may not experience these potential benefits. In summary, the low extent of interactive technology use, as evidenced by the 3 frequent, 5 occasional, and a combined 16 rare or never observations, implies that most students are not benefiting from the dynamic and engaging learning experiences that technology can offer. This could lead to disengagement, limited digital literacy, and missed opportunities for innovation in teaching. Addressing the barriers to technology use such as teacher training, resource availability, and curriculum alignment could significantly improve student outcomes and engagement.

The frequency of engaging in collaborative learning activities was observed to be minimal across the observations grades (6 frequent and 9 occasional). The fact that collaborative learning activities were observed to be frequent in only 6 instances and occasional in 9 suggests that active learning strategies are being applied inconsistently across different lessons or teachers. With only 6 frequent and 9 occasional observations of collaborative learning, there is a possibility that learners in some classes or with some teachers are receiving more exposure to group work than others. This inconsistency can lead to inequality in learning experiences, where some learners develop stronger collaborative and communication skills while others do not. This disparity could have long-term effects, especially for learners who thrive in environments where they can interact with peers to learn and process new information. The findings of this study aligns well with Otto, Bertel, Lyngdorf, Markman, Andersen and Ryberg (2024) observations regarding minimal engagement in collaborative learning activities, emphasizing the need for targeted interventions to enhance collaborative practices in educational settings.

This has several implications for the learning environment and learner outcomes. Collaborative learning environments allow learners to learn from one another, sharing diverse perspectives and insights. When these opportunities are minimized, learners miss out on valuable peer-to-peer interactions that can enhance understanding, build critical thinking, and foster deeper learning. This means that learners may rely more on the teacher for knowledge, rather than engaging in learner-centered learning where they are active participants in constructing their own knowledge. Maseyi and Ong'ang'a (2023) concurs that teacher frequent use of collaborative learning methods promotes critical thinking, communication, and teamwork among students. Teachers should

encourage more active participation through collaborative learning activities that require learners to collaborate on environmental research, problem-solving and advocacy initiatives such as collaborative projects and community-based initiatives. Working in groups teaches learners how to resolve conflicts and negotiate differences of opinion constructively, skills that are valuable in environmental advocacy and collaborative projects.

According to Bjelobaba, Savić, Tošić, Stefanović and Kocić (2023), collaborative learning is a powerful approach in environmental education, fostering engagement, communication skills, critical thinking and global citizenship among learners. Collaborative learning requires learners to critically analyze environmental issues and consider multiple viewpoints. This promotes deeper understanding and informed decision-making regarding conservation practices. Bjelobaba, et al. (2023) further argue that collaborative learning fosters empathy towards environmental challenges faced by different communities and ecosystems. Through collaborative projects, learners develop a greater appreciation for diverse perspectives and the interconnectedness of global environmental issues. By integrating collaborative learning activities, teachers can enhance learners' environmental conservation competencies and prepare them to address complex environmental challenges collaboratively.

The minimal use of collaborative learning activities also suggests that learners may not be benefiting from inter-motivational boosts, potentially leading to lower engagement and less active participation in lessons. To addressing these gaps, teachers should be encouraged and supported to integrate more collaborative activities into their lessons. This can be done through professional development on how to facilitate group work, effective classroom management techniques, and using collaborative learning to meet curriculum goals. Increasing the focus on collaborative learning can lead to more dynamic, inclusive, and interactive classroom environments that better prepare students for future academic and social challenges.

Data displayed in Table 20 indicate very low frequency of use of experiential learning activities in presenting environmental conservation lessons in lower primary schools in

Tharaka Nithi County with 3 observations made for occasional use, 8 rare and 8 observations for non-implementation. This suggests a significant gap in utilizing experiential learning, which is known to enhance children's engagement and understanding of concepts through hands-on experiences. Experiential learning emphasizes learning through direct experience, which is particularly effective in teaching environmental conservation as it allows learners to engage with nature and its surroundings (Kolb, 2014). The low frequency of experiential learning suggests that learners are missing out on hands-on, practical learning opportunities that could help them internalize environmental concepts more effectively. Without such experiences, learners may struggle to connect theoretical knowledge to real-world environmental issues, potentially leading to a superficial understanding of important conservation principles.

Experiential learning activities, such as nature walks, gardening, field trips, or environmental projects, make learning more engaging and interactive, especially for young learners in lower primary school. The minimal use of these activities could lead to lower learner engagement and motivation, as they are more likely to become passive recipients of information rather than active participants in their learning process. This could contribute to a less stimulating classroom environment, where learners are not excited or curious about environmental conservation topics. At the lower primary level, building environmental awareness and fostering a sense of responsibility towards the environment are critical goals. Experiential learning can deeply influence learners' attitudes and behaviors by showing them the real-world impact of environmental issues. With limited implementation of experiential activities, learners may not develop a strong connection to nature or a deep appreciation for the environment, which is crucial for promoting environmental stewardship from an early age.

In summary, the infrequent use of experiential learning suggests an over-reliance on more traditional teaching methods, such as lectures or textbook-based learning. These methods often focus on rote memorization rather than active learning, which can be less effective in helping students retain and apply knowledge. Hitherto, the inconsistency in adopting experiential learning methods implies that learners are not receiving the full benefits of this instructional pedagogy across lessons. Since experiential learning enhances engagement, critical thinking, and real-world problem-solving skills, its

inconsistent use could limit the development of these skills in learners. Some learners may be more passive missing out on the opportunities to actively engage with the material. The rare and non-implementation observations for experiential learning suggest potential challenges. Teachers may be facing difficulties in accessing materials, designing activities, or managing time to implement experiential learning consistently. Hence, the low adoption rate of experiential learning activities highlights the need for further professional development, resources, and support for teachers to integrate experiential learning effectively into their lessons.

4.6 Influence of Multimodal Instructional Method on Acquisition of Environmental Conservation Core-Competencies

Objective three sought to determine the influence of multimodal instructional method on learners' acquisition of environmental conservation core-competencies in lower primary schools in Tharaka Nithi County, Kenya. To achieve this, a pre-test was conducted before engaging the learners in different multimodal instructional activities using the model guidelines developed leveraging the DBR.

A summary of the pre-test performance results is shown in Table 21.

Table 21: Pre-test Performance Results

Area	Aspect	N	Number of learners that scored marks indicated for each aspect tested for general and core-competencies					Mean	SD
			1	2	3	4	5		
General Competencies	Knowledge	322	4	90	168	40	20	2.944	0.836
	Skills	322	2	120	126	56	18	2.901	0.886
	Attitude	322	0	40	99	90	93	3.733	1.011
	Behaviour	322	25	60	148	29	60	3.121	1.148
Core-Competencies	Communication and Collaboration	322	15	30	90	107	80	3.643	1.092
	Critical Thinking and Problem Solving	322	50	70	108	46	48	2.913	1.253
	Imagination and Creativity	322	20	55	93	102	52	3.345	1.124

Source: Field Data (2024)

The data indicates that a significant portion of learners (90 out of 322) scored at a mid-level (3marks), with a smaller number at the higher end (4 and 5 marks). This suggests a moderate understanding of environmental knowledge among the learners, though the high standard deviation indicates considerable variability. In terms of skill competence, the results indicate that learners had lower proficiency in environmental skills ($\bar{x}$ = 2.944; SD = 0.836). This means that most learners scored around marks out of five.

In terms of attitude competences, the results further show that a significant number of learners scored 3-5 marks ($\bar{x}$ = 2.901; SD = 0.886), reflecting favorable attitude disposition for environmental conservation. In terms of behaviours assessment the mean score of 3.121 and SD =1.148 indicates moderate environmental behavior among learners, with a distribution suggesting that many learners have some positive environmental behaviors, though there is variability. From the results shown in Table 13 learners exhibited strong communication and collaboration skills as indicated by a relatively high mean score ($\bar{x}$ = 3.643; SD = 1.092) and moderate variability. A substantial number scored high (4 and 5 marks), showing competence in these areas. The results further indicate that learners had moderate abilities in critical thinking and problem solving skills ($\bar{x}$ = 2.913; SD = 1.253).

The results also indicate that learners had a fairly good level of imagination and creativity, with many scoring above the mid-level ($\bar{x}$ = 3.345; SD = 1.124). This suggests that learners can think creatively and innovatively to some extent. Overall, the pre-test results revealed that learners had varying levels of competencies and core competencies for environmental conservation. While attitudes, communication and creativity are relatively strong, knowledge, skills and critical thinking were weak. The variability in scores across different aspects suggested the need for an intervention to address the diverse entry abilities of learners effectively. The study therefore concludes that there was variability in environmental conservation competencies among learners, with strengths in attitudes, communication, and creativity but weaknesses in knowledge, skills, and critical thinking. This underscored the need for targeted interventions that was done in Phase II of the study to map out the diverse entry abilities of learners. A multimodal instructional model was developed and tested on 380 grade three learners.

Post-test was administered to learners after engagement with the intervention (multimodal instructional model guidelines) for three weeks. This was critical in measuring learning outcomes and effectiveness of the teaching methods and materials used. A summary of the post-test results is shown in Table 22.

Table 22: Post-Test Performance Results

Area	Aspect	N	Number of learners that scored marks indicated for each aspect tested					Mean	SD
			1	2	3	4	5		
General Competencies	Knowledge	380	2	60	160	90	68	3.426	0.975
	Skills	380	1	90	130	100	59	3.332	1.011
	Attitude	380	0	20	60	120	180	4.211	0.893
	Behaviour	380	10	40	120	110	100	3.658	1.058
Core-Competencies	Communication and Collaboration	380	10	20	70	140	140	4.000	1.000
	Critical Thinking and Problem Solving	380	20	60	110	90	100	3.500	1.187
	Imagination and Creativity	380	10	40	100	130	100	3.711	1.049

Source: Field Data (2024)

The data indicate that there is a noticeable improvement in the average score for knowledge aspect ($\bar{x}$ = 3.426; SD = 0.975) from the pre-test scores (Table 21). This means that learners had gained more knowledge. The significantly lower SD in the post-test suggests a more consistent performance among learners. Learners' skills improved significantly, as reflected in the higher mean score ($\bar{x}$ = 3.332; SD = 1.011). There was a marked increase in the mean attitude score ($\bar{x}$ = 4.211; SD = 0.893) from ($\bar{x}$ = 2.944; SD = 0.836) showing a more positive outlook among learners. The lower SD suggests that this positive attitude is widespread among the learners. Higher mean behavior scores ($\bar{x}$ = 3.658: SD =1.058) indicate improved overall behavior among learners.

Data in Table 22 show that learners displayed fairly good communication and collaboration skills after the intervention ($\bar{x}$ = 4 .000: SD =1.000). The relatively high SD = 1.187 shows that learners had a basic to moderate ability in critical thinking and problem-solving after engagement with multimodal instructional method. The

improvement in the average score 3.711 from 3.643 suggests that learners had become more imaginative and creative after engagement with the intervention. The low SD = 1.049 indicates more consistent performance in this area.

In a nutshell, learners showed substantial improvement in the general and core-competencies, with higher mean scores in post-test. This indicates that the instructional methods and interventions applied between the pre-test and post-test were effective. Most areas exhibited reduced standard deviations, indicating more consistent performance among learners. This is a positive outcome of this study, as it means that most learners had benefited from the intervention. Specific areas like attitude, communication and collaboration, imagination and creativity show notable improvements, suggesting that the instructional strategies may have been particularly effective in these areas.

Observational data was collected to gather real-time data on learners' demonstration of desired general competencies (knowledge, skills, attitude and behaviors) and core-competencies (communication and collaboration, critical thinking and problem solving, imagination and creativity). Learners were observed in 3 learning activities as described:

To assess the competency of learners in communication and collaboration, they were engaged and observed in two activities that required them to work together, share ideas and communicate effectively and one reflective session. Activities included Buddy Reading where learners were paired and engaged in reading a short story or passage on environmental degradation together. After reading, they were allowed to discuss the story and answered questions about it. They were assessed on how well they listened to each other, discussed the content and provided input. The second activity involved Solving puzzles together. Learners were provided with a puzzle or a set of environmental problems that they were required to solve as a group. They were observed on how they communicated ideas, tasks sharing, and helping each other to solve the puzzle. They were also assessed on how well they handled differences in opinions. Activity three involved reflection and feedback. Learners were engaged in a reflection session after the two activities where they talked about what they did, how

they felt and what they learned about working together in the learning activities. Their ability to reflect on their experiences, communicate their thoughts and provide constructive feedback to their peers was assessed.

To assess learners' competencies in critical thinking and problem solving, they were engaged and observed in two activities that required them to analyze information, make decisions and solve problems and one reflective session. Learning activity one involved doing simple experiment of planting seeds, observing their growth draw conclusions and make predictions. Learners ability to form hypotheses, follow procedures, observe results, and draw logical conclusions was assessed. Learners reasoning process and ability to explain findings was also evaluated. Activity two entailed involving learners in real-world problem solving activity. Learners were presented with a real-world problem that was relevant to their community or classroom (For example, how to reduce waste) and had them brainstorm solutions. Learners ability to identify the problem, generate possible solutions and evaluate the pros and cons of each solution was assessed. Learners creativity, reasoning and decision-making was assessed. A reflection session was held to generate learners' views on what they did, how they approached the problem, and what they learnt. The learners' ability to reflect on their experiences, articulate their thought process and provide insights into their problem-solving strategies was assessed.

To assess the competency of learners in imagination and creativity, they were engaged and observed in two activities that encouraged them to think creatively (outside the box) by coming up with original ideas about protecting and preserving the environment and one reflection session. Activity one involved solving an environmental problem. Learners were presented with an environmental scenario (For example, a polluted river) and asked to brainstorm and present creative solutions. They were evaluated on their ability to think critically and creatively about solving the problem, originality in proposing solutions and understanding of the impact of the solutions. Learners engagement in group discussions and presentations was also assessed. Activity two involved creating an outdoor art installation. The activity was organized in such a way that learners created outdoor art installations using natural materials (For example, leaves, sticks, stones) to promote environmental conservation. Learners creativity in using natural local materials to design and construct installations and their message

about the environment was assessed. Learners understanding of how art can be used to inspire conservation efforts was also assessed. A reflection session after learner engagement in the activities was carried out where learners discussed what they learnt, how they felt, and what creative ideas they came up with for conservation. Their ability to reflect on their experiences, articulate their thoughts about environmental conservation, and provide insights into their creative process was assessed. Learners understanding of the importance of conservation and their motivation to take action was also evaluated.

Results of observations generated by using observation guide (Appendix F) during learner engagement in various activities as described in are presented in Table 23.

Table 23: Performance Level Indicators and Core-Competencies Demonstrated by Learners

Performance Level Indicators	Core-Competencies Demonstrated by Learners		
	Communication and collaboration	Critical thinking and problem solving	Imagination and creativity
Poor/Novice/Limited	20	15	10
Fair/Developing/Some	50	30	25
Good/Proficient/Moderate	100	80	70
Very Good/Advanced/High	120	110	90
Excellent/Expert/Exceptional)	91	146	186
N	381	381	381

Source: Field Survey (2024)

The data on Table 23 shows a distribution where higher levels of performance (Levels 4 and 5) are more frequent compared to lower levels (Levels 1 and 2). This suggests that a significant portion of the performance in communication and collaboration is at a proficient to advanced level, with Level 4 being the most frequent. Similar to communication and collaboration, critical thinking and problem solving also shows a trend where higher levels (Levels 4 and 5) dominate. Levels 4 and 5 together account for a larger proportion of the occurrences, indicating strong critical thinking skills across the dataset. The results show that imagination and creativity exhibit the highest frequencies at Levels 4 and 5, indicating a strong presence of advanced and exceptional creative abilities within the dataset. Level 5 particularly stands out as the most frequent

category, suggesting a high proficiency in imagination and creativity among the learners. Generally, these results suggest that the population assessed demonstrates strong capabilities in the core-competencies, particularly at the higher levels of proficiency and expertise. In order to provide a more comprehensive description of learners' core competency levels before the intervention, mean, range and variance were tabulated.

Table 24 shows the mean, range and variance for each category.

Table 24: Measures of Variability Statistics

Core Competency	Mean	Range	Variance
Communication and collaboration	3.55	4	0·910
Critical thinking and problem solving	3.90	4	0·146
Imagination and creativity	4.10	4	0·186

Source: Field Data (2024)

Based on the results, the mean for communication and collaboration is approximately 3.55, suggesting that, on average, learners' performance in communication and collaboration activities falls between "Good" and "Very Good". This indicates a moderate to strong level of competence in communication and collaboration skills before the intervention. A variance of 0.910 indicates moderate variability around the mean score of 3.55. This suggests that while the average performance is around "Good", there are some fluctuations in individual scores within this competency.

The results indicate that the mean for critical thinking and problem solving is approximately 3.90. With a mean score of 3.90, learners' performance in critical thinking and problem solving is closer to "Very Good". This suggests that learners generally demonstrated a strong ability to synthesize information, evaluate solutions, and creatively solve problems in the given scenarios before the intervention. A lower variance of 0.146 suggests less variability around the mean score of 3.90. This indicates that learners' scores are more tightly clustered around the higher end of the performance scale, reflecting consistent strong performance in critical thinking and problem-solving skills.

The highest mean score of 4.10 in imagination and creativity indicates that learners excelled particularly well in generating original ideas, thinking outside the box, and exploring unconventional solutions. This suggests a high level of creativity and innovation potential among the learners in this competency area before the intervention. A variance of 0.186 suggests moderate variability around the mean score of 4.10. This indicates that while learners generally performed well in this area, there are some variability in their ability to demonstrate high levels of imagination and creativity.

The range of 4 for each core competency indicates that the spread of scores across different levels of performance is consistent. This suggests that while there is variability in individual performance levels, the majority of learners are distributed across all levels of performance from Poor/Novice/Limited to Excellent/Expert/Exceptional. Overall, the results indicate an average level of performance across each core competency.

Overall, these results imply that learners may have had stronger foundational skills in critical thinking and creativity prior to the intervention, as evidenced by the higher mean scores for imagination and creativity (4.10) and critical thinking and problem solving (3.90) than for communication and collaboration (3.55). Critical thinking and creativity, in the words of Kustianingsih and Muchlis (2021), are systematic and transparent mental processes that entail making decisions, solving problems, finding scientific processes, and evaluating presumptions. According to Pujiana, Rohaeti, Suyanta, Asmiati, Sari and Syahana (2024), Critical thinking and creativity skills enable learners to receive and analyze information as well as evaluate it and relate it to a larger context, which aids in the development of these skills.

Results of both observations and pre-post analysis indicate that multimodal instructional methods significantly improved teaching practices and learner outcomes in environmental activities. The pre-test scores indicated that learners had some level of competencies in the skills tested. The intervention aimed to refine and enhance existing skills further, leading to even higher levels of competence and greater mastery of these core competencies. Thus, the intervention can still be justified as a means to

enhance, sustain, and further develop these competencies, ensure their application in varied contexts, and address specific areas for improvement.

The findings of the current study indicate that instructional activities of multimodal instructional method have a positive influence in enhancing learners' environmental conservation core-competencies. One empirical study that supports the positive influence of multimodal instructional methods on enhancing learners' competencies, including environmental conservation, is that of Dole, Bloom and Kowalske (2016). This study emphasizes the importance of integrating multiple instructional strategies, including problem-based learning, collaborative methods, and experiential activities, to enhance learner engagement and core competencies across various subjects, including environmental education. The findings demonstrate that multimodal instructional approaches provide diverse pathways for learning and skill development, supporting learners' ability to apply knowledge in real-world contexts such as environmental conservation.

This study tested the null hypothesis that there is no statistically significant influence of multimodal instructional method on learners' acquisition of environmental conservation core-competencies in lower primary schools in Tharaka Nithi County, Kenya $\alpha = 0.05$ level of significance.

A summary of the results obtained are presented in Table 25.

Table 25: Differences in Pre-Test and Post-Test Performances Scores

Variable/Aspect	Pre-Test $\bar{x}$ N=322	Post-Test $\bar{x}$ N=380	Diff.	t-statistic	df	p-value	Decision	Remarks
General Competencies								
Knowledge	2.944	3.426	0.482	7.05	699.90	0.00000000000425	Significant	Improved Significantly
Skills	2.901	3.332	0.431	6.02	699.20	0.00000000283	Significant	Improved Significantly
Attitude	3.733	4.211	0.478	6.58	646.43	0.0000000000956	Significant	Improved Significantly
Behaviour	3.121	3.658	0.537	6.40	659.84	0.000000000293	Significant	Improved Significantly
Core-Competencies								
Communication and collaboration	3.643	4.000	0.357	4.49	657.92	0.00000859	Significant	Improved Significantly
Critical thinking and problem solving	2.913	3.500	0.587	6.34	667.77	0.000000000434	Significant	Improved Significantly
Imagination and Creativity	3.345	3.711	0.366	4.43	663.55	0.0000109	Significant	Improved Significantly

Source: Field Data (2024)

The results indicate that across all competency areas measured, all of the p-values are significantly less than 0.05 ($p \ll 0.05$), confirming that the p-value is extremely small, indicating a very strong statistical significance indicating that improvements in all aspects are statistically significant. This means there were significant improvements from the pre-test to the post-test assessments as statistically significant differences were observed. Similar findings were generated by Salamanti, Park, Ali and Brown (2023) who interrogated the effects of collaborative, multimodal learning approaches on the English as a Second Language learner's English language proficiency and levels of engagement at the secondary level in the United Kingdom. In this study, the post-test scores yielded results indicating that the experimental group had significantly improved performance and high engagement and motivation compared to those in their control group. Thus, environmental activity lessons should be taught using multimodal instructional methods to improve learners' abilities in interpreting and comprehending concepts

To further identify which multimodal instructional method was better than the other, a post hoc analysis was applied. To perform the Post Hoc test, data for each method and the frequency of use ratings was organized. One-way ANOVA was performed to check if there are any significant differences between the methods. Table 26 summarizing the ANOVA test result is shown.

Table 26: ANOVA Test Results on Differences Between the Methods

Statistic	Value
F-statistic	0.158
p-value	0.985

The F-statistic is a measure of the variance between the group means relative to the variance within the groups. In this case, the F-statistic is very low (0.158), suggesting that the variance between the group means is not significantly greater than the variance within the groups. The p-value indicates the probability that the observed differences between the group means occurred by chance. A p-value greater than 0.05 evidence is not enough to reject the null hypothesis, which states that all group means are equal. In this case, the p-value is 0.985, which is much higher than 0.05, indicating that there is no statistically significant difference between the instructional methods in terms of their

influence. Thus, the result of the ANOVA test in this case means that there is no statistically significant difference in the frequency of use ratings between the different instructional methods (visual, auditory, reading and writing, kinesthetic, interactive technology, collaborative learning and experiential learning). Based on the results of the ANOVA and the subsequent Post Hoc test, the table summarizing the findings for each instructional type is as presented in Table 27.

Table 27: Post Hoc Results for Each Instructional Type

Instruction Type	Post-Test $\bar{x}$	p-value	Decision	Remarks
Visual	1.71	0.985	Accept $H0_1$	No significant difference
Auditory	1.75	0.985	Accept $H0_1$	No significant difference
Read/Write	1.67	0.985	Accept $H0_1$	No significant difference
Kinesthetic	1.58	0.985	Accept $H0_1$	No significant difference
Interactive Technology	1.13	0.985	Accept $H0_1$	No significant difference
Collaborative	1.75	0.985	Accept $H0_1$	No significant difference
Experiential	0.58	0.985	Accept $H0_1$	No significant difference
Level of Significance = 0.05				

Source: Field Data (2024)

The results indicate that the p-value from the ANOVA and Post Hoc tests is the same for all instructional types. This indicates no significant differences between instructional methods. The null hypothesis fails to be rejected because evidence is not enough to say there are significant differences between the means of the groups. This implies that there are no significant differences between the instructional types in terms of frequency of use ratings. To determine if there was a statistically significant difference in post-test scores across these different competencies and core competencies, a t-tests for each pair of pre-test and post-test scores was performed. t-tests are appropriate because same group of learners were compared before and after engagement with multimodal instructions. t-test was conducted since normality of data and homogeneity of variances were appropriately ascertained.

Table 28 provides a clear summary of the paired t-test results.

Table 28: T-Test Results for Pre-Test and Post-Test Scores

Area and Aspect	Pre-Test ($\bar{x}1$)	Post-Test ($\bar{x}2$)	Difference ($\bar{x}2 - \bar{x}1$)	t-value	Df.	p-value	Result
General Competencies							
Knowledge	2.944	3.426	0.482	11.154	321	0.00000000000425	Statistically Significant
Skills	2.901	3.332	0.431	10.136	321	0.00000000283	Statistically Significant
Attitude	3.733	4.211	0.478	11.436	321	0.0000000000956	Statistically Significant
Behaviour	3.121	3.658	0.537	11.065	321	0.000000000293	Statistically Significant
Core-Competencies							
Communication and collaboration	3.643	4.000	0.357	7.791	321	0.00000859	Statistically Significant
Critical thinking and problem solving	2.913	3.500	0.587	11.266	321	0.000000000434	Statistically Significant
Imagination and Creativity	3.345	3.711	0.366	6.385	321	0.0000109	Statistically Significant

Source: Field Data (2024)

The data shows that the overall p-values associated with each t-test are extremely small ($p \ll 0.05$), indicating very strong statistical significance for all aspects that were tested. For instance, all four aspects of general competencies (Knowledge, Skills, Attitude and Behaviour) have p-values much smaller than 0.05, suggesting highly significant improvements in each area from pre-test to post-test. Similarly, all three aspects of environmental conservation core-competencies (Communication and Collaboration, Critical Thinking and Problem Solving, Imagination and Creativity) also have p-values far below 0.05, confirming that the improvements in these competencies are statistically significant. Overall, the p-values for all aspects are extremely small, well below the standard significance threshold of 0.05. This means that the probability of these improvements being due to chance is near zero. The improvements observed in both general and core-competencies are statistically significant, meaning the intervention or learning process between the pre-test and post-test had a measurable and substantial positive effect on the learners' performance across all areas. Thus, the data demonstrates consistent and significant improvements in all tested aspects, with near-zero probability that these results occurred by chance. Based on this, the null hypothesis that there is no statistically significant influence of multimodal instructional methods learners acquisition of environmental conservation core-competencies in Tharaka Nithi County, Kenya was rejected. This means that there was a statistically significant difference in post-test scores of learners after engagement with multimodal instructions.

Results of empirical studies in education and skills development align closely with the findings obtained in the current study. For instance, Johnson and Marsh (2019) evaluated the impact of competency-based learning programs on students' knowledge, skills, attitudes, and behaviors across multiple subject areas. The study focused on both general competencies and core competencies like communication, problem-solving, and critical thinking. The researchers used a pre-test and post-test methodology, comparing the baseline competencies of students before and after participating in a structured learning program. The study found a statistically significant increase in students' subject matter knowledge, with a mean difference of 0.5 and a p-value of < 0.001, indicating strong knowledge gains as a result of the intervention. Skills such as problem-solving, collaboration, and technical skills showed a significant improvement, with a mean increase of 0.45 and similarly low p-values, suggesting strong statistical significance. Improvements in students' attitudes toward learning and behavior in

classroom settings were also found to be statistically significant (p-value < 0.01), closely resembling the improvements in "Attitude" and "Behavior" in your study. Competencies such as communication and critical thinking were emphasized, showing improvements with mean differences between 0.35 and 0.6 and statistically significant p-values in all areas tested ($p < 0.001$). It is therefore concluded that competency-based learning approaches, which focus on both general and core competencies, lead to substantial gains in knowledge, skills, attitudes and behaviors. Hitherto, engagement with multimodal instructions led to statistically significant improvements in all measured areas and aspects. The findings of this study therefore suggest that direct instruction using traditional methods such as lecture only may not be enough to enhance learners' environmental conservation core-competencies in lower primary schools. Instead, use of multimodal instructions may be a better way to deliver environmental activity lessons and increase learners competencies for environmental conservation.

4.7 Pedagogical Challenges of Implementing Multimodal Instructional Activities

Objective four of the study sought to examine the pedagogical challenges associated with implementation of multimodal instructional activities in delivering environmental conservation lessons in lower primary schools in Tharaka Nithi County, Kenya. Data were collected quantitative responses from participants. The quantitative data generated is presented in Table 29.

Table 29: Pedagogical Challenges of Implementing Multimodal Instructional Activities

Pedagogical Challenge	% Responses (n=8)					Mean	St. Dev
	SA	A	N	D	SD		
Resource limitation	50.0	37.5	12.5	0	0	4.38	0.52
Teacher training and development support	37.5	50	12.5	0	0	4.25	0.46
Time constraints	37.5	50	12.5	0	0	4.25	0.46
Technological challenges	25.0	50	25.0	0	0	4.00	0.71
Teacher capacities, self-efficacy and experience	37.5	37.5	25.0	0	0	4.13	0.64
Dictates of the curriculum	50.0	37.5	12.5	0	0	4.38	0.52
High cost of developing or procuring instructional materials	37.5	50.0	12.5	0	0	4.25	0.46

Key: SA-Strongly Agree; A-Agree; N-Neutral; D-Disagree; SD-Strongly Disagree

Source: Field Data (2024)

Teachers were interviewed to gain deeper insights into the pedagogical challenges faced in implementing multimodal instructional method. While the questionnaire data provided measurable evidence of the extent to which various constraints were experienced, the qualitative interviews allowed for a more nuanced understanding of these issues. Through interviews, teachers articulated specific experiences, contextual challenges, and personal perspectives that numbers alone could not capture. This combination of quantitative and qualitative data ensured a comprehensive analysis, highlighting not only the prevalence of the challenges but also the underlying reasons and real-world implications, thereby enriching the overall findings of the study. NVivo 12 plus software was use to aid in thematic analysis. The software offers automated coding features where it can identify and code segments based on pre-defined keywords or patterns. It performs text search queries to find specific words or phrases within the interview data to see how frequently they appear and in what context. This helps in identifying common themes and areas of focus in the interview responses. Interview transcripts and audio files were first imported into NVivo. Using a combination of coding, queries, visualization and advanced text analysis techniques, the software generated thematic areas and extracted key findings from interview data. A summary of thematic areas and key findings are shown in Table 30.

Table 30: Responses on Pedagogical Constraints of Implementing Multimodal Instructional Methods

Thematic Area	Findings
Resources	Resources are insufficient to effectively implement multimodal instructional method
Training	Inadequate support and training limits teachers ability to incorporate multimodal instructional methods in their teaching
Time	Time limitations prevent teachers from fully exploring and implementing multimodal instructional strategies
Technology	Insufficient access to technology or technical support complicates the integration of multimedia elements into teaching practices
Competence	Teachers lack the necessary skills, confidence, or experience to effectively use multimodal instruction methods
Curriculum	Prescribed curriculum limits flexibility and autonomy in adopting innovative instructional approaches such as multimodal instruction
Cost	High cost for developing or procuring instructional materials

Source: Field Data (2024)

The study identified resource limitations, inadequate training, time constraints, technological challenges, teacher incompetence, curriculum dictates and costs as significant barriers that need to be addressed to improve the effectiveness of multimodal instructional methods. A discussion of both quantitative and qualitative data is provided in the subsequent sections to provide a holistic view of the pedagogical challenges encountered while implementing the multimodal instruction in lower primary schools in Tharaka Nithi County.

4.7.1 Resource Limitation

The quantitative data indicates that a combined 87.5% of teachers agreed that resources in school were insufficient to effectively implement multimodal instruction (Mean = 4.38; SD = 0.52). Interviews revealed that teachers often struggle with a lack of necessary materials and tools to deliver multimodal lessons effectively. This constraint hinders their ability to engage students using diverse instructional methods. The alignment between the high levels of agreement in the quantitative data and the qualitative insights underscores the critical impact of resource limitations on teaching effectiveness. Similar finding was found by Ajayi (2010) who studied preservice teachers' knowledge, attitudes and perception of their preparation to teach using multimodality. Participants in Ajayi's study did not only express concerns regarding the inadequacy of resources available to them but also lamented on schools' constraint in availing the resources needed to teach using multimodality. In a similar vein, Kaimara, Fokides, Oikonomou and Deliyannis (2021) found that a major obstacle is the inefficient allocation of available financial resources. Resources are required for the supply of up-to-date equipment, devices and educational software.

4.7.2 Inadequate Training and Development Support

Data in Table 25 show that 87.5% of teachers also agreed that support and training provided for incorporating multimodal instruction techniques was inadequate (Mean = 4.25; SD = 0.46). During interviews, teachers expressed a need for more professional development opportunities focused on multimodal instruction. They highlighted the importance of continuous training to stay updated with new instructional methods. The quantitative and qualitative findings both point to a significant gap in teacher training and development, emphasizing the need for targeted professional development

programs. Ryan, Scott and Walsh (2010) avers that teachers' reluctance to adopt multimodal practices is embedded in in their knowledge ineptness as a result of inadequate training.

4.7.3 Time Constraints

A majority (87.5%) of teachers that took part in the survey agreed that time constraints prevented them from fully exploring and implementing multimodal instructional strategies (Mean = 4.25; SD = 0.46). Teachers noted during interviews that, the extensive curriculum and administrative duties bestowed on them leaves little time for planning and implementing multimodal lessons. They indicated that more time allocation for lesson preparation would enhance their ability to use diverse instructional methods. The data indicates a consensus on the challenge of time constraints, which significantly affects the quality of lesson delivery. This is tandem with Hidayat, Fajriah and Nugraha (2024) study findings that focused on integrating multimodal texts in genre-based approach: teacher's and students' challenges and benefits. The findings of Hidayat et al. (2024) research shows that major challenges that teachers faced included difficulties with resource accessibility, technical proficiency, time allocation, and preparation stage.

4.7.4 Technological Challenges

There was concurrence from a majority (75%) of teachers that limited access to technological tools or technical support complicated integration of multimedia elements into their teaching practices (Mean = 4.00; SD = 0.71). Interviewees highlighted a lack of adequate technological infrastructure and support, which makes it difficult to incorporate digital tools and resources in their teaching. The consistency between the quantitative agreement and the qualitative narratives highlights the need for improved technological access and support in schools. Bhusal (2019) established that teachers lack the skills necessary to implement multimodal learning. Further, Bhusal (2019) contends that Digital technologies are increasingly transforming how people seek information, exchange ideas and interact. This evolution necessitates agile utilization of skills, strategies and attitudes to effectively navigate, communicate and collaborate across diverse online platforms and environments.

4.7.5 Inadequate Teacher Capacities, Self-efficacy and Experience

The quantitative result further shows that 75% of teachers concurred that they lacked the necessary skills, confidence and experience to effectively use multimodal instruction methods (Mean = 4.13; SD = 0.64). Teachers that were interviewed admitted feeling unprepared to implement multimodal instruction due to gaps in their training and experience. They stressed the need for more practical training and support. This finding suggests a clear need for enhancing teacher competence through targeted training and mentorship programs. Masinde, Barasa and Mandillah (2023) research focused on effectiveness of using multimodal approaches in teaching and learning listening and speaking skills. The study revealed that 95% of teachers lacked experience in using multimodal instructional methods, primarily due to inadequate training and a lack of awareness of these approaches. The study highlighted the need for comprehensive professional development programs and better infrastructure to support the integration of multimodal instructional methods in environmental education.

4.7.6 Dictates of the Curriculum

A majority 87.5% of the teachers that participated in the survey agreed that the prescribed curriculum limits flexibility and autonomy in adopting innovative instructional approaches such as multimodal instruction (Mean = 4.38; SD = 0.52). During interviews, teachers expressed frustration with the rigid curriculum, which they feel does not allow room for creative and flexible teaching methods. They called for curriculum reforms to support innovative instructional strategies. Both quantitative and qualitative data underscore the restrictive nature of the current curriculum, which inhibits the adoption of multimodal instructional methods. Karakus (2021) posits that traditional curriculum structures can hinder the implementation of multimodal learning is a common topic in educational research and policy discussions. This is because multimodal learning often involves the use of diverse media and technologies, which may not be fully aligned with existing curriculum frameworks. This can lead to challenges in integrating new approaches and ensuring effective implementation.

4.7.7 High Costs of Instructional Materials

The data in Table 25 show that a majority (87.5%) of teachers mentioned the high cost of developing and acquiring instructional materials as a significant barrier. This cost

factor is particularly challenging given the limited budgets of many schools. While the cost was primarily highlighted in the qualitative interviews, it complements the resource limitation findings established through questionnaires, suggesting that financial constraints further exacerbate the lack of adequate resources. Kaimara, Fokides, Oikonomou and Deliyannis (2021) established that lack of infrastructure such as lack of computers, technical assistance and software limits teachers use of multimodal instructional methods.

4.8 Effectiveness of Applying Multimodal Instructional Model Guidelines in Enhancing Learners Acquisition of Environmental Conservation Core Competencies

Objective four of this study sought to determine the effectiveness of applying multimodal instructional model guidelines developed using the DBR iterative framework in enhancing learners acquisition of environmental conservation core-competencies in lower primary schools in Tharaka Nithi County, Kenya. To achieve the goal of this objective, a model prototype was developed leveraging on ADDIE model design phases. The development research process is briefly illustrated in Figure 9.

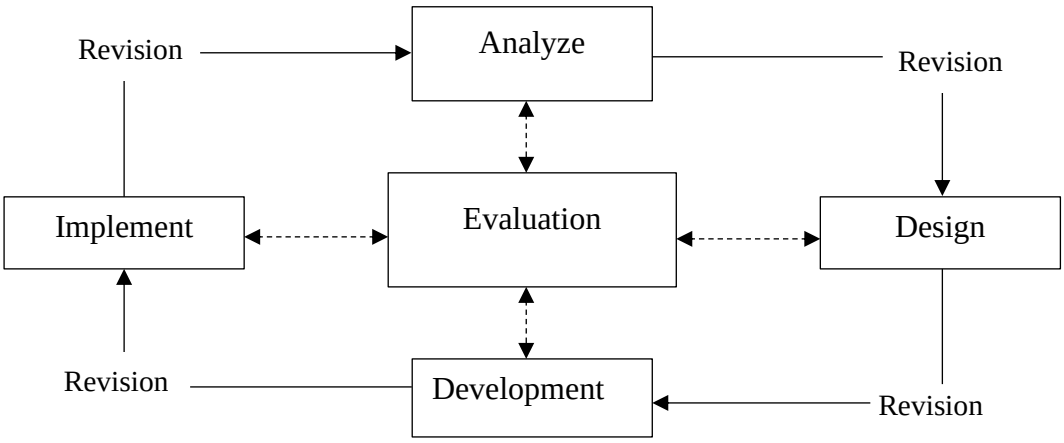


Figure 9: Development Research Process

4.8.1 Initial Analysis

Iteration activities involved conducting a needs assessment to understand the gaps in current instructional practices for environmental activities. Literature on best practices and existing models of environmental education was reviewed. Data from teachers and learners regarding challenges, preferences and existing methods used in teaching environmental activities was collected. Critical gaps, such as limited use of multimodal

instructional methods, inadequate resources and the need for more engaging, learner-centered approaches were identified. This established a foundational understanding of the specific needs and context for the instructional model.

4.8.2 Development and Testing of the Model Prototype

The development of the model prototype was crucial in transitioning from a conceptual design to a tangible, testable version of the instructional model. The iteration activities and results for this stage included:

Creation of the Prototype

Developed a prototype of the Environmental Activity Instructional Model (pg 150), incorporating the multimodal instructional methods identified in the design stage. This included creating detailed lesson plans, instructional materials (such as visual aids, multimedia resources, and hands-on activity guides), and assessment tools incorporating insights from the initial analysis.

Expert Review and Feedback

Engaged a panel of experts in environmental education, instructional design, and pedagogy to review the prototype. This review focused on assessing the practicality, effectiveness, and alignment with educational objectives. The iterative process also engaged stakeholders, including teachers and environmental experts to gather feedback on the draft design. Feedback from the experts and other stakeholders, highlighted areas where the prototype could be improved, such as simplifying complex activities, ensuring resource availability, and enhancing the clarity of instructions. The study iteratively refined the model design based on feedback, focusing on aligning it with pedagogical goals and environmental education objectives.

Refinement Based on Feedback

Iteratively refined the prototype based on the feedback received. Adjustments included revising lesson plans to be more adaptable to different classroom settings, improving the accessibility of materials, and enhancing the integration of multimodal methods to better cater to diverse learning styles.

Small-Scale Testing

Conducted a small-scale pilot test of the prototype in select classrooms. This involved implementing the prototype in real classroom settings and observing its impact on both teachers' instructional practices and learners' engagement and learning outcomes. Gathered data through observations, teacher interviews, and learner assessments to evaluate the effectiveness of the prototype in practice.

Further Refinement

Based on the pilot test results, further refinements were made to the prototype. This included making the instructional materials more user-friendly, adjusting the pacing of lessons to fit within typical classroom time constraints, and ensuring that the activities were appropriately challenging for the learners' age group.

This resulted in an improved version of the prototype that integrated multimodal methods (visual, auditory, experiential, and collaborative) to enhance environmental education. The design was adjusted to address practical challenges, such as resource limitations and time constraints, ensuring it was adaptable to different classroom contexts.

4.8.3 Implementation Stage

The implementation stage is a crucial phase in the instructional model's development, focusing on translating theoretical design into practical application. This stage was divided into three main activities: teacher training, pilot implementation and data collection through observation of model implementation in classrooms. Eight teachers were selected based on their willingness to participate and their diversity in teaching styles and subjects. This small group ensured manageable and focused oversight. The implementation was carried out in a controlled setting to closely monitor the process and outcomes. This environment allowed for adjustments and interventions as needed. Continuous support was provided to these teachers during the pilot phase. Regular observations and coaching sessions were conducted to ensure fidelity to the model. Collaboration among the participating teachers was encouraged. They were given platforms to share their experiences, challenges and successes, fostering a community of practice. Iteration activities included: 1) implementing the model across a broader range of classrooms, with ongoing support and training for teachers, 2) collecting data

on the model's effectiveness in enhancing learner engagement and environmental conservation competencies, and 3) continued refinement of the model based on teacher feedback and learner outcomes, focusing on areas such as teacher competence and resource availability.

The model was successfully implemented, demonstrating improvements in learner engagement and competency acquisition. Feedback led to further refinements, such as enhancing teacher training components and incorporating more adaptable resource options.

4.8.4 Evaluation Stage

An ongoing evaluation approach was adopted that ensured continuous monitoring and evaluation of the model’s effectiveness, repeating the iteration process as necessary to ensure the instructional model was continuously refined and improved based on feedback and empirical data. This process was grounded in data and empirical evidence making the instructional model more robust and effective. The study utilized various tools to collect quantitative and qualitative data for evaluation. This included surveys, classroom observations, learner performance assessments, and teacher self-reflections. Iteration activities for this stage included: 1) conducting a comprehensive evaluation of the model's impact, including both qualitative and quantitative data collection, 2) engagement in iterative analysis of evaluation results, comparing learner outcomes before and after the model's implementation and 3) soliciting feedback from teachers, learners, and other stakeholders to assess the model's long-term viability and effectiveness.

The evaluation confirmed the model's effectiveness in improving environmental conservation competencies among learners, particularly when multimodal instructional methods were fully utilized. The evaluation process also identified areas for future improvement, such as increasing accessibility to resources and further enhancing teacher training. This analysis was documented in detailed reports to inform further refinements of the instructional model.

4.8.5 Validation of the Model Guidelines

A validation workshop to gather feedback from teachers on the strengths, weaknesses and areas that needed improvement was done at the end of the implementation phase. This enabled refinement, adjustments and re-implementation of the revised model to be made. Hitherto, assessment of the effectiveness of the changes made in each iteration was done to determine their impact and guide further modifications. The study was flexible and responsive to new information and insights that emerged during each iteration thereby enhancing the instructional model progressively.

This structured approach ensured that the instructional model was thoroughly tested and refined before broader implementation, increasing the likelihood of its success in diverse educational settings. Through these iterative processes, the environmental activity-multimodal instructional (EA-MMI) model guidelines was designed (pg 150). The purpose of this instructional model is to provide teachers with a robust framework for designing effective environmental activity instruction that aligns with the learning goals and objectives of the learner for sustainable environmental conservation. The model also provides a guide for selecting and development of instructional materials. The model proposes eight key features that include:

1. Instructional Design Framework

a) Objectives and Goals

Clearly define the learning objectives focusing on awareness, knowledge, skills and actions related to environmental issues. Learning activities should be aligned to conform with curriculum standards and environmental literacy goals.

b) Learner-Centered Approach

Take into consideration the diverse learning styles and needs of learners and encourage active learning and participation of learners.

2. Instructional Strategies

a) Direct Instruction

Use lectures, presentations, and demonstrations for foundational knowledge. Incorporate multimedia presentations (videos, animations, slides).

b) Inquiry-Based Learning

Promote exploration and questioning through research projects and experiments. Use of case studies and problem-solving activities are encouraged.

c) Collaborative Learning

Implement group projects, discussions and peer teaching. Use cooperative learning strategies like Think-Pair-Share and jigsaw activities.

d) Experiential Learning

Engage learners in hands-on activities, field trips and environmental projects. Include community service and citizen science projects.

3. Multimodal Resources and Tools

a) Digital Tools

Digital tools such as online simulations, virtual labs can be applied in teaching environmental activity lessons. Educational apps and software are useful multimodal instructional tools.

b) Visual Aids

Use models, diagrams, posters, infographics and environmental charts to explain complex concepts.

c) Textual Resources

Incorporate diverse reading materials including textbooks (fiction and non-fiction), articles and environmental reports.

d) Audio Resources

These may include audiobooks and storytelling podcasts, recorded lectures and environmental sounds.

e) Hands-On Materials

Have a variety of kits for experiments and projects as well as recycled materials for creative projects.

4. Assessment Methods

a) Formative Assessment

Explore use of diverse assessment practices such as quizzes, reflections and use of observation and checklists during activities.

b) Summative Assessment

In addition to use of standardized tests and written exams, teachers can explore use of projects, presentations and reports as part of summative evaluation.

c) Self and Peer Assessment

Encourage learner to assess their own and their peers' contributions. Use rubrics and checklists for consistent evaluation.

5. Integration with Other Subjects

a) Science and Math

Conduct scientific experiments related to environmental topics.

b) Social Studies

Explore environmental policies, history and geography. Discuss the impact of human activities on the environment.

c) Language Activities

Assign environmental essays, debates and reports. Use literature related to environmental themes.

d) Art and Music Activities

Create eco-art projects and environmental posters. Write and perform songs about environmental issues.

6. Community and Expert Involvement

a) Guest Speakers

Invite environmental scientists, activists and local experts. Consider using virtual meetings for remote guest speakers and experts.

b) Community Projects

Partner with local organizations for community service projects and organize environmental campaigns and awareness drives.

c) Parental Involvement

Encourage parents to participate in community initiated ECDE programs, activities and projects and encourage them to provide resources for at-home environmental education of their children.

7. Technology Integration

a) Virtual Reality

Use virtual reality for virtual field trips and simulations and explore ecosystems and environmental scenarios.

b) Augmented Reality

Implement augmented reality apps to visualize environmental data and models and use AR for interactive learning experiences.

c) Online Platforms

Use Learning Management Systems for resource sharing and assignments. Create online discussion forums and blogs.

8. Sustainability and Continuous Improvement

a) Feedback Mechanisms

Collect feedback from learners and parents. Use surveys and suggestion boxes to generate feedback.

b) Professional Development

Provide training for teachers on the latest environmental education techniques and encourage participation in workshops and conferences.

c) Curriculum Review

Regularly update the curriculum to include new research and best practices. Adapt to changes in environmental policies and standards. The development of the model was an iterative and collaborative process that ensured the final instructional model was not only theoretically sound but also practical and effective in real-world educational settings. Figure 10 illustrates the environmental Activity Multimodal Instructional (EA-MMI) Model guidelines that were developed.

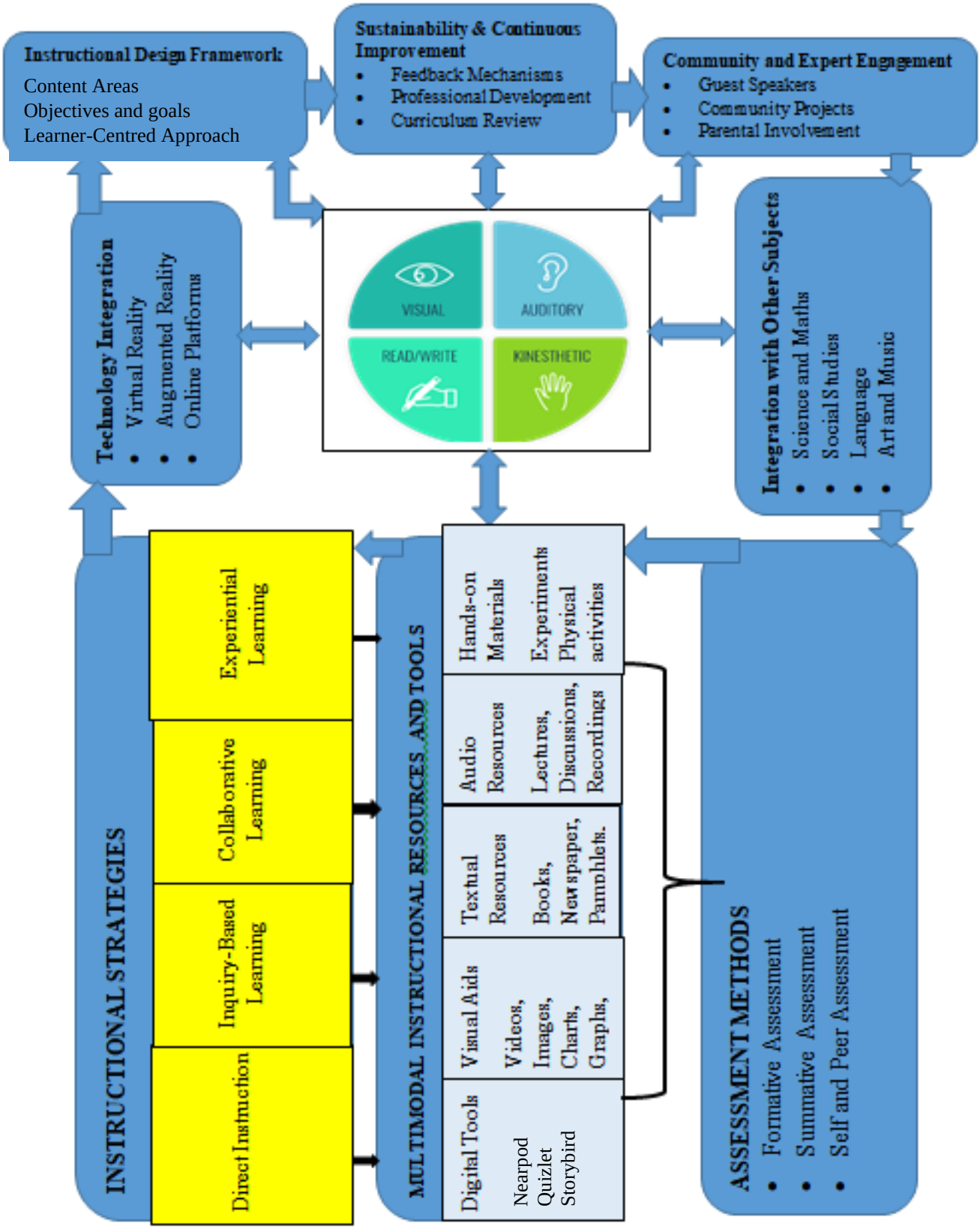


Figure 10: Environmental Activities Multimodal Instructional Model (EA-MMI) Guidelines

The EA-MMI Model guidelines recognizes that because learners represent different generations, different personality types and different learning styles, teachers and instructional designers should seek to try to use multiple strategies to meet the needs of a wide spectrum of learners.

The study further tested the null hypothesis that there is no statistically significant effectiveness in application of multimodal instructional model practices to enhance learner acquisition of environmental conservation core competencies in lower primary schools in Tharaka Nithi County, Kenya at 0.05 level of significance. Chi-square test was used to determine the model effectiveness. Dataset based on teachers' responses on evaluating the model guideline effectiveness is provided in Table 31.

Table 31: Dataset Based on Teachers' Evaluation of the Model Effectiveness

Parameters	Indicators	N	Yes	No
Clear Expectations	Instructional goals are clear, aligned with the requirements of the learning area and meet content standards	8	8	0
	Instructional model clearly defines performance expectations for both teachers and learners	8	8	0
	Lesson plans, instructional materials, media and assessments, aligned with learning needs	8	7	1
Content Coverage	Instructional model adequately covers the required curriculum content	8	8	0
	Lessons are presented in a meaningful and relevant way	8	8	0
Learner Engagement	Learners are engaged and actively involved in authentic learning	8	7	1
	Learners' attention is focused/motivated on the learning activities	8	7	1
Materials	Instructional materials and learning activities are complete, accurate, and relevant	8	8	0
Teacher Support	Model provided teachers with adequate support and resources	8	7	1
Assessment	Model provided opportunities for ongoing assessment and feedback	8	8	0
Learning Outcome	Learners acquired the desired knowledge, skills, attitudes, behaviours, and core competencies	8	7	1
Behaviour Change	Learners are motivated to change behavior (attendance and punctuality	8	7	1
	Learners are able to transfer their learning into the desired contextual setting	8	7	1
Differentiation	Model allowed for differentiated instruction to meet the needs of diverse learners	8	7	1
Data Collection	Model allowed for the collection and analysis of data to inform instruction	8	8	0

Source: Field Data (2024)

From the data, the observed frequencies for "Yes" and "No" responses for each indicator are shown in Table 32.

Table 32: Observed Frequencies for Yes and No Responses

Parameter	Yes	No
Clear Expectations	23	1
Content Coverage	16	0
Learner Engagement	14	2
Materials	8	0
Teacher Support	7	1
Assessment	8	0
Learning Outcome	7	1
Motivation	14	2
Differentiation	7	1
Data Collection	8	0

Source: Field Data (2024)

The data presented in Table 32 summarizes observed frequencies for "Yes" and "No" responses across several model guideline parameters. The highest frequency of "Yes" responses is seen in the area of clear expectations, with 23 affirmatives and only one negative response, indicating that expectations were generally well communicated. Similarly, learner motivation and engagement received strong affirmative responses, with 14 "Yes" and 2 "No" responses each. Content coverage also had a notable 16 "Yes" responses, and no negative responses, suggesting comprehensive content delivery. The data also reveals that aspects like materials, assessment, and data collection were well-supported, as each had 8 "Yes" responses and no "No" responses. Teacher support, learning outcomes, and differentiation were less robust but still predominantly positive, with 7 "Yes" and 1 "No" response each. Overall, the table indicates that the model parameters were generally well addressed, though some areas, such as learner engagement and teacher support, show slight room for improvement. The results of Chi-square test performed using the data in Table 32 are presented in Table 33.

Table 33: Chi-square test results on Model Effectiveness

Observed Category	Observed Frequency (O)	Expected Frequency (E)	(O - E)	$(O - E)^2$	$(O - E)^2 / E$
Yes	112	60	52	2704	45.07
No	8	60	-52	2704	45.07
Total	120	120			90.13

Chi-square statistic (χ^2): 90.13; Degrees of Freedom (df): 1; P-value: $2.23\times10^{-21;}$ Significance Level (α): 0.05

Since the Chi-square statistic of 90.13 is much larger than the critical value of 2.706 for 1 degree of freedom at the 0.05 significance level, and the p-value is far less than 0.05, the null hypothesis was rejected. This indicates a statistically significant effectiveness of the multimodal instructional model practices in enhancing learner acquisition of environmental conservation core competencies in lower primary schools in Tharaka Nithi County, Kenya.

The model's metrics and features were enhanced through expert assessment and validation. This was necessary for several key reasons: First, gathering validation from experts ensured that the model was built on sound theoretical and practical foundations. It provided credibility to the model, confirming that the model aligns with best practices and educational standards. Second, expert evaluation of the model precision and sensitivity helped in determining its ability to accurately and consistently measure what it was intended to measure. This was crucial in ensuring that the model guidelines could to improve learner outcomes, which is particularly important for enhancing learner competencies for environmental conservation. Third, assessing specificity ensured that the model guidelines were effective in targeting the specific competencies or behaviors it is designed to improve, without being influenced by unrelated factors. Fourth, assessing accuracy ensured that the model produces correct results that reflect the true performance or learning outcomes. High accuracy is critical to the model's overall reliability and effectiveness in an educational setting.

The fifth reason why expert review of the implementation aspect of the model is that this helped broaden understanding of how easily the model could be integrated into real classroom settings. It also highlights any potential challenges or barriers that need to be addressed for successful deployment on a larger scale. Expert evaluation of the postulated learning activities to actively engage learners also helped in determining whether the model was effectively capturing the learners' attention and encouraging active participation. High engagement is a strong indicator that the instructional methods are resonating with students, making the learning process more effective. Positive feedback from learners provided direct insight into their experiences with the model guidelines and materials. This information was crucial for understanding the

learners' perspectives and identifying areas for improvement to enhance their learning experience. Assessing the overall effectiveness of the model was the ultimate measure of its success. The result provided evidence of the model effectiveness. Data presented in Table 34 shows the model metrics and features that were evaluated in order to determine its overall effectiveness.

Table 34: Assessment of Model Metrics and Features

No	Criteria	Conclusion
1	Expert Validation	Valid
2	Precision/Sensitivity	Reliable and Sensitive
3	Specificity	High Specificity
4	Accuracy	Accurate
5	Implementation	Good
6	Learner engagement	Good
7	Learner Feedback	Positive
8	Effectiveness	Effective

Source: Field Data (2024)

Data in Table 34 show that the model guidelines (pg 150) underwent validation by experts in the relevant field, ensuring its relevance, appropriateness, and applicability. This validation process confirms that the tool or approach was theoretically sound and aligns with best practices. The model demonstrates high reliability, meaning it consistently produced stable and consistent results across different scenarios of use. From the data in Table 34, it is evident that the model is highly specific in terms of learning outcomes, meaning it effectively targets and measures the intended aspects or components of learning without being influenced by irrelevant factors.

The accuracy of the model indicates that it provides correct and truthful measurements or outcomes. This accuracy ensures that the results closely reflect the true values or conditions being assessed. The implementation process of the model guidelines were-executed, with clear guidelines and strategies that made it feasible and practical in real-world settings. This allowed for efficient adoption and integration into existing systems or practices. The model successfully engages learners, meaning it captures their attention, stimulates their interest, and motivates active participation. This engagement is crucial for effective learning and retention. Feedback from learners regarding the tool or method has been predominantly positive. This indicates that learners find the tool

beneficial, user-friendly, and supportive of their learning experience. The overall effectiveness of the model was evident in its ability to achieve the desired outcomes. The model successfully meets its intended purpose, demonstrating tangible benefits and positive impacts on the learners' acquisition of environmental conservation core-competencies.

Based on the outcomes of the pretest and posttest, it was determined that the teaching resources were sensitive, practical, valid, and dependable. This was in accordance with the statement of Nieveen (2013) that the instructional tools are said to be of good quality if meet the criteria of validity, practicality and effectiveness. The implications of finding a statistically significant effectiveness of the multimodal instructional model practices in enhancing learner acquisition of environmental conservation core competencies in lower primary schools in Tharaka Nithi County, Kenya, are multifaceted and impactful. The significant effectiveness indicates that students are better acquiring environmental conservation core competencies. This suggests the instructional model is successful in imparting the desired knowledge, skills, attitudes, behaviors, and competencies. With the positive responses related to learner engagement and motivation, it implies that students are more involved and motivated to learn and apply environmental conservation practices.

The model provides adequate support and resources for teachers, which can lead to improved teaching practices and a more supportive learning environment. The findings support the integration of multimodal instructional practices into the curriculum. Policymakers and curriculum developers can consider these practices as part of the standard teaching methodology for environmental education. The positive results highlight the need for ongoing professional development for teachers to effectively implement and utilize multimodal instructional strategies. The successful implementation of the model guidelines in Tharaka Nithi County can serve as a reference. Education stakeholders can consider scaling and replicating the multimodal instructional model in other counties or even nationally. The findings contribute to the growing body of evidence supporting the effectiveness of multimodal instructional strategies underscoring the need to adopt the intervention to enhance educational outcomes and contribute to broader societal goals, such as environmental conservation and sustainable development.

CHAPTER FIVE
SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of the Findings

The study sough to examine influence of multimodal instructional methods on environmental conservation core-competences (critical thinking and problem solving, creativity and innovation, communication and collaboration) demonstrated by learners in lower primary schools in Tharaka Nithi County, Kenya.

The first objective sought to find out the multimodal instructional activities used in presenting environmental conservation lessons in lower primary schools in Tharaka Nithi County, Kenya. The study established several key findings: visual aids such as diagrams, photographs, and videos were not commonly employed, whereas auditory methods like lectures, oral presentations, recitations, and storytelling were frequently used. Reading and writing activities were highly practiced, and a significant portion of teachers reported employing hands-on and interactive methods. There was moderate use of interactive technology while a significant majority of teachers engaged in collaborative methods during environmental activity lessons.

The second objective sought to examine the extent of utilization of multimodal instructional methods in delivering environmental activities lessons in lower primary schools in Tharaka Nithi County, Kenya. The results reveal significant variability in the frequency of use of different multimodal instructional methods for environmental activities. The study established that auditory methods were the most frequently used, with the highest mean frequency of use and relatively low variability. In contrast, visual, collaborative and experiential methods were used less frequently, with a significant number of teachers rarely or never using them. Reading and writing and kinesthetic methods were moderately used, with most teachers using them occasionally. Interactive technology showed a balanced distribution, with a significant portion of instructors rarely or never using it, leading to moderate use overall. Overall, auditory methods were the most frequently used. Other multimodal instructional methods were underutilized. The Kruskal-Wallis H test was used to determine if there were statistically significant differences between the grade levels. The Kruskal-Wallis H test results showed no significant differences in the frequency of multimodal instructional

use between grade 1, 2, and 3 teachers for all the methods considered (all p-values > 0.05). This suggests that the use of these instructional methods did not vary significantly across the different grade levels.

The Wilcoxon signed-rank test was performed to compare two related samples, matched samples, or repeated measurements on a single sample to assess whether their population mean ranks differed. The results showed that for visual methods no significant differences were found between the grades. Significant differences were found between Grade 1 vs Grade 2 and Grade 2 vs Grade 3 with auditory method. As for read and write, kinesthetic and experiential methods, no significant differences were found between the grades. A significant difference was however, found between Grade 2 and Grade 3 with the collaborative method. In summary, most instructional methods did not show significant differences in application frequency across grades.

Objective three aimed at determining the influence of multimodal instructional methods on learner acquisition of environmental conservation core competencies in lower primary schools in Tharaka Nithi County, Kenya. The null hypothesis tested was that there is no statistically significant influence of multimodal instructional methods on lower primary school learners acquisition of environmental conservation core competencies in Tharaka Nithi County, Kenya $\alpha = 0.05$ level of significance. Results of the study revealed that there were statistically significant differences in the pre-test and post-test assessments. A post hoc analysis was applied to identify the multimodal instructional method that was better. One-way ANOVA was performed to check if there were any significant differences between the methods. The F-statistic generated (0.158) was very low, suggesting that the variance between the group means was not significantly greater than the variance within the groups, indicating that there is no statistically significant difference between the instructional methods in terms of their influence.

The fourth objective examined the pedagogical challenges encountered in implementing multimodal instructional methods for teaching environmental activities in lower primary schools in Tharaka Nithi County, Kenya. The study identified resource limitations, inadequate teacher training and professional development, time constraints,

technological challenges, teacher incompetence, curriculum dictates and costs as significant barriers that need to be addressed to improve the effectiveness of multimodal instructional methods.

The fifth objective entailed determination of the effectiveness of applying multimodal instructional model that was developed (describe how it was done). The model guidelines were produced as shown in Figure 10. The study tested the null hypothesis that there is no statistically significant effectiveness in application of multimodal instructional model in enhancing acquisition of environmental conservation core competencies among learners in lower primary schools in Tharaka Nithi County, Kenya $\alpha = 0.05$ level of significance. The Chi-square statistic generated (90.13) was much larger than the critical value for 1 degree of freedom $\alpha = 0.05$ significance level, and the p-value was far less than 0.05. Therefore, the null hypothesis was rejected implying a statistically significant effectiveness of the model guidelines.

5.2 Conclusion

Based on the findings, the following conclusions were made: The study concluded that in lower primary schools in Tharaka Nithi County, Kenya, auditory methods such as lectures and storytelling were the most commonly used instructional methods for environmental activities, while visual aids like diagrams and videos were rarely employed. Hands-on and interactive methods were moderately utilized, and there was a positive response towards experiential learning. Collaborative methods were frequently used, whereas interactive technology had moderate usage, indicating a diverse but uneven application of multimodal instructional methods.

The study further concluded that there was significant variability in the frequency of use of different multimodal instructional methods. Auditory methods were the most frequently used with low variability, while visual, collaborative, and experiential methods were less frequently employed. Reading, writing, and kinesthetic methods were used occasionally by most teachers, and interactive technology had a balanced but moderate use. The study also concluded that no significant differences existed in the frequency of multimodal instructional methods use across grades, except for auditory

and collaborative methods, which showed significant differences between certain grade comparisons.

The study concluded that several pedagogical challenges constrained implementation of multimodal instructional methods, including resource limitations, inadequate teacher training, time constraints, technological challenges, teacher incompetence, curriculum constraints, and high costs. These barriers highlight the need for targeted interventions to improve the effectiveness of multimodal instructional methods in teaching environmental activities.

The study further made the conclusion that the environmental activity multimodal instructional model guidelines was effective in enhancing learners' acquisition of environmental conservation core competencies. The Chi-square statistic indicated that the multimodal approach was significantly effective. This underscores the value of employing a variety of instructional methods to improve environmental education outcomes in lower primary schools in Tharaka Nithi County, Kenya. The study further concludes that despite an overall positive impact of multimodal instructional methods on learners, no single method proved to be significantly superior than the other.

5.3 Recommendations

Based on the conclusions made by this study, the following recommendations for theory, practice and policy were made:

i. The findings of this study challenges the effectiveness of traditional instructional methods in enhancing learner acquisition of 21st century skills and competencies for environmental conservation such as communication and collaboration, critical thinking and problem solving as well as imagination and creativity. Scholars should further expand research on the integration of diverse multimodal instructional strategies in environmental education. This can be achieved by encouraging further academic studies to assess the comparative efficacy of different multimodal approaches and how different learning styles interact with multimodal methods to optimize competence acquisition.

ii. Ministry of Education in Kenya to revise the curriculum for grade one, two and three environmental activities to incorporate multimodal methods as a core teaching strategy for environmental conservation education. The curricula can

include practical activities like environmental clean-ups, nature walks and projects where students create solutions to environmental problems. County Government may come in handy to provide financial and logistical support to schools for field trips and outdoor experiential learning activities.

iii. Ministry of Education in Kenya should ensure schools are equipped with basic teaching resources such as visual aids, field-based activity kits, and classroom technologies and design workshops and continuous professional development programs for teachers to effectively integrate various multimodal methods in their instruction. County Government should collaborate with schools in provision of funding to support regular workshops and training sessions for teachers on how to effectively apply the multimodal instructional model guidelines in their classrooms.

iv. Ministry of Education in Kenya should consider developing national policies that support and incentivize the use of multimodal instructional methods in all subjects, not just environmental education with clear guidelines on how to balance these approaches. Policy-Makers at the Ministry should create policies that encourage teacher professional development, particularly in using multimodal teaching methods as well policies to address issues of resource allocation and teacher competency, especially in remote areas, to ensure equity in the delivery of high-quality, multimodal instruction.

5.4 Suggestions for Further Study

Based on the findings and conclusions of the study, the following are suggestions for further study to deepen understanding of multimodal instructional methods and their impact on environmental education, particularly in lower primary schools:

i. Impact of Multimodal Instruction on Long-Term Retention and Behavioral Change in Environmental Conservation. The current study focused on immediate acquisition of core competencies, further research could investigate the long-term effects of multimodal instructional methods on learners' retention of environmental knowledge and their behavioral changes towards conservation practices. Future studies may explore how different combinations of multimodal

methods impact learners' ability to retain knowledge and apply it to real-world environmental conservation over time.

ii. Comparative Study on the Effectiveness of Multimodal Instructional Methods in Urban Versus Rural Schools. The current study was not conducted in specific regions in Tharaka Nithi County. Therefore, it would be important to investigate if the effectiveness of multimodal instructional methods varies between urban and rural settings, where access to resources and technologies may differ. Such studies can compare the effectiveness and challenges of implementing multimodal instruction in resource-rich urban environments versus resource-constrained rural schools, focusing on environmental education.

iii. The Role of Teacher Competency in the Successful Implementation of Multimodal Instructional Methods. Teacher competency was identified as a challenge in this study. Further research could explore the specific skills and training needed to effectively implement multimodal instructional methods. Such a study can investigate the correlation between teacher training programs in multimodal methods and the successful acquisition of core competencies in students, identifying the most effective professional development approaches for teachers.

iv. Effectiveness of Multimodal Instruction in Other Subjects in Primary Education. While the current study focused on environmental conservation, further research could examine the broader application of multimodal instructional methods across other subjects (for example, mathematics, science, literacy) in lower primary education. An assessment of how multimodal methods impact learners' performance across various core subjects, and whether these methods are as effective in cognitive-heavy disciplines as they are in experiential learning topics like environmental conservation would be useful.

v. Influence of Socioeconomic Factors on the Implementation of Multimodal Instructional Methods. The current study identified several challenges related to resource availability, which are often tied to socioeconomic factors. Investigating how socioeconomic status influences access to multimodal learning resources would provide insights into equity in education. Studies can also explore how schools in low socioeconomic status areas implement

multimodal instruction and whether students in these areas are receiving the same quality of environmental education as those in more affluent regions.

vi. Development of a Comprehensive Multimodal Instructional Framework for Environmental Conservation. The current study concluded that no single method was significantly superior. Further research could focus on developing a comprehensive multimodal instructional framework that optimally combines various methods for teaching environmental conservation. Such studies can design and test a framework that integrates auditory, visual, kinesthetic, collaborative, and experiential methods, tailored for lower primary environmental education, and assess its impact on students' learning outcomes. In addition, studies can use the model guidelines developed in this study to investigate the appropriateness of developing learning for other levels and subjects of learning.

REFERENCES

Abdullah, F., Hidayati, A., Andriani, A., Silvani, D., Ruslan, R., Tandiana, S., & Lisnawati, N. (2022). Fostering Students' Multimodal Communicative Competence through Genre-based Multimodal Text Analysis. | *Studies in English Language and Education Journal*, 632-650.

Ademola, I., Okebukola, P., Oladejo, A., Onowugbeda, F., Gbeleyi, O., & Agbanimu, D. (2021). Teachers' Qualifications and Teaching Experience: Impact on Quality Assurance in Nigeria Secondary Education. NOUN Journal of Management and International Development, 6(1), 260-272.

Ajaps, S., & Forh Mbah, M. (2022). Towards A Critical Pedagogy of Place for Environmental Conservation. *Environmental Education Research*, *28*(4), 508-523

Ajayi, L. (2010). Preservice Teachers' knowledge, Attitudes and Perception of Their Preparation to Teach Multiliteracies/Multimodality. *The Teacher Educator, 46*(1), 6-31.

Akala, B. (2021). Revisiting Education Reform in Kenya: A Case of Competency Based Curriculum (CBC). *Social Sciences & Humanities Open*, *3*(1), 100107.

Azeez, F., & Aboobaker, N. (2024). Exploring New Frontiers of Experiential Learning Landscape: A Hybrid Review. *The Learning Organization*.

Bajracharya, J. (2019). Instructional Design and Models: ASSURE and Kemp. *Journal of Education and Research, 9*(2), 1-9.

Banamwana, C., Musoke, D., Ntakirutimana, T., Buregyeya, E., Ssempebwa, J., Maina, G., & Tumwesigye, N. (2022). Complexity of Adoption and Diffusion of Ecological Sanitation Technology: A Review of Literature. *Journal of Water, Sanitation and Hygiene for Development*, *12*(11), 755-769.

Banga, B. (2023). Empowering Future Educators: A Multi-Faceted Analysis of Emotional Intelligence and Self-Confidence in Preparing Aspiring Teachers for Complex Educational Challenges. *International Journal for Multidimensional Research Perspectives*, *1*(3), 211-225.

Bassachs, M., Serra, T., Bubnys, R., Cañabate, D., & Colomer, J. (2022). Multimodal Approaches to Math and Physical Education Within Cooperative Learning to Enhance Social Attitudes. *Sustainability*, *14*(24), 16961.

Behrendt, M., & Franklin, T. (2014). A Review of Research on School Field Trips and Their Value in Education. International Journal of Environmental and Science Education, 9(3), 235-245.

Bell, E., Bryman, A., & Harley, B. (2022). *Business Research Methods*. Oxford University Press.

Bendini, M., & Devercelli, A. (2022). *Quality Early Learning: Nurturing Children's Potential*. Washington, D.C: World Bank Publications.

Bengochea, A., Sembiante, S., & Gort, M. (2020). Attracting and Responding to an Audience: Preschoolers' Multimodal Composing in Show-And-Tell Activity. *Language Arts*, *97*(3), 135-145.

Benvenuti, M., Cangelosi, A., Weinberger, A., Mazzoni, E., Benassi, M., Barbaresi, M., & Orsoni, M. (2023). Artificial Intelligence and Human Behavioral Development: A Perspective On New Skills and Competences Acquisition for The Educational Context. *Computers in Human Behavior*, *148*, 107903.

Bhusal, A. (2019). Addressing FYC Instructors' Lack of Technological Expertise in Implementing Multimodal Assignments. In *Marginalia in modern learning contexts* (pp. 166-186). IGI Global.

Bitok, E. (2020). Establishing Instructional Strategies Used by Teachers in Public Early Childhood Education Centers in Uasin-Gishu County, Kenya.

Bjelobaba, G., Savić, A., Tošić, T., Stefanović, I., & Kocić, B. (2023). Collaborative learning supported by Blockchain Technology as a model for improving the Educational process. *Sustainability*, *15*(6), 4780.

Burer, S. (2014). *Influence of Environmental Education On Conserving Environment in Kenya, Case Study Moiben Constituency, Uasin Gishu County* (Doctoral dissertation).

Cade, J., Wardle, F., & Otter, J. (2022). Toddler and Preschool Teachers' Beliefs and Perceptions About the Use of Developmentally Appropriate Practice. *Cogent Education*, *9*(1), 2018908.

Candiasa, I. (2022). Application of Instructional Design Models by Prospective Teacher Students. *Jurnal Pendidikan dan Pengajaran*, *55*(3), 640-652.

Carr, J., Schoephoerster, K., & Riegel, C. (2024). The Impact of Kinesthetic Instructional Strategies and Manipulatives on Fourth Grader's Self-Efficacy and Self-Confidence Toward Multiplication. Mathematical Thinking and Learning, 1-17.

Castells, N., Minguela, M., & Nadal, E. (2023). Writing A Synthesis Versus Reading: Strategies Involved and Impact On Comprehension. *Reading and Writing*, *36*(4), 849-880.

Chang, T., Wang, H., Haynes, A., Song, M., Lai, S., & Hsieh, S. (2022). Enhancing Student Creativity Through an Interdisciplinary, Project-Oriented Problem-Based Learning Undergraduate Curriculum. *Thinking Skills and Creativity*, *46*, 101173.

Chango, W., Lara, J., Cerezo, R., & Romero, C. (2022). A Review On Data Fusion in Multimodal Learning Analytics and Educational Data Mining. Wiley Interdisciplinary Reviews: *Data Mining and Knowledge Discovery*, 12(4), e1458.

Chaudhry, N., Ashar, A., & Ahmad, S. (2020). Association of Visual, Aural, Read/Wite, and Kinesthetic (VARK) Learning Styles and Academic Performances of Dental Students. *Pakistan Armed Forces Medical Journal*, *70*(Suppl-1), 58-63.

Cheruiyot, G. (2019). *Effect of Computer Assisted Teaching Strategy On Students' Academic Achievement and Motivation in Biology in Public Secondary Schools in Baringo County, Kenya* (Doctoral dissertation, Chuka University).

Chisika, S. & Yeom, C. (2024). Optimizing Environmental Education and Awareness Strategies for Sustainable Forest Management in Kenya. Lessons from Cherangany, Mount Kenya, Aberdares, and Kakamega Forest Ecosystems. *Visions for Sustainability*, 21, 8704,1-31

Chondrogianni, A., & Tsalaporta, P. (2023). Reversing Environmental Deterioration: The Role of Human Capital in Developing Countries. *Economic Change and Restructuring*, *56*(3), 1585-1599.

Choriev, R., Khujakeldiev, K., Kucharov, S., Khayitova, S., Abdiev, N., & Amirqulov, X. (2022). Pedagogical Problems of Distance and Traditional Education. *Journal of Pharmaceutical Negative Results*, 2895-2904.

Cirkony, C., & Kenny, J. (2022). Using Formative Assessment to Build Coherence Between Educational Policy and Classroom Practice: A Case Study Using Inquiry in Science. *Australian Journal of Teacher Education (Online)*, *47*(10), 77-105.

Cope, B., & Kalantzis, M. (2022). Futures for Research in Education. *Educational Philosophy and Theory*, *54*(11), 1732-1739.

Crescenzi-Lanna, L. (2023). Literature Review of the Reciprocal Value of Artificial and Human Intelligence in Early Childhood Education. *Journal of Research on Technology in Education*, *55*(1), 21-33.

D'Angelo, S., Marcus, R., & Ngabonzima, E. (2022). Teaching and Learning for Life Skills Development: Insights from Rwanda's 12+ Programme for Adolescent Girls: Special Issue Youth & Adolescent Skills Development: Preparing Young People for Diverse Global Challenges. *Development Policy Review*, *40*, e12622.

Dar, M., Kudare, R., Dar, Y., Ali, I., & Mohammed, S. (2022). Role of Projected and Non-Projected Teaching Aids in Teaching Learning Process. *Journal of Positive School Psychology*, *6*(10), 1725-1743.

Das, R., & Singh, T. (2023). Multimodal Sentiment Analysis: A Survey of Methods, Trends and Challenges. *ACM Computing Surveys*, *55*(13s), 1-38.

de Oliveira Biazus, M., & Mahtari, S. (2022). The Impact of Project-Based Learning (Pjbl) Model On Secondary Students' Creative Thinking Skills. *International Journal of Essential Competencies in Education*, *1*(1), 38-48.

de Souza, R., Toebe, M., Mello, A., & Bittencourt, K. (2023). Sample Size and Shapiro-Wilk Test: An Analysis for Soybean Grain Yield. *European Journal of Agronomy*, *142*, 126666.

Dick, W. (1996). The Dick and Carey Model: Will It Survive the Decade? *Educational Technology Research and Development*, *44*(3), 55-63.

Djalilova, Z. (2023). Pedagogical Educational Technology: Essence, Characteristics and Efficiency. *Академические исследования в современной науке*, *2*(23), 29-38.

Dole, S., Bloom, L., & Kowalske, K. (2016). Transforming Pedagogy: Changing Perspectives from Teacher-Centered to Learner-Centered Instruction. *Interdisciplinary Journal of Problem-Based Learning*, *10*(1), 45-58.

Domenici, V. (2022). STEAM Project-Based Learning Activities at The Science Museum as an Effective Training for Future Chemistry Teachers. *Education Sciences*, *12*(1), 30.

Dousay, T., & Branch, R. (2023). *Survey of Instructional Design Models*. Amazon: Brill.

Dunlop, L., & Rushton, E. (2022). Putting Climate Change at The Heart Of Education: Is England's Strategy A Placebo For Policy? *British Educational Research Journal*, *48*(6), 1083-1101.

Duoblienė, L., Kaire, S., & Vaitekaitis, J. (2023). Education for The Future: Applying Concepts from The New Materialist Discourse to UNESCO and OECD Publications. *The Journal of Environmental Education*, *54*(3), 213-224.

Dzwigol, H. (2022). Research Methodology in Management Science: Triangulation. *Virtual Economics*, *5*(1), 78-93.

Edmonds, G., Branch, R., & Mukherjee, P. (1994). A Conceptual Framework for Comparing Instructional Design Models. *Educational technology research and development*, *42*(4), 55-72.

Emerson, R. (2022). ANOVA Assumptions. *Journal of Visual Impairment & Blindness*, *116*(4), 585-586.

Fang, W., Hassan, A., & LePage, B. (2022). Environmental Learning and Communication. In *The Living Environmental Education: Sound Science Toward a Cleaner, Safer, and Healthier Future*. Singapore: Springer Nature Singapore.

Firmannandya, A. (2023). Developing Global Collaboration Skills in The Era of Unlimited Learning. *Widyagogik: Jurnal Pendidikan dan Pembelajaran Sekolah Dasar*, *10*(2), 457-477.

Firmansyah, B. (2021). The Effectiveness of Multimodal Approaches in Learning. *EDUTEC: Journal of Education and Technology*, *4*(3), 469-479.

Fleming, N., & Baume, D. (2006). Learning Styles Again: VARKing up the Right Tree. *Educational Developments*, *7*(4), 4.

Fokides, E., & Kostas, A. (2020). Pre-Service Teachers and Computers: A (Still) Troubled Relationship. In *Handbook of Research On Diverse Teaching Strategies for The Technology-Rich Classroom*. IGI Global.

Fraenkel, J., Wallen, N., & Hyun, H. (1993). *How to Design and Evaluate Research in Education 10th ed*. McGraw-Hill Education.

Fu, H. (2022). *Identifying Instructional Design Strategies in Differentiated Instruction in China: A Systematic Review*. The University of Western Ontario: ProQuest Dissertations Publishing.

Gagné, F. (1995). From Giftedness to Talent: A Developmental Model and Its Impact On the Language of the Field. *Roeper review*, *18*(2), 103-111.

Gale, A., Chapman, J., White, D., Ahluwalia, P., Williamson, A., Peacock, K. & Cooke, S. (2022). On Embracing the Concept of Becoming Environmental Problem Solvers: The Trainee Perspective on Key Elements of Success, Essential Skills and Mindset. *Environmental Reviews*, *30*(1), 1-9.

Gani, S., Razali, R., & Burhansyah, B. (2023). Promoting Sustainability and Conservation Practices Through Environmental Education in Aceh, Indonesia. *World Journal of Advanced Research and Reviews*, *18*(3).

Gardner, H. (2020). *A Synthesizing Mind: A Memoir from The Creator of Multiple Intelligences Theory*. Mit Press.

Gillies, R. M. (2016). Cooperative Learning: Review of Research and Practice. Australian Journal of Teacher Education, 41(3).

Ginsburg, S., & Jablonka, E. (2021). Evolutionary Transitions in Learning and Cognition. *Philosophical Transactions of the Royal Society B*, *376*(1821), 20190766.

Glaser, B., & Strauss, A. (2017). *Discovery of Grounded Theory: Strategies for Qualitative Research*. London, United Kingdom Routledge.

Gonfa, M., Birhanu, A., & Gendo, K. (2024). Review on Practice and Challenges of ICT Integration as Pedagogical Tools in Ethiopian Primary School Curriculum Implementation. *Discover Education*, *3*(1), 88.

Greenhow, C., Graham, C. R., & Koehler, M. J. (2022). Foundations of Online Learning: Challenges and Opportunities. *Educational Psychologist*, *57*(3), 131-147.

Gresch, D., Boettcher, S., van Ede, F., & Nobre, A. (2024). Shifting Attention Between Perception and Working Memory. *Cognition*, *245*, 105731.

Guerrero, A. (2022). *Early Childhood Leaderships' Perceptions of Developmentally Appropriate Instruction* (Doctoral dissertation, The University of Texas at San Antonio).

Gugssa, M. (2023). Characterizing Environmental Education Practices in Ethiopian Primary Schools. *International Journal of Educational Development*, *102*, 102848.

Guthrie, C., Santos, A., Henderson, K., Norfolk-Beadle, A., Fordham, E., & Baucal, A. (2022). Empowering Teachers to Improve their Practice. Bosnia and Herzegovina: OECD Reviews of Evaluation and Assessment in Education.

Halkos, G., & Gkampoura, E. (2021). Where Do We Stand On The 17 Sustainable Development Goals? An Overview On Progress. *Economic Analysis and Policy*, *70*, 94-122.

Hallam, J., Gallagher, L., & Owen, K. (2022). The Secret Language of Flowers: Insights from an Outdoor, Arts-Based Intervention Designed to Connect Primary School Children to Locally Accessible Nature. *Environmental education research*, *28*(1), 128-145.

Hanushek, E., Rivkin, S., & Schiman, J. (2016). Dynamic Effects of Teacher Turnover On the Quality of Instruction. *Economics of Education Review*, *55*, 132-148.

Hassan, S., & Umar, O. (2024). Actualizing the Sustainable Development Goals 2030: The Role of Environmental Education in Poverty Eradication and Tackling Insecurity in Nigeria. *Scholar J*, *2*(1).

Heinich, R., Molenda, M., Russel, J., & Smaldino, S. (1996). Instructional Media and Tecbnologies for Leaming. *New Jersey: Printice-Hall, lnc. A Simon & Schuster Company*.

Hendry, D., Ford, P., Williams, A., & Hodges, N. (2015). Five Evidence-Based Principles of Effective Practice and Instruction. In *Routledge Handbook of Sport Expertise*. London, United Kingdom: Routledge.

Herat, S. (2021). E-waste Management in Asia Pacific Region: Review of Issues, Challenges and Solutions. *Nature Environment and Pollution Technology*, *20*(1), 45-53.

Hernández del Barco, M., Sánchez Martín, J., & Corbacho Cuello, I. (2022). Is Sustainability an Exhausted Concept? Bridging The Gap from Environmental Awareness to Emotional Proficiency in Science Education Through Integral Sustainability.

Hidayat, R. R. A., Fajriah, Y. N., & Nugraha, I. (2024). Integrating Multimodal Texts in Genre-Based Approach: Teacher's and Students' Challenges and Benefits. *English Education and Applied Linguistics Journal (EEAL Journal)*, *7*(1), 13-22.

Hili, C., & Schembri, H. (2022). Cross-Curricular Teaching Within the Learning Outcomes Framework: The Experiences of Primary Teachers in Two State Schools in Malta. *Education*, *3*(2), 231-258.

Hite, K. & Seitz, J. (2021). *Global Issues: An introduction*. London: John Wiley & Sons.

Hiver, P. (2022). Engaging The Learner: Linking Teaching Practice to Learners' Engagement and Development. *Researching Language Learning Motivation*, 51-59.

Hoadley, C., & Campos, F. (2022). Design-Based Research: What It Is and Why It Matters to Studying Online Learning. *Educational Psychologist*, *57*(3), 207-220.

Hogan, D., & O'Flaherty, J. (2022). Exploring The Nature and Culture of Science as an Academic Discipline: Implications for The Integration of Education for Sustainable Development. *International Journal of Sustainability in Higher Education*, *23*(8), 120-147.

Höllerer, M., van Leeuwen, T., Jancsary, D., Meyer, R., Andersen, T., & Vaara, E. (2018). Visual and Multimodal Research in Organization and Management Studies. London and New York: Routledge.

Holtom, B., Baruch, Y., Aguinis, H., & A Ballinger, G. (2022). Survey Response Rates: Trends and a Validity Assessment Framework. *Human Relations*, *75*(8), 1560-1584.

Holtom, B., Baruch, Y., Aguinis, H., & Ballinger, G. (2022). Survey Response Rates: Trends and A Validity Assessment Framework. *Human relations*, *75*(8), 1560-1584.

Hussain, I. (2017). Pedagogical Implications of VARK Model of Learning. *Journal of Literature, Languages and Linguistics*, *38*(2422-8435), 5.

Izza, N. N., & Rusydiana, A. S. (2022). A Qualitative Review on Zakat Innovation: NVivo 12 Approach. In *Indonesian Conference of Zakat-Proceedings* (pp. 10-21).

Jiang, L., Yu, S., & Zhao, Y. (2022). Incorporating Digital Multimodal Composing Through Collaborative Action Research: Challenges and Coping Strategies. *Technology, Pedagogy and Education*, *31*(1), 45-61.

Johnson, S., & Marsh, P. (2019). The Impact of Competency-Based Learning on Student Performance and Engagement. *Journal of Educational Research and Development*, 45(3), 125-138.

Jones, S. (2022). Storying Gender Equality in Northwest Uganda: Educators Develop Contextually-And Culturally Responsive Stories in Professional Development Courses. *Teaching and Teacher Education*, *111*, 103600.

Kagawa, F. (2022). Quality Education with the Planet in Mind: Towards a Climate-Responsive and Nature-Positive Framework for the Education System of Lower-Income Countries. *Global Partnership for Education*. 44, 82-94.

Kaimara, P., Fokides, E., Oikonomou, A., & Deliyannis, I. (2021). Potential Barriers to The Implementation of Digital Game-Based Learning in The Classroom: Pre-Service Teachers' Views. *Technology, Knowledge and Learning*, *26*(4), 825-844.

Kaimara, P., Poulimenou, S. M., & Deliyannis, I. (2020). Digital Learning Materials: Could Transmedia Content Make The Difference In The Digital World?. In *Epistemological Approaches to Digital Learning in Educational Contexts*. New York: Routledge.

Kaminski, A. (2019). Young Learners' Engagement with Multimodal Texts. *ELT Journal*, *73*(2), 175-185.

Karakus, G. (2021). Solutions for Barriers in Curriculum Implementation. *African Educational Research Journal, 9*(2), 591-599.

Kariuki, C., Kathambi, B., & Inyega, J. (2023). Incorporating Capacity Building as a Pathway to Environmental Stewardship for Public Schools in Kenya. *Indonesian Journal of Social and Environmental Issues*, *4*(1), 1-11.

Kariuki-Githinji, S., Boyo, B., Bowen, M., & Kiambi, P. (2022). School Curriculum and Environmental Sustainability. *Technium Social Sciences Journal*, *32*, 126.

Karmali, D., Argento, A., Kirenga, B., Batra, H., Lee, H., MacRosty, C. & Jackson, P. (2023). A Longitudinal Study of Multimodal Bronchoscopy Training in Uganda. *ATS Scholar*, *4*(2), 152-163.

Kaua, C., Mutheu, J., & Thenya, T. (2019). Contextualizing Climate Variability in Tharaka South Subcounty, Tharaka Nithi County, Kenya. *Journal of Environmental Science, Toxicology and Food Technology*, *13*(12).

Kearsley, G., & Shneiderman, B. (1998). Engagement Theory: A Framework for Technology-Based Teaching and Learning. *Educational Technology*, *38*(5), 20-23.

Keng, S. (2018). Tenure System and Its Impact on Grading Leniency, Teaching Effectiveness and Student Effort. *Empirical Economics*, *55*, 1207-1227.

Kiesler, N. (2023). Approaching the Concept of Competency. In *Modeling Programming Competency: A Qualitative Analysis*. Cham: Springer International Publishing.

Kim, D., & Downey, S. (2016). Examining the Use of the ASSURE Model by K–12 Teachers. *Computers in the Schools*, *33*(3), 153-168.

Kim, P., Suh, E., & Song, D. (2015). Development of a Design-Based Learning Curriculum Through Design-Based Research for a Technology-Enabled Science Classroom. *Educational Technology Research and Development*, *63*, 575-602.

Kim, S., & Lee, Y. (2022). Developing students' attitudes toward convergence and creative problem solving through multidisciplinary education in Korea. *Sustainability*, *14*(16), 9929.

Kimalel, B. (2023). Teachers' Attitude Towards Assessment On Learners' Environmental Activities Performance in Public Pre-Primary Schools in Nandi County, Kenya. *GPH-International Journal of Educational Research*, *6*(10), 28-42.

Kimosop, H. (2019). Teacher Preparedness in the Implementation of Early Childhood Education Development Curriculum in Kenya: A Case of Baringo North Sub County, Kenya.

Kinuthia, C. (2023). *Re-Imaging Inclusive Education: Analyzing The Gap Between Theory and Practice in The Kenyan Education System*: A Case Study of Primary Schools Vis-À-Vis Policy Documents.

Kirchhoff, C., & Mision, M. (2022). Audio-Assisted Extensive Reading: Learners' Experience and Attitudes. *The Reading Matrix: An International Online Journal*, *22*(2), 1-12.

Kirimi, J. (2016). The Role of Examinations on the Development of Holistic Learners in Secondary Schools, Kiambu County, Kenya. *International Journal of Social Sciences & Education*, *2*(3).

Kolb, D. (2014). *Experiential Learning*: Experience as The Source of Learning and Development. London: FT Press.

Krasny, M. (2020). *Advancing Environmental Education Practice* (p. 312). Cornell University Press.

Krejcie, R., & Morgan, D. (1970). Determining Sample Size for Research Activities. *Educational and Psychological Measurement*, 30(3), 607-610.

Kumar, P., Paramjit, & Anand, S. (2023). An Analysis of the Performance of Sustainable Development Goals (SDGs) in the North-East Region of India: An Economics Perspective. In *Sustainable Development Goals in Northeast India: Challenges and Achievements*. Singapore: Springer Nature Singapore.

Lasaiba, D. (2024). Classroom Management Strategies in the Transformation of Education in the Digital Era: Integration of Technology and Teaching Methodologies. Jendela Pengetahuan, 17(1):77-95.

Leasa, M., Corebima, A., & Batlolona, J. (2020). The Effect of Learning Styles On the Critical Thinking Skills in Natural Science Learning of Elementary School Students. *Ilkogretim-Elementary Education Online*, 19 (4), 2086-2097.

Lefebvre, A. (2022). Leader and Follower: Towards the Organization for Economic Co-Operation and Development's Two Interactional Categories to Describe Learning Situations. *Bandung*, *9*(1-2), 183-222.

Letina, A. (2020). Development of Students' Learning to Learn Competence in Primary Science. *Education sciences*, *10*(11), 325.

Lian, R. (2022). The Effects of Multimodal Teaching for Primary Students in L2 Primary School Classrooms. In *2022 International Conference on Science Education and Art Appreciation (SEAA 2022)* (pp. 745-754). Atlantis Press.

Lieponienė, J., Micevičienė, D., & Sargūnas, G. (2023). Sustainable Education for A Sustainable Future: Incorporating Green Skills in Higher Education. *Taikomieji Tyrimai Studijose Ir Praktikoje-Applied Research in Studies and Practice,* 19(1), 5-11.

Lilian, G. (2022). Education for Sustainable Development Pedagogy in Pre-Primary Social Studies Curriculum in Kenya: Review of Literature. *Journal of Education Science* 3 (3): 69-80.

Lina, E., & Desnita, D. (2022). Validity and Reliability of Critical Thinking Instruments to Measure the Effectiveness of Context-Based Physics E-Module on Wave Materials. *Jurnal Penelitian & Pengembangan Pendidikan Fisika*, *8*(1), 57-64.

Lomos, C., Luyten, J. W., & Tieck, S. (2023). Implementing ICT In Classroom Practice: What Else Matters Besides The ICT Infrastructure? *Large-Scale Assessments in Education*, *11*(1), 1.

Love, H., Cook, B., & Cook, L. (2022). Mixed–Methods Approaches in Special Education Research. *Learning Disabilities Research & Practice*, *37*(4), 314-323.

Lozano, R., Merrill, M., Sammalisto, K., Ceulemans, K., & Lozano, F. (2017). Connecting competences and pedagogical approaches for sustainable development in higher education: A literature review and framework proposal. *Sustainability*, *9*(10), 1889.

Lu, P., Mishra, S., Xia, T., Qiu, L., Chang, K., Zhu, S., & Kalyan, A. (2022). Learn to Explain: Multimodal Reasoning via Thought Chains for Science Question Answering. *Advances in Neural Information Processing Systems*, *35*, 2507-2521.

Luo, L., Wang, X., & Guo, H. (2022). Contribution of UNESCO Designated Sites to the Achievement of Sustainable Development Goals. *The Innovation*, *3*(3).

Lysenko, L., Abrami, P. C., Wade, A., Kiforo, E., & Iminza, R. (2022). Learning Mathematics with Interactive Technology in Kenya Grade-One Classes. *International Journal of Innovation in Science and Mathematics Education*, *30*(5).

Mahdi, H., & Al-Dera, A. (2013). The Impact of Teachers' Age, Gender and Experience on the Use of Information and Communication Technology in EFL Teaching. *English Language Teaching*, *6*(6), 57-67.

Maijala, M. (2023). Multimodal Postcards to Future Selves: Exploring Pre-Service Language Teachers' Process of Transformative Learning During One-Year Teacher Education Programme. *Innovation in Language Learning and Teaching*, *17*(1), 72-87.

Manase, J. (2016). The Adequacy of Environmental Education Techniques and Strategies Employed in Uluguru Mountains Hotspot. *International Journal of Education and Literacy Studies, 4*(4), 65-70.

Mandilla, L. (2021). *Enhancing Learners' Reading Comprehension Skills Using Multimodality in A Form Two Classroom in A Public Secondary School in Taita Taveta County*: An Action Research.

Mangaroska, K., Martinez, R., Vesin, B., & Gašević, D. (2021). Challenges and Opportunities of Multimodal Data in Human Learning: The Computer Science Students' Perspective. *Journal of Computer Assisted Learning*, *37*(4), 1030-1047.

Mangaroska, K., Sharma, K., Gašević, D., & Giannakos, M. (2022). Exploring Students' Cognitive and Affective States During Problem Solving Through Multimodal Data: Lessons Learned from A Programming Activity. *Journal of Computer Assisted Learning, 38*(1), 40-59.

Marques, R., & Xavier, C. (2020). The Challenges and Difficulties of Teachers in the Insertion and Practice of Environmental Education in the School Curriculum. *International Journal on Social and Education Sciences, 2*(1), 49-56.

Marulanda-Grisales, N., & Vera-Acevedo, L. (2023). Analysis of Core Competences and Competitive Advantages in Higher Education Institutions: An Intellectual Capital Approach. *Knowledge Management Research & Practice*, *21*(5), 957-971.

Maseyi, S., & Ong'ang'a, H. (2023). Teacher Efficacy a Determinant of Use of Collaborative Instructional Strategy: A Case of Lower Primary Grade Teachers in Mombasa City, Kenya. *International Journal of Research in Social Science and Humanities*, 4(8), 24-28.

Mashaba, E., Maile, S., & Manaka, M. (2022). Learners' Knowledge of Environmental Education in Selected Primary Schools of the Tshwane North District, Gauteng Province. *International Journal of Environmental Research and Public Health*, *19*(23), 15552.

Masinde, R. (2023*). Utilization of Multimodal Approaches in The Teaching and Learning of Oral Skills to Grade One Pupils in Selected Primary Schools in Western Kenya*. (Doctoral Dissertation, Masinde Muliro University of Science and Technology).

Masinde, R. (2023). Utilization of Multimodal Approaches in The Teaching and Learning of Oral Skills to Grade One Pupils in Selected Primary Schools in Western Kenya.

Masinde, R., Mandillah, L., & Barasa, D. (2023). Multimodal Approaches in The Competency of Listening and Speaking Skills Among Grade 1 Learners in Kenya. *International Journal of English Language Studies*, *5*(3), 67-81.

Matarirano, O., Gqokonqana, O., & Yeboah, A. (2021). Students' Responses to Multi-Modal Emergency Remote Learning During COVID-19 in a South African Higher Institution. *Research in Social Sciences and Technology, 6*(2), 199-218.

Matere, A. (2024). From 8-4-4 to CBC: Emerging Issues of Transition in Education in Kenya: Transition in Education in Kenya. *International Journal of Curriculum and Instruction, 16*(1), 76-86.

Mathee, M. (2023). *Enhancing The Visual Literacy of First-Year Students by Means of Self-Directed Multimodal Mobile Learning* (Doctoral dissertation, North-West University (South Africa).

Matusiak, K., Gendron, H., Heinbach, C., & Taylor, N. (2019). Visual Literacy in Practice: Use of Images in Students' Academic Work. *College & Research Libraries*, 80(1), 123-147.

Megagianni, P., & Kakana, D. (2021). The Educational Value and Impact of Serious Games in Cognitive, Social and Emotional Development in Middle Childhood: Perceptions of Teachers in Greece. *Research on E-Learning and ICT in Education: Technological, Pedagogical and Instructional Perspectives*, 129-145.

Merritt, E., Stern, M., Powell, R., & Frensley, B. (2022). A Systematic Literature Review to Identify Evidence-Based Principles to Improve Online Environmental Education. *Environmental Education Research, 28*(5), 674-694.

Mertayasa, I., Sumarni, N., & Indraningsih, K. (2024). A Literature Review: The Impact of Experiential Learning on Developing Students' Critical Thinking Skills in Indonesia. *International Journal of Current Educational Studies, 3*(1).

Mills, K., Heck, E., Brown, A., & Funnell, P. (2023). *Senses Together: Multimodal Literacy Learning in Primary Education*. Australian Catholic University.

Monte, T., & Reis, P. (2021). Design of A Pedagogical Model of Education for Environmental Citizenship in Primary Education. *Sustainability*, *13*(11), 6000.

Mónus, F. (2022). Environmental Education Policy of Schools and Socioeconomic Background Affect Environmental Attitudes and Pro-Environmental Behavior of Secondary School Students. *Environmental Education Research, 28*(2), 169-196.

Moraa, M., Thuba, E., & Kithinji, W. (2022). Social-Cultural Factors Influencing Female Under-Representation in the Management of Public Primary Schools in Rigoma Sub-County, Nyamira County, Kenya. *Journal of Education, 2*(3), 21-30.

Morrison, G., Ross, S., Morrison, J., & Kalman, H. (2019). *Designing Effective Instruction*. John Wiley & Sons.

Muchira, J., Morris, R., Wawire, B., & Oh, C. (2023). Implementing Competency Based Curriculum (CBC) In Kenya: Challenges and Lessons from South Korea and USA. *Journal of Education and Learning*, 62-77.

Mugabe, P., Mbah, M., & Apollo, A. (2022). Towards an Integrated Approach to Climate Change Education in Tanzania: The Role of Indigenous Knowledge Systems. In *Indigenous Methodologies, Research and Practices for Sustainable Development* (pp. 267-284). Cham: Springer International Publishing.

Mukagihana, J., Nsanganwimana, F., & Aurah, C. (2022). Effect of Instructional Methods on Pre-Service Science Teachers Learning Outcomes: A Meta-Analysis. *Education and Information Technologies*, *27*(2), 2137-2163.

Muruganantham, G. (2015). Developing of E-Content Package by Using ADDIE Model. *International Journal of Applied Research*, *1*(3), 52-54.

Naik, G., Chitre, C., Bhalla, M., & Rajan, J. (2020). Impact of Use of Technology on Student Learning Outcomes: Evidence from A Large-Scale Experiment in India. *World Development*, *127*, 104736.

Nalumenya, B., Rubinato, M., Kennedy, M., Catterson, J., Bakamwesiga, H., & Blackett, M. (2023). Water Management Education in the East African Region: A Review of the Challenges to Be Addressed. *Sustainability*, *15*(15), 11597.

Nasir, N., Lee, C., Pea, R., & McKinney de Royston, M. (2021). Rethinking Learning: What The Interdisciplinary Science Tells Us. *Educational Researcher*, *50*(8), 557-565.

Ndungu, M. (2021). *A Philosophical Analysis of the Objectives of Competency Based Curriculum in Kenya: A Critical Approach* (Doctoral dissertation, University of Nairobi).

Nguyen, C. (2021). The Construction of Age-Appropriate Pedagogies for Young Learners of English in Primary Schools. *The Language Learning Journal*, *49*(1), 13-26.

Nieveen, N., & Folmer, E. (2013). Formative Evaluation in Educational Design Research. *Design Research*, *153*(1), 152-169.

Nyatuka, B. (2020). Education for Sustainable Development in Kenya: Rhetoric and Reality in Basic Education. *Global Journal of Transformative Education*, *2*(1), 86-98.

Nyika, J., & Mwema, F. (2021). Environmental Education and Its Effects on Environmental Sustainability. In *Handbook of Research on Environmental Education Strategies for Addressing Climate Change and Sustainability* (pp. 182-199). IGI Global.

Okitasari, M., & Katramiz, T. (2022). The National Development Plans After the SDGs: Steering Implications of the Global Goals Towards National Development Planning. *Earth System Governance*, 12, 100136.

Okolie, U., Mlanga, S., Oyerinde, D., Olaniyi, N., & Chucks, M. (2022). Collaborative Learning and Student Engagement in Practical Skills Acquisition. *Innovations in Education and Teaching International*, *59*(6), 669-678.

Olivier, J. (2020). Self-Directed Multimodal Learning to Support Demiurgic Access. *Radical Solutions and eLearning: Practical Innovations and Online Educational Technology*, 117-130.

Omonayajo, B., Al-Turjman, F., & Cavus, N. (2022). Interactive and Innovative Technologies for Smart Education. *Computer science and information systems*, *19*(3), 1549-1564.

Osuntuyi, B., & Lean, H. (2023). Environmental Degradation, Economic Growth, And Energy Consumption: The Role of Education. *Sustainable Development*, *31*(2), 1166-1177.

Otachi, D. (2023). *A Critique of Pedagogical Methodologies Used in Science in Early Years of Education in Nyamira County-Kenya* (Doctoral dissertation, University of Nairobi).

Otto, S., Bertel, L., Lyngdorf, N., Markman, A., Andersen, T., & Ryberg, T. (2024). Emerging Digital Practices Supporting Student-Centered Learning Environments in Higher Education: A Review of Literature and Lessons Learned from The COVID-19 Pandemic. *Education and Information Technologies*, *29*(2), 1673-1696.

Padios, A., Pascua, S., & Orleans, A. (2023). Multimodal Representations Across Scientific Genres: Perspectives from Science Teachers' Practices. *International Journal of Education*, *16*(2), 89-100.

Palardy, G., & Rumberger, R. (2008). Teacher Effectiveness in First Grade: The Importance of Background Qualifications, Attitudes, and Instructional Practices for Student Learning. *Educational Evaluation and Policy Analysis*, 30(2), 111-140.

Pan, G., Seow, P., & Koh, G. (2019). Examining Learning Transformation in Project-Based Learning Process. *Journal of International Education in Business*, *12*(2), 167-180.

Paul, O., Begi, N., & Mwangi, M. (2021). Influence of Teachers' Subject Competence and Teaching Experience on Use of Instructional Strategies to Enhance Pupil's Literacy Skills in Busia County, Kenya. *Randwick International of Education and Linguistics Science Journal*, *2*(3), 315-324.

Pek, J., Hoisington-Shaw, K., & Wegener, D. (2022). Avoiding Questionable Research Practices Surrounding Statistical Power Analysis. In *Avoiding Questionable Research Practices in Applied Psychology*. Cham: Springer International Publishing.

Pereira, T., Amaral, A., & Mendes, I. (2022, September). A Competency Definition Based on the Knowledge, Skills, and Human Dispositions Constructs. In *International Conference on Internet of Everything*. Cham: Springer Nature Switzerland.

Piotrowska, I., Cichoń, M., Sypniewski, J., & Abramowicz, D. (2022). Application of Inquiry-Based Science Education, Anticipatory Learning Strategy, and Project-Based Learning Strategies in the Context of Environmental Problems of the Contemporary World. In *Didactic Strategies and Resources for Innovative Geography Teaching* (pp. 23-50). IGI Global.

Porte, L., Boucheix, J. M., Rapet, L., Drai-Zerbib, V., & Martinez, J. L. (2024). Immersive Virtual Reality for Learning About Ecosystems: Effect of Two Signaling Levels and Feedback on Action Decisions. *Frontiers in Psychology*, *15*, 1359071.

Pujiana, E., Rohaeti, E., Suyanta, S., Asmiati, L., Sari, D., & Syahana, S. (2024). The Role of Communication Skills in Guided Inquiry Process to Improve Critical Thinking Skills. *Jurnal Penelitian Pendidikan IPA*, *10*(3), 1458-1464.

Quintero-Angel, M., Duque-Nivia, A., & Molina-Gómez, C. (2024). A Teaching Strategy Based On Active Learning Which Promotes Strong Sustainability That Empowers Students to Have a Different Type of Relationship with The Environment. *Environmental Education Research*, 30(4), 560-579.

Ramírez Suárez, V., Acosta-Castellanos, P., Castro Ortegon, Y., & Queiruga-Dios, A. (2023). Current State of Environmental Education and Education for Sustainable Development in Primary and Secondary (K-12) Schools in Boyacá, Colombia. *Sustainability*, *15*(13), 10139.

Rickinson, M., Cirkony, C., Walsh, L., Gleeson, J., Cutler, B., & Salisbury, M. (2022). A Framework for Understanding the Quality of Evidence Use in Education. *Educational Research*, *64*(2), 133-158.

Robles, A. (2023). Teaching Strategies in Science, Technology, Engineering, and Mathematics Education for Kinesthetic Learners. *Capstone Projects and Master's Theses*, 1636.

Ryan, J., Scott, A., & Walsh, M. (2010). Pedagogy in The Multimodal Classroom: An Analysis of the Challenges and Opportunities for Teachers. *Teachers and Teaching: theory and practice*, *16*(4), 477-489.

Saber, A., Tajik, A., & Etemad Ahari, A. (2022). Identifying Curriculum Components Based On Environmental Literacy in The First Grade of High School in Varamin City. *Biannual Journal of Education Experiences*, *5*(1), 190-209.

Sabri, S., & Abdul, M. (2020). Integration of Dick and Carey Design in String Ensemble Class Instructional Material Design. *International Journal of Innovation, Creaivity and Change*, *14*(11), 359-388.

Sakulprasertsri, K. (2020). Teachers' Integration of Multimodality into 21st Century EFL Classrooms in Thailand: Practice and Perception. *LEARN Journal: Language Education and Acquisition Research Network*, *13*(2), 225-242.

Salamanti, E., Park, D., Ali, N., & Brown, S. (2023). The Efficacy of Collaborative and Multimodal Learning Strategies in Enhancing English Language Proficiency among ESL/EFL Learners: A Quantitative Analysis. *Research Studies in English Language Teaching and Learning*, *1*(2), 78–89.

Saldaña, J. (2021). Coding Techniques for Quantitative and Mixed Data. *The Routledge Reviewer's Guide to Mixed Methods Analysis*, 151-160.

Sankey, M., Birch, D., & Gardiner, M. (2011). The Impact of Multiple Representations of Content Using Multimedia on Learning Outcomes Across Learning Styles and Modal Preferences. *International Journal of Education and Development using ICT*, *7*(3), 18-35.

Schuller, K., & Gill-Peterson, J. (2020). Introduction: Race, The State, And The Malleable Body. *Social Text, 38*(2), 1-17.

Seau, L. (2021). Design Principles of a Responsive Pedagogical Model for Multimodal Skills of Oral Presentation. *Malaysian Journal of ELT Research*, *18*(1).

Setiawati, D., Purnawarman, P., & Sukyadi, D. (2021). Promoting Students' Critical Thinking Through Multimodal Digital Classroom Assessments in Online Learning. In *2021 3rd International Conference on Modern Educational Technology* (pp. 75-81).

Shammas, N. (2022). An Exploration of Direct Instruction: Why Teaching Matters. In *The Sharjah International Conference on Education in Post COVID-19*. Singapore: Springer Nature Singapore.

Sharma, N. (2023). Integrating Planetary Citizenship as a Cross-Curricular Theme and a Whole-School Approach: Using a Value-Creating Approach to Learning. *International Journal of Development Education and Global Learning*, *15*(1), 14-26.

Shrestha, N. (2020). Detecting Multicollinearity in Regression Analysis. *American Journal of Applied Mathematics and Statistics*, *8*(2), 39-42.

Sihombing, I., & Simanjuntak, D. (2023). The Use of Digital Audio in Enhancing Learners' Listening Proficiency. *Journal of English Teaching & Applied Linguistic*, *4*(2), 64-74.

Silva, I., Fleming, C., Noonan, M., Alston, J., Folta, C., Fagan, W., & Calabrese, J. (2022). Autocorrelation-Informed Home Range Estimation: A Review and Practical Guide. *Methods in Ecology and Evolution*, *13*(3), 534-544.

Simons, A., McHugh, K., Appling, S., Harris, S., & Burgoon, J. (2022). Instructional Approaches: Anatomy Education of Physical Therapists. *Anatomical Sciences Education*, *15*(1), 102-114.

Sinakou, E., Donche, V., & Van Petegem, P. (2022). Action-Orientation in Education for Sustainable Development: Teachers' Interests and Instructional Practices. *Journal of Cleaner Production*, *370*, 133469.

Siraj, I., Taggart, B., Melhuish, E., Sammons, P., & Sylva, K. (2014). *Exploring Effective Pedagogy in Primary Schools*: Evidence from Research. London, Great Britain: Pearson (eng).

Škrinjarić, B. (2022). Competence-Based Approaches in Organizational and Individual Context. *Humanities and Social Sciences Communications*, *9*(1), 1-12.

Sobočan, A. (2022). Social Inclusion and Research: Ethical Considerations. In *Handbook of Social Inclusion: Research and Practices in Health and Social Sciences*. Cham: Springer International Publishing.

Sofiq, H., & Nikolay, T. (2023). Designing A Multimodal Environment for Cognitive and Creative Activity in Pre-School Education-Competence of The Teacher. *International Journal of Cognitive Research in Science, Engineering and Education*, *11*(2), 351-358.

Sølvik, R., & Glenna, A. (2022). Teachers' potential to promote students' deeper learning in whole-class teaching: An observation study in Norwegian classrooms. *Journal of Educational Change*, *23*(3), 343-369.

Sorhe, R. (2024). *Factors Influencing Gender Disparities in Professional Development Among Early Childhood Education Teachers in Kakamega East Sub-County, Kakamega County, Kenya* (Doctoral Dissertation, Masinde Muliro University of Science and Technology).

Spatioti, A., Kazanidis, I., & Pange, J. (2022). A Comparative Study of The ADDIE Instructional Design Model in Distance Education. *Information*, *13*(9), 402.

Spiteri, J. (2023). Approaches to Foster Young Children's Engagement with Climate Action: A Scoping Review. *Sustainability*, *15*(19), 14604.

Summerville, J., & Reid-Griffin, A. (2008). Technology Integration and Instructional Design. *TechTrends*, *52*(5), 45-51.

Taherdoost, H. (2022). Different Types of Data Analysis; Data Analysis Methods and Techniques in Research Projects. *International Journal of Academic Research in Management*, *9*(1), 1-9.

Tamim, R., Bernard, R., Borokhovski, E., Abrami, P., & Schmid, R. (2011). What Forty Years of Research Says About the Impact of Technology on Learning: A Second-Order Meta-Analysis and Validation Study. *Review of Educational research*, *81*(1), 4-28.

Tan, L., Zammit, K., D'warte, J., & Gearside, A. (2020). Assessing Multimodal Literacies in Practice: A Critical Review of Its Implementations in Educational Settings. *Language and Education*, *34*(2), 97-114.

Tawfik, A., Gatewood, J., Gish-Lieberman, J., & Hampton, A. (2022). Toward A Definition of Learning Experience Design. *Technology, Knowledge and Learning*, *27*(1), 309-334.

Teddlie, C., Stringfield, S., Wimpelberg, R., & Kirby, P. (2022). Contextual Differences in Models for Effective Schooling in the USA. In *School Effectiveness and School Improvement* (pp. 117-130). Routledge.

Toma, R., & Lederman, N. (2022). A Comprehensive Review of Instruments Measuring Attitudes Toward Science. *Research in Science Education*, *52*(2), 567-582.

Tomczyk, Ł., Jáuregui, V., de La Higuera Amato, C., Muñoz, D., Arteaga, M., Oyelere, S., & Porta, M. (2021). Are Teachers Techno-optimists or Techno-pessimists? A Pilot Comparative Among Teachers in Bolivia, Brazil, the Dominican Republic, Ecuador, Finland, Poland, Turkey, and Uruguay. *Education and Information Technologies*, *26*(3), 2715-2741.

Tulim, D. & Eva, N. (2020). Competences for Environmental Sustainability: A Systematic Review on the Impact of Absorptive capacity and Capabilities. *Journal of Business Ethics*, 162: 881-906

Ullah, A., & Anwar, S. (2020). The Effective Use of Information Technology and Interactive Activities to Improve Learner Engagement. *Education Sciences*, *10*(12), 349.

Umeze, M. (2022). Management Competency Needs of Principals for Effective Administration in Anambra State Public Secondary Schools. *Journal of Educational Research & Development*, *5*(1).

Valverde-Berrocoso, J., & Fernández-Sánchez, M. (2020). Instructional Design in Blended Learning: Theoretical Foundations and Guidelines for Practice. *Blended learning: Convergence between technology and pedagogy*, 113-140.

van de Wetering, J., Leijten, P., Spitzer, J., & Thomaes, S. (2022). Does Environmental Education Benefit Environmental Outcomes in Children and Adolescents? A Meta-Analysis. *Journal of Environmental Psychology*, *81*, 101782.

Van Teijlingen, E., & Hundley, V. (2001). The Importance of Pilot Studies. *Social Research Update*, (35), 1-4.

VanderHoeven, H., Bradford, M., Jung, C., Khebour, I., Lai, K., Pustejovsky, J. & Blanchard, N. (2024). Multimodal Design for Interactive Collaborative Problem-Solving Support. In *International Conference on Human-Computer Interaction* (pp. 60-80). Cham: Springer Nature Switzerland.

Veiesund, M. (2023). *A Multimodal Classroom: A Study on Teachers' Use of Multimodal Ensembles in the Norwegian English as an Additional Language Classroom* (Master's thesis, NTNU).

Waigera, J., Mweru, M., & Ngige, L. (2020). Relationship Between Teachers' Demographic Characteristics and Levels of Utilization of Instructional Materials in Pre-Primary Schools in Kenya. *East African Journal of Education Studies*, *2*(1), 67-77.

Walker, S., Bruyere, B., Zarestky, J., Yasin, A., Lenaiyasa, E., Lolemu, A., & Pickering, T. (2022). Education and Adaptive Capacity: The Influence of Formal Education On Climate Change Adaptation of Pastoral Women. *Climate and Development*, *14*(5), 409-418.

Walldén, R. (2022). Focusing On Content or Strategies? Enactment of Reading Strategies in Discussions About Science Texts. *Classroom Discourse*, 13(4), 407-424.

Wanchana, Y., Inprom, P., Rawang, W., & Ayudhya, A. (2020). Environmental Education Competency: Enhancing the Work of Teachers. *Journal of Teacher Education for Sustainability*, *22*(2), 140-152.

Wang, Y., Sommier, M., & Vasques, A. (2022). Sustainability education at higher education institutions: pedagogies and students' competences. *International Journal of Sustainability in Higher Education*, *23*(8), 174-193.

Wilmes, S., & Siry, C. (2020). Science Notebooks as Interactional Spaces in A Multilingual Classroom: Not Just Ideas On Paper. *Journal of Research in Science Teaching*, *57*(7), 999-1027.

Wu, M., Zhao, K., & Fils-Aime, F. (2022). Response Rates of Online Surveys in Published Research: A Meta-Analysis. *Computers in Human Behavior Reports*, 7, 100206.

Wulansari, D., Oktariani, A., & Pulungan, M. (2023). Contextual Learning Model in Elementary Schools in Improving Learning Outcomes. *Journal of Basic Education Research*, *4*(3), 104-111.

Yadav, S., Banerjee, A., Jhariya, M., Meena, R., Raj, A., Khan, N. & Sheoran, S. (2022). Environmental Education for Sustainable Development. In Natural Resources Conservation and Advances for Sustainability (pp. 415-431). Elsevier.

Yao, J. (2023). Exploring Experiential Learning: Enhancing Secondary School Chemistry Education Through Practical Engagement and Innovation. *Journal of Education, Humanities and Social Sciences*, *22*, 475-484.

Yeo, J., & Nielsen, W. (2020). Multimodal Science Teaching and Learning. *Learning: Research and Practice*, *6*(1), 1-4.

Yi, Z., Chen, Y., Yin, Y., Cheng, K., Wang, Y., Nguyen, D., & Kim, E. (2022). Brief Research Report: A Comparison of Robust Tests for Homogeneity of Variance in Factorial ANOVA. *The Journal of Experimental Education*, *90*(2), 505-520.

Zedeck, S. (1977). An Information Processing Model and Approach to The Study of Motivation. *Organizational Behavior and Human Performance*, *18*(1), 47-77.

Zenda, R., & Dlamini, R. (2023). Examining Factors That Influence Teachers to Adopt Information and Communication Technology in Rural Secondary Schools: An Empirical Study. *Education and Information Technologies*, *28*(1), 815-832.

Zhang, L., & Ma, Y. (2023). A Study of the Impact of Project-Based Learning on Student Learning Effects: A Meta-Analysis Study. *Frontiers in psychology*, *14*, 1202728.

APPENDICES

Appendix A: Introductory Letter

Dear Participant,

Subject: Invitation to Participate in a Research Survey on Multimodal Instructional Approaches and Grade Three Learners' Core Competences for Environmental Conservation in Tharaka Nithi County, Kenya

I hope this letter finds you well. My name is Joachim Njagi, and I am a Student at Chuka University pursuing a Doctor of Philosophy Degree in Early Childhood Development and Education (ECDE). I am writing to invite you to participate in an important research survey focused on the educational landscape of Tharaka Nithi County, Kenya.

The purpose of this survey is to investigate the effectiveness of multimodal instructional approaches in enhancing Grade Three learners' core competences for environmental conservation. I am particularly interested in understanding the impact of various teaching methods and strategies on learners' knowledge, attitudes and behaviors related to environmental conservation.

Your participation in this study is crucial as it will provide valuable insights into the educational practices and challenges faced by Grade Three teachers and learners in Tharaka Nithi County. By sharing your experiences and perspectives, you will contribute to the advancement of knowledge in the field of education and help inform future educational policies and practices.

Participation in this survey involves completing a questionnaire that will take approximately 20 minutes of your time. Your responses will be kept confidential and will only be used for research purposes. Your participation is voluntary and you have the right to withdraw from the study at any time without any repercussions.

To participate in the survey, please sign the consent provided. If you encounter any difficulties or have any questions about the survey, please feel free to contact me at 0724 374 453 or email at jnjagi@chuka.ac.ke.

Thank you for considering this invitation to participate in my research survey. Your input is greatly appreciated, and your contribution will make a meaningful difference in our understanding of educational practices and environmental conservation efforts in Tharaka Nithi County.

Sincerely,

Joachim Njagi

Appendix B: Informed Consent for Teachers

Title of the Study: Multimodal Instructional Approaches and Grade Three Learners' Core Competences for Environmental Conservation in Tharaka Nithi County, Kenya.

Principal Investigator: Mr. Joachim Njagi

Introduction: You are being invited to participate in a research study conducted by Joachim Njagi, a researcher from Chuka University. The purpose of this study is to investigate the effectiveness of multimodal instructional approaches in enhancing Grade Three learners' core competences for environmental conservation in Tharaka Nithi County, Kenya. Your participation in this study is voluntary.

Procedures: If you agree to participate, you will be asked to complete a survey questionnaire. The questionnaire will inquire about your experiences, practices, and perspectives related to teaching Grade Three learners and environmental conservation efforts in Tharaka Nithi County. Your responses will be anonymous and confidential.

Risks and Benefits: Participation in this study involves minimal risks. Some questions may prompt you to reflect on your teaching practices and experiences, which could evoke emotional responses. The potential benefits of participating in this study include contributing to the advancement of knowledge in the field of education and environmental conservation.

Confidentiality: Your responses will be kept confidential and will only be accessed by the researcher and authorized members of the research team. Data collected from this study will be stored securely and will only be used for research purposes.

Voluntary Participation and Withdrawal: Participation in this study is voluntary. You have the right to refuse to participate or withdraw from the study at any time without penalty. Your decision will not affect your current or future relationship with the researcher or any associated institutions.

Contact Information: If you have any questions or concerns about the study, please feel free to contact Mr. Joachim Njagi on 0724 374 453 or email at jnjagi@chuka.ac.ke. If you have any questions or concerns about your rights as a participant in this research study, you may contact Chuka University Research and Ethics Committee, P.O Box 109-60400, Chuka.

Consent: By signing below, you indicate that you have read and understood the information provided in this consent form, and you voluntarily agree to participate in the study.

Participant's

Signature: _____ Date: _____

Researcher's Signature: _____ Date: _____

Appendix C: Baseline Questionnaire for Teachers

QFT 1: Survey on the Status of MMIM Use

I am conducting a study to assess your opinion with regard to various aspects of teaching grade three environmental activity curriculum. The information you provide will be kept strictly anonymous and confidential and will be used solely for the purpose of the study. Would you like to participate in filling in this questionnaire?

Yes[ ] No [ ]

Section 1: General Information and Demographics

1. Please indicate the Sub County your school is located……..
2. How long have you taught length in the current school?
   1-5 yrs [ ] 6-10 yrs [ ] 11-15 yrs [ ] 16-20 yrs [ ] 21-25 yrs [ ] 26-30 yrs [ ] 31-35 yrs [ ]
3. Kindly indicate your gender
   Male [ ] Female [ ] Other [ ]
4. Do you mind telling me how old you are?
   18-29 yrs [ ] 30-39 yrs [ ] 40-49 yrs [ ] 50-59 yrs [ ] 60 and above yrs [ ]
5. What is your highest level of education?
   Primary [ ]Secondary[ ]College Diploma[ ]University Degree[ ]
   Post-graduate Degree [ ]
6. What is your experience in teaching using multimodality?
   Below 10 yrs [ ] 11-20 yrs [ ] 21-30 yrs [ ] Above 31yrs [ ]

Section 2: Multimodal Instructional Methods

On a scale of 1-5 where 1 is strongly disagree and 5 strongly agree, please indicate the extent to which you agree or disagree with the following statements related to each multimodal instructional methods using the Likert scale provided. Strongly Disagree (SD); Disagree (D); Neutral (N); Agree (A) and Strongly Agree (SA).

Description	Level of Agreement				
	SA	A	N	D	SD
You deliver environmental activity lessons using diagrams, graphs, photographs, posters, flashcards, TV shows, displays, Power Point Presentations, charts, demonstration, videos, use of highlighter among other visual aids in delivering					
You deliver environmental activity lessons using lecture, oral presentation, group discussions, oral recitations, musical performance, radio show, verbal games, storytelling, tape recordings and reading among other hearing aids in delivering environmental activity lessons.					
You deliver environmental activity lessons through engaging learners in reading and writing.					
You deliver environmental activity lessons by engaging learners in drawing activities, experimental work, playing games, cutting and pasting tasks, artistic work, project and field trips					
You teach environmental activities lessons interactive technology such as interactive whiteboards, educational software, online resources, and multimedia presentations					
You encouraging group work, discussions, peer teaching, and cooperative learning to enhance understanding during environmental activities lessons					
You engage learners in experiential learning during environmental activity lessons by providing opportunities for students to learn through direct experience, such as field trips, simulations, and role-playing					

Section 3: Extent of Multimodal Instruction Use

On a scale of 0-3 where 0 is never used and 3 is frequently used, please answer the questions related to the frequency in which you apply multimodal instructional methods in delivering environmental activities lessons. Use the Likert scale provided to provide your responses. 1. Frequently (F); 2 Occasionally (O); 3 Rarely (R); and Never (N).

Method	Question	Frequency of Use in the Learning Process			
		F	O	R	N
Visual	How frequently do you deliver environmental activity lessons using visual instructional materials?				
Auditory	How frequently do you deliver environmental activity lessons using auditory instructional materials?				
Read/Write	How frequently do you deliver environmental activity lessons by engaging learners in reading and writing activities?				
Kinesthetic	How frequently do you deliver environmental activity lessons by engaging learners in physical movement and manipulation of objects?				
Interactive technology	How frequently do you deliver environmental activity lessons using interactive smart boards, whiteboards, educational software, online resources, and multimedia presentations?				
Collaborative	How frequently do you deliver environmental activity lessons through group work, discussions, peer teaching, and cooperative learning to enhance understanding and teamwork?				
Experiential	How frequently do you provide opportunities for learners to learn through direct experience, such as field trips, simulations, and role-playing during environmental activity lessons?				

Thank you

Appendix D: Pedagogical Challenges Questionnaire for Teachers

QFT 2: Challenges of Implementing Multimodal Method

Please use the provided Likert scale to rate each pedagogical constraint based on your experience with multimodal instructional approaches in teaching grade three environmental activity lessons. The scale options are: Strongly Disagree (SD), Disagree (D), Neutral (N), Agree (A), and Strongly Agree (SA).

Constraint	Description	Level of Agreement				
		SA	A	N	D	SD
Resource limitation	The available resources are insufficient to effectively implement multimodal instruction					
Teacher training & development support	There is inadequate support and training provided to teachers for incorporating multimodal instruction techniques					
Time constraints	Time limitations prevent teachers from fully exploring and implementing multimodal instructional strategies					
Technological challenges	Insufficient access to technology or technical support complicates the integration of multimedia elements into teaching practices					
Teacher capacities, self-efficacy & experience	Teachers lack the necessary skills, confidence, or experience to effectively use multimodal instruction methods					
Dictates of the curriculum	The prescribed curriculum limits flexibility and autonomy in adopting innovative instructional approaches such as multimodal instruction					

Thank you

Appendix E: Observation Schedule of Teaching

	Observations on Frequency of Use			
Method	**Rating**: Frequently **Indicator:** Applied in all the 3 observed lessons **Scoring:** 3	**Rating:** Occasionally **Indicator:** Applied in 2 of the 3 observed lessons **Scoring:** 2	**Rating:** Rarely **Indicator:** Applied in only 1 of the observed lessons **Scoring:** 1	**Rating:** Never **Indicator:** Not used at all **Scoring:** 0
Visual				
Auditory				
Read/Write				
Kinesthetic				
Interactive Technology				
Collaborative				
Experiential				

Additional Notes (Document)

1. Good Practices: (programmatic practices, organizational practices, generalizable practices, context-specific practices)

……
……
……
……

2. Promising Practices (deliberately portrayed)

……
……
……
……

3. Emerging practices (spontaneously elicited)

……
……
……
……

Appendix F: Observation of Learners Core Competencies

Educational Activity and EC Core Competency	**Criteria**	**Levels of Performance** 1.Poor; 2. Fair; 3. Good; 4. Very Good; 5. Excellent				
		1	2	3	4	5
Communication & Collaboration environmental conservation learning activities	Clarity of expression					
	Active listening					
	Contribution to group discussions or projects					
	Provision of constructive feedback					
Critical Thinking & Problem Solving environmental conservation learning activities		**Levels of Performance** 1. Novice; 2. Developing 3. Proficient; 4. Advanced 5. Expert				
	Criteria	1	2	3	4	5
	Synthesis of information & ideas					
	Evaluation of solutions					
	Creativity in problem-solving					
Imagination & Creativity & environmental conservation learning activities		**Levels of Performance** 1. Limited; 2. Some 3. Moderate; 4. High 5. Exceptional				
	Criteria	1	2	3	4	5
	Originality of ideas					
	Ability to think outside the box					
	Willingness to explore unconventional solutions					

Appendix G: Pre and Post Test for Learners

Learner Code…… School…….

Gender……... Date……

Instructions

1. This quiz has **Two main sections**. Each section will be administered on separate days.

Answer all the questions by ticking the correct answer in the answer sheet provided.

2. Time allocated to answer the questions in each section is 40 minutes (One lesson).

3. In case you fail to understand the requirements for a particular question, ask your teacher to explain or clarify.

Section One: Has five multiple-choice questions for each category: knowledge, skills, attitudes, and behaviors related to environmental conservation.

Knowledge:

1. What should you do with items like plastic bottles and paper?
   a) Throw them in the trash
   b) Recycle them
   c) Leave them on the ground
   d) Do nothing

2. Which of the following is an example of conserving water?
   a) Leaving the tap running while brushing your teeth
   b) Taking long showers every day
   c) Using a watering can to water plants instead of a hose
   d) Filling up the bathtub to the top every time you bathe

3. What can we do to help protect animals and their habitats?
   a) Throw litter in rivers and lakes
   b) Use plastic bags instead of reusable bags
   c) Plant trees and flowers to create habitats
   d) Cut down trees in forests

4. What can we do to take care of plants and trees?
   a) Water them with soda instead of water
   b) Plant them in concrete instead of soil
   c) Pull off their leaves
   d) Water them regularly and give them sunlight

5. How can we reduce waste in our daily lives?
    a) Buy single-use plastic items
    b) Use reusable containers instead of disposable ones
    c) Throw away food that we don't finish
    d) Always choose products with excessive packaging

Skills:

1. What should you do if you see rubbish on the ground?
    a) Step on it
    b) Pick it up and put it in the trash
    c) Ignore it
    d) Kick it around

2. How can you help plants grow?
    a) Water them regularly
    b) Sing to them
    c) Give them sunlight
    d) All of the above

3. What can you do to minimize misuse of water while brushing your teeth?
    a) Let the tap run
    b) Use a small cup of water
    c) Leave the tap on all the time
    d) Brush your teeth in the shower

4. How can you help reduce air pollution?
    a) Ride a bicycle instead of asking for a ride in a car
    b) Throw trash out of the car window
    c) Use a lot of hairspray
    d) Play with fire

5. What should you do if you see a plant that looks dry?
    a) Pour a lot of water on it
    b) Leave it alone
    c) Give it a little bit of water
    d) Step on it

Attitudes:

1. Is it important to take care of animals and plants?
    a) Yes (b) No (c) Maybe (d) I don't know

2. Do you like seeing trash on the ground?
    a) Yes, it's fun to see
    b) No, it makes me sad
    c) I don't care
    d) I haven't thought about it

3. Should we turn off lights when we leave a room?
    a) Yes, to save energy
    b) No, lights are pretty
    c) I don't know
    d) It doesn't matter

4. Why is it important to pick up or collect litter from the ground?
    a) Because it's fun to collect trash
    b) To keep our environment clean and safe
    c) Because litter is valuable
    d) To make more space for animals to play

5. Is it important to listen to grown-ups when they talk about taking care of the environment?
    a) Yes (b) No (c) I don't know (d) Sometimes

Behaviors:

1. What should you do with a plastic bottle after you finish drinking from it?
    a) Throw it on the ground
    b) Put it in the recycling bin
    c) Keep it in your pocket
    d) Give it to a friend

2. What should you do if you see someone littering the school compound?
    a) Tell them it's okay
    b) Pick it up and put it in the waste bin
    c) Laugh at them
    d) Ignore them

3. How should you treat plants and trees?
    a) Step on them
    b) Water them regularly
    c) Pull off their leaves
    d) Ignore them

4. What should you do if you see someone cutting down trees?
    a) Cheer them on
    b) Ask them to stop
    c) Help them cut more trees
    d) Watch and do nothing

5. What can you do to help protect animals?
    a) Feed them unhealthy food
    b) Leave waste in their habitat
    c) Plant trees for them
    d) Scare them away

Section Two: Has 15 questions. Kindly answer all the questions by ticking against the answer you think is the correct one.

A. Communication and Collaboration

1. Which activity best promotes talking and teamwork among grade 3 children learning about environmental conservation?
   a) Each learner drawing of animals
   b) Group discussion about recycling
   c) Independent exploration of nature books
   d) Silent observation of plants in the garden

2. What is an example of collaborative communication during an environmental conservation lesson?
   a) Sharing ideas about planting trees with classmates
   b) Ignoring others' ideas and working alone
   c) Listening to the teacher without responding
   d) Playing independently during outdoor activities

3. During a project on reducing waste, which action shows effective communication and collaboration?
   a) Completing tasks without discussing with peers
   b) Working silently without interacting with peers
   c) Ignoring peers' suggestions and ideas
   d) Asking peers for help when facing challenges

4. How can grade 3 learners in your school effectively communicate their ideas about saving water?
   a) Through written essays
   b) Through group discussions and role-plays
   c) By watching videos alone
   d) By drawing pictures individually

5. In what situation are grade 3 learners most likely to collaborate to conserve the environment?
   a) When playing alone indoors
   b) While watching television
   c) During a group clean-up activity in the playground
   d) When sitting quietly during story-time

B. Critical Thinking and Problem Solving

1. Which activity requires argument skills with regard to environmental conservation?
   a) Following step-by-step instructions to color a picture
   b) Suggesting ideas to reduce plastic usage
   c) Memorizing names of animals without understanding
   d) Repeating facts about recycling without analysis

2. What is an example of thinking carefully when learning about environmental conservation?
   a) Accepting information without questioning its correctness
   b) Asking why it's important to recycle
   c) Copying others' actions without understanding
   d) Ignoring environmental problems around them

1. During an outdoor nature walk, what finding solutions activity can grade 3 children participate in to conserve the environment?
   a) Picking flowers for personal enjoyment
   b) Running through the bushes without care
   c) Ignoring damaged trees and bushes
   d) Cleaning up litter found along the trail

4. Which situation shows serious thinking about environmental conservation?
   a) Questioning the impact of littering on animals
   b) Accepting all suggestions without discussion
   c) Ignoring the teacher's guidance during a lesson
   d) Following instructions without understanding their purpose

5. How can grade 3 learners in your school apply careful thinking when learning about planting trees?
   a) Following instructions without questioning
   b) Asking questions about the benefits of trees
   c) Planting trees randomly without planning
   d) Refusing to participate in tree planting activities

C. Imagination and Creativity

1. Which activity encourages imagination and creativity with regard to environmental conservation?
   a) Memorizing facts about threatened species
   b) Designing a poster to promote recycling
   c) Watching a documentary on wildlife conservation
   d) Copying drawings of animals from a book

2. What is an example of imagination when learning about environmental conservation?
   a) Reciting facts about pollution without understanding
   b) Ignoring the importance of nature in everyday life
   c) Creating a story about saving endangered animals
   d) Following instructions without any personal contribution

3. During a lesson on reducing waste, what creative solution can grade 3 learners' in your school propose?
   a) Using single-use plastic utensils
   b) Creating art from recycled materials
   c) Ignoring the concept of recycling
   d) Disposing of waste in the wrong bins

6. Which situation shows imagination in environmental conservation?
   a) Following a set pattern for nature exploration
   b) Watching videos without engaging creatively
   c) Ignoring natural elements during outdoor play
   d) Creating a new game using recycled materials

7. How can grade 3 children express their imagination and creativity in a lesson on conserving water?
   a) Painting pictures of water conservation scenes
   b) Reciting water-saving tips without personal input
   c) Watching others conserve water without participation
   d) Following instructions without any creative input

Appendix H: Marking Scheme for Pre and Post Test Assessments

SECTION A

Knowledge

Number	1	2	3	4	5
Answer	B	C	C	D	A

Skills

Number	1	2	3	4	5
Answer	B	A	B	A	C

Attitudes

Number	1	2	3	4	5
Answer	A	B	A	B	A

Behaviours

Number	1	2	3	4	5
Answer	B	B	B	B	C

SECTION B

Communication and Collaboration

Number	1	2	3	4	5
Answer	B	A	D	B	C

Critical Thinking and Problem Solving

Number	1	2	3	4	5
Answer	B	B	D	A	B

Imagination and Creativity

Number	1	2	3	4	5
Answer	B	C	B	D	A

Appendix I: Interview Guide for Teachers

Date: ……

Teaching Methods

1. Can you describe the teaching methods and strategies you typically use when delivering environmental activities lessons to Grade Three learners?
2. How do you ensure that environmental concepts are effectively communicated to Grade Three learners during your lessons? Are there any specific instructional techniques or approaches you find particularly effective?

Utilization of Multimodal Instructional Methods

3. How frequently do you utilize a variety of instructional modalities, such as visual, auditory, kinesthetic, and tactile activities to accommodate diverse learning preferences and abilities of learners?

Pedagogical Challenges

4. What challenges did you encounter when implementing the multimodal instructional methods?

5. What strategies did you employ to overcome these limitations?

Appendix J: Checklist for Evaluating Effectiveness of the Model Guidelines

A checklist for teachers to evaluate the effectiveness of an instructional model

Parameters	Indicators	Yes	No
Clear Expectations	Instructional goals are clear, aligned with the requirements of the learning area and meets content standards		
	Instructional model clearly defines performance expectations for both teachers and learners		
	Lesson plans, instructional materials, media and assessments, aligned with learning needs		
Content Coverage	Instructional model adequately cover the required curriculum content		
	Lessons are presented in meaningful and relevant way		
Learner Engagement	Learners are engaged and actively involved in authentic learning		
	Learners attention is focused on the learning activities		
Materials	Instructional materials and learning activities complete, accurate and relevant		
Teacher Support	Model provided teachers with adequate support and resources		
Assessment	Model provided opportunities for ongoing assessment and feedback		
Learning Outcome	Learners acquired the desired knowledge, skills, attitudes, behaviours, and core-competencies		
Motivation	Learners are motivated to change behavior		
	Learners are able to transfer their learning into the desired contextual setting		
Differentiation	Model allowed for differentiated instruction to meet the needs of diverse learners		
Data Collection	Model allowed for the collection and analysis of data to inform instruction		

Appendix K: Table of Sample Size Determination

The table determines the needed Sample Size from given finite population N cases such that the sample proportion P will be within plus or minus 0.05 of the population P with 95 % level of confidence.

N	S	N	S	N	S
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	3O2
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	241	9000	368
140	103	700	248	10,000	370
150	108	750	254	15,000	375
160	113	800	260	20,000	377
170	118	850	265	30,000	379
180	123	900	269	40,000	380
190	127	950	274	50,000	381
200	132	1000	278	75,000	382
210	136	1100	285	100,000	384

N=Population Size; S= Sample Size

Adopted from Kathuri and Pals (1993)

Appendix L: Training Program for Teachers

Course Overview: This training program aims to equip educators with the knowledge and skills necessary to effectively implement multimodal instructional approaches in their teaching practice. Participants will explore various methods of incorporating multiple modes of communication to enhance student learning and engagement.

Course Objectives:

1. Understand the principles and theories behind multimodal instructional approaches.
2. Learn practical strategies for designing and delivering multimodal lessons.
3. Explore technology tools and resources to support multimodal teaching and learning.
4. Reflect on personal teaching practices and identify opportunities for integrating multimodal approaches.
5. Develop a plan for implementing multimodal instructional strategies in the classroom.

Three Days Training Course Structure:

Areas to Cover in DAY 1:

1. Introduction to Multimodal Instruction

- Overview of multimodal instructional approaches
- Theoretical foundations: cognitive load theory, multimedia learning theory
- Benefits and challenges of multimodal teaching

2. Designing Multimodal Lessons

- Understanding diverse learning styles and preferences
- Principles of Universal Design for Learning (UDL)
- Planning and organizing multimodal lesson components

3. Incorporating Visual Elements in Lessons

- Effective use of images, diagrams, and infographics
- Visual literacy skills for students
- Tools and resources for creating visual content

Areas to Cover in DAY 2:

4. Integrating Audio and Video

- Incorporating podcasts, audio recordings, and video clips
- Strategies for creating and curating multimedia content
- Copyright and fair use considerations

5. Engaging Kinesthetic and Tactile Learning

- Hands-on activities and experiments

- Movement-based learning strategies
- Utilizing manipulatives and tactile materials

6. Technology Tools for Multimodal Teaching

- Introduction to educational technology tools
- Interactive whiteboards, multimedia presentations, and digital storytelling platforms
- Assessment and feedback tools for multimodal assignments

Areas to Cover in DAY 3:

7. Case Studies and Best Practices

- Examining examples of successful multimodal instruction
- Peer review and feedback on multimodal lesson plans
- Strategies for overcoming common challenges

8. Implementation and Reflection

- Developing an action plan for integrating multimodal approaches into teaching practice
- Reflective practice: evaluating the effectiveness of multimodal instruction
- Next steps and ongoing support resources

9. Assessment

- Participation in discussions and activities
- Development of a multimodal lesson plan
- Reflection papers on the implementation of multimodal approaches

References:

- Mayer, R. E. (2014). The Cambridge Handbook of Multimedia Learning.
- Rose, D. H., & Meyer, A. (2002). Teaching Every Student in The Digital Age: Universal Design for Learning.
- Puentedura, R. R. (2006). Transformation, Technology, And Education. T.H.E. Journal, 33(6), 50-56.

This syllabus provides a structured framework for a teacher training program on multimodal instructional approaches, covering theory, practical strategies, technology integration, and reflection. Adjustments can be made based on the specific needs and context of the participants.

Appendix M: Institutional Introductory Letter

CHUKA UNIVERSITY

Knowledge is Wealth *(Sapientia divitia est)* Akili ni Mali

OFFICE OF THE DIRECTOR
BOARD OF POSTGRADUATE STUDIES

Telephones: 020-2310512/18
Direct Line: 020-268 7625
postgraduate@chuka.ac.ke
P. O. Box 109-60400, Chuka
Website: www.chuka.ac.ke

REF: ED19/58173/22 **16th August, 2024**

Director
National Commission for Science Technology and Innovation
Off Waiyaki Way, Upper Kabete
P O Box 30623, 00100
Nairobi.

Dear Sir / Madam,

JOACHIM NJAGI

The above-named person is a *bona fide* student of Chuka University pursuing PhD in Early Childhood Education and Development proposal titled**: Multimodal Instructional and Lower Primary School Learners' Environmental Conservation Core Competences in Tharaka Nithi County, Kenya.**

Mr. Njagi has defended at the Faculty level and is now expected to conduct research.
Any assistance accorded will be highly appreciated.

Yours sincerely,

16 AUG 2024

Prof. Moses Muraya, Ph.D.

DIRECTOR
BOARD OF POSTGRADUATE STUDIES

Appendix N: Chuka University Ethics Clearance

CHUKA UNIVERSITY

Knowledge is Wealth *(Sapientia divitia est)* Akili ni Mali

CHUKA UNIVERSITY INSTITUTIONAL ETHICS REVIEW COMMITTEE

Telephones: 020-2310512/18
Direct Line: 0772894438
Email: info@chuka.ac.ke,
P. O. Box 109-60400, Chuka
Website: www.chuka.ac.ke

13th August, 2024

REF: CUIERC/ NACOSTI/605
TO: **Joachim Njagi**

RE: Multimodal Instructional Method and Lower Primary School Learners' Environmental Conservation Core Competences in Tharaka Nithi County, Kenya

This is to inform you that *Chuka University IERC* has reviewed and approved your above research proposal. Your application approval number is *NACOSTI/NBC/AC-0812*. The approval period is 13th August, 2024 – 13th August, 2025.

This approval is subject to compliance with the following requirements;

i. Only approved documents including (informed consents, study instruments, MTA) will be used
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by *Chuka University IERC*.
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to *Chuka University IERC* within 72 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to *Chuka University IERC* within 72 hours
v. Clearance for export of biological specimens must be obtained from relevant institutions.
vi. 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.
vii. Submission of an executive summary report within 90 days upon completion of the study to *Chuka University IERC*.

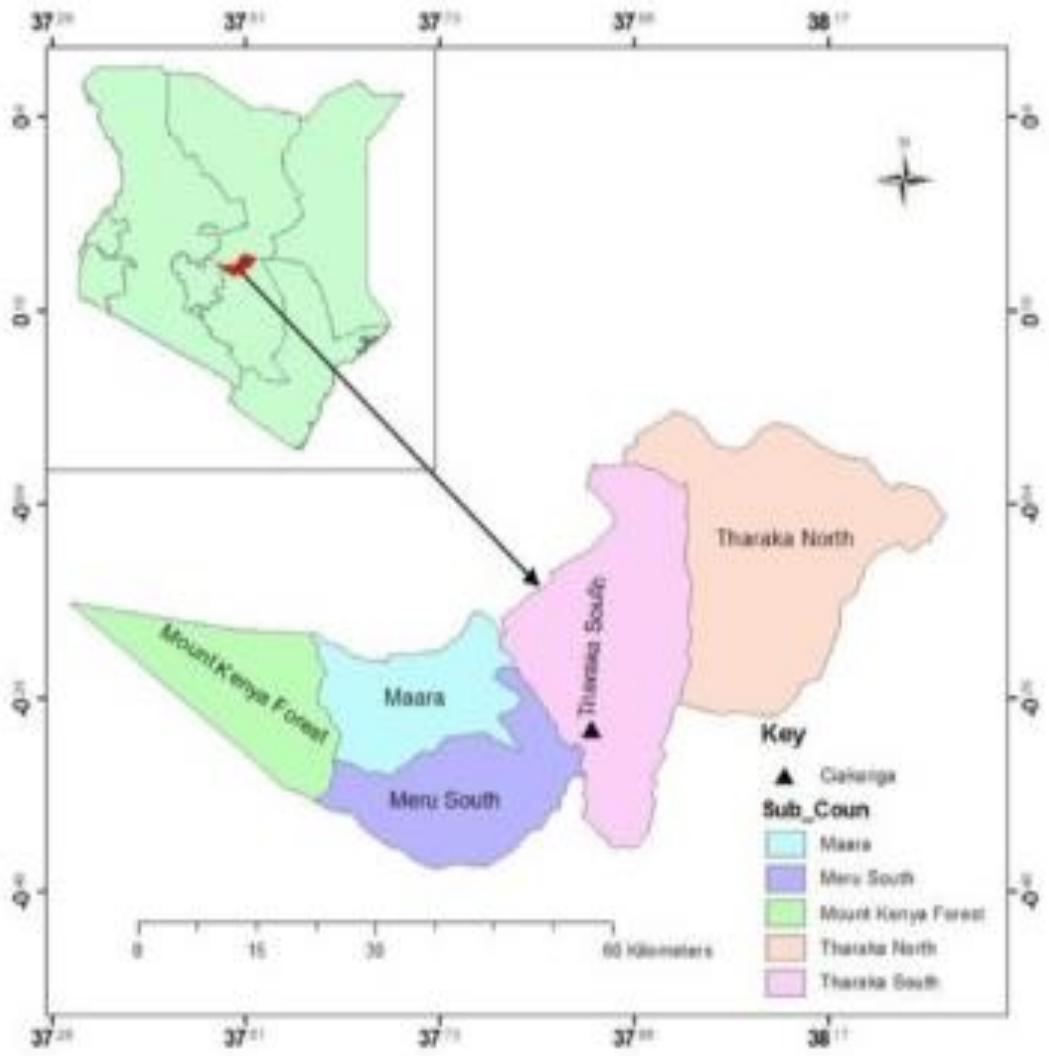
Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://oris.nacosti.go.ke and also obtain other clearances needed.

Yours sincerely

Dr. Benjamin Kanga
SECRETARY

INSTITUTIONAL ETHICS REVIEW COMMITTEE
16 AUG 2024
P.O. Box 109-60400, CHUKA
CHUKA UNIVERSITY

Appendix O: Map of Kenya Showing the Geographic Location of Tharaka Nithi County



Source: Tharaka-Nithi County Integrated Development Plan, 2018

Appendix P: Research License

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **967049**

Date of Issue: **21/August/2024**

RESEARCH LICENSE

This is to Certify that Mr.. JOACHIM NJAGI KIREA of Chuka University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Tharaka-Nithi on the topic: MULTIMODAL INSTRUCTIONAL METHOD AND LOWER PRIMARY SCHOOL LEARNERS' ENVIRONMENTAL CONSERVATION CORE COMPETENCES IN THARAKA NITHI COUNTY, KENYA for the period ending : 21/August/2025.

License No: **NACOSTI/P/24/39315**

967049

Applicant Identification Number

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