MASTER'S THESIS

INTEGRATION OF DIGITAL TECHNOLOGIES IN CBE IMPLEMENTATION IN PUBLIC PRIMARY SCHOOLS: AN ASSESSMENT OF SCHOOL PREPAREDNESS IN KAJIADO NORTH

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SCHOOL OF EDUCATION

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OPEN UNIVERSITY OF KENYA

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DECLARATION

This thesis is my original work and has not been submitted to any university for award of a degree.

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DEDICATION

I would like to dedicate this piece of research to my husband and our daughters for the support and encouragement they accorded me during the period of my study. You were always a consistent and reliable source of inspiration and for this I will ever cherish you.

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ABBREVIATIONS AND ACRONYMS

AI:	Artificial Intelligence
CBC:	Competence Based Curriculum
CBE:	Competence Based Education
CLT:	Constructivist Learning Theory
DLP:	Digital Literacy Programme
DOI:	Diffusion of Innovations
FPE:	Free Primary Education
ICT:	Information Communication Technology
KICD:	Kenya Institute of Curriculum development
KNBS:	Kenya National Bureau of Statistics
LMS:	Learning Management Systems
MoE:	Ministry of Education
NGOs:	Non-Governmental Organizations
OECD:	Organization for Economic Cooperation and Development
TAM:	Technology Acceptance Model
TSC:	Teachers Service Commission
UNESCO:	United Nations Education and Scientific Organization
VAR:	Virtual Augmented Reality

ABSTRACT

The purpose of this study was to establish school preparedness for digital integration in competency based education implementation in Kajiado North public primary schools. The study sought to achieve three objectives: to establish the digital technologies adopted, to ascertain the level of training among teachers and to establish the challenges faced by schools in digital integration. The study adopted a descriptive survey design. The population of the study was 78 public primary schools in Kajiado North. The sample was 50 public primary schools selected through stratified random sampling. Primary data was collected from ICT officers, Headteachers and teachers using questionnaires. Data was analyzed through descriptive statistics. Results were presented in tables and graphs. The study established that digital technology integration in the implementation of the Competency-Based Education (CBE) curriculum in public primary schools in Kajiado North Sub-County remains constrained despite notable progress in selected areas. One other important finding observed from the study was the reality that a significant number of schools were struggling with inadequate ICT infrastructure and this seriously inhibits their efforts to embrace digital learning. The truth based on facts from the study is that the two digital learning tools that have been widely adopted among the public primary schools in Kajiado North Subcounty include educational videos and interactive multimedia raising a pertinent question on the adoption many other tools such as AI, cloud computing, e-assessment platforms among others. In addition to the above stated findings, it was also revealed that most of the teachers benefited from the initial foundational training equipping them with digital competencies but opportunities for further improvement of their digital skills were rare or unavailable.

CHAPTER ONE

INTRODUCTION

1.1 Background to the research

Modern reforms are largely characterized by the integration of digital technologies into the competence-based education (CBE) curriculum. The leading argument for this practice is the desire and need to prepare learners adequately for them to fit into modern economy which heavily relies on digital technologies. The implication of these developments is that access to hardware and connectivity are not adequate in terms of school preparedness for digital integration and thus many other factors such as alignment of the curriculum, digital competencies of the teachers among others must be considered. Organizations that have conducted research on digital technologies in education such as OECD (2021) guide that a school can be considered digitally prepared when it has intentionally entrenched digital technologies into instructional practices in order to improve collaboration, creativity and problem solving. The guidance by OECD was supported by UNESCO (2022) who also accentuated that for digital integration to be effectively integrated into a CBE framework; a lot of preparedness is required. This was also confirmed by a recent study by König, Jäger-Biela & Glutsch, 2023) which emphasized on having in place strong digital governance structures and continuous capacity building in order to succeed in digital integration.

A careful review of the existing knowledge reveals that there are a significant number of African countries that have embraced CBE curriculum but its implementation has been derailed by lack of readiness of the learning institutions and minimal instructional and digital capabilities among the teachers (World Bank, 2022). Evidence from East and South Africa reveals that schools that have deliberately trained their teachers on digital matters and where there is adequate leadership

support have recorded high levels of preparedness for CBE implementation (Tondeur *et al*., 2021). Furthermore, African Union (2023) reports emphasize that there are regional specific initiatives such as the Continental Education Strategy for Africa that give priority to digital revolution although serious inequalities exist between urban and rural schools.

A few years ago, Kenya switched from the 8-4-4 system of education and adopted CBE based education and key among the disturbing concerns related to preparedness of the schools to integrate digital technologies into CBE curriculum. There have been efforts by the government to invest in digital infrastructure and policy frameworks, but reality concerning preparedness among various schools speaks volumes and huge disparities exist among various counties. This is something worth investigating among the public primary schools in Kajiado North Sub-county. The institution tasked with curriculum development in Kenya KICD (2021) asserts that the key factors that can lead to successful CBE implementation include, adequate digital learning technologies, digitally trained teachers and support from leadership. The most important objective of this study is whether Kajiado North public primary schools meet the above requirements bearing in mind that there is evidence from Mugo, Njagi & Chemwei (2022) indicating that most schools in Kenya face the challenges mentioned herein.

1.1.1 Competence Based Education

Myriad definitions exist with regard to CBE education. As far as the World Bank (2023) is concerned, CBE is a type of educational curriculum which puts more emphasis on clear definition of competencies, attitudes, skills and values learners must demonstrate. A definition that is closely related to the World Bank one is by Pane *et al.,* (2022) who equally view CBE as an instructional approach where learners must be able to illustrate mastery of a particular skill or

competence before proceeding to another level of learning. Counted among high profile definitions of CBE is UNESCO (2022) which also considers CBE as an education system that appreciates the role of social, cognitive and emotional aspects in learning. Modern CBE is more than just vocational training and encompasses greater evolution fueled by competency frameworks (Mulder, 2021).

In the wisdom of UNESCO (2023) CBE and digital technologies are inseparable since the utilization of these technologies strongly supports its important structures such as continuous evaluation, outcome-based learning, self-engineered learner progression, and demonstration of mastery. This makes Learning Management Systems and digital platforms the central pillars supporting CBE education. Tools that enhance online assessment and learning analytics enable continuous monitoring of progress, and e-portfolios and digital badges provide evidence of skill mastery. Additionally, mobile learning, simulations, and virtual or augmented reality facilitate flexible, real-world skill application, making CBE more effective and accessible (UNESCO, 2023). Furthermore, institutional readiness and teacher professional development are critical enablers of effective CBE delivery, particularly in digitally supported environments. Recent research also highlights the importance of policy alignment and stakeholder engagement in sustaining CBE reforms across different education systems (UNESCO, 2023).

Kenya has made a number of milestones in implementation of CBE. Owalla (2021) asserts that Kenya has made significant achievements in implementing CBE in several perspectives. Among the achievements include the first pilot class under CBE curriculum in 2017, training of personnel involved in CBE implementation based on multi sectoral approach, development and dissemination of CBE related documents such as schemes and lesson plans. Despite the

significant progress made in implementation of CBE, several challenges are yet to be overcome and these include lack of adequate learning materials such as textbooks due to delays in publishing, lack of parental support, understaffing in public schools, large class numbers, poor information communication skills among teachers and increased workload for teachers (Owalla, 2021).

1.1.2 Integration of Digital Technologies

Digital integration in competence-based education (CBE) refers to the deliberate embedding of digital technologies into curriculum design, instructional practices, assessment systems, and learning analytics to support the development and demonstration of learner competencies. CBE ensures that digital tools are aligned with clearly defined competencies so that technology enhances mastery-based progression rather than merely digitizing traditional instruction. Redecker (2021) also supports the above position by explaining that in order to effectively integrate digital technologies into CBE, there must be careful alignment with pedagogy and only make use of technologies which support active learning. He further proceeds to list possible technologies such as tracking platforms, e-portfolios, simulation software, and collaborative cloud-based tools. Further in support of the digital technologies, Bond *et al*. (2021) asserts that authentic learning is enhanced by them through collaboration and real-world problem-solving. These technologies continue to gain prominence due to their ability to personalize learning and give consistent feedback (Scherer *et al.,* 2023).

There are a number of digital tools currently in use among public schools in Kenya and these include devices distributed under the Digital Literacy Programme (DLP), such as tablets and laptops, as well as digital content platforms, Learning Management Systems, and broadcast

media like radio and television for instruction (Ministry of Education, Kenya, 2023). However, the integration of these technologies is constrained by challenges such as inadequate infrastructure, unreliable electricity and internet connectivity, limited teacher capacity in digital skills, and high costs of maintenance and support (Karsenti & Collin, 2022). Even with the barriers mentioned above, it still emerges that digital technologies have a positive influence on learning outcomes by improving learner engagement, enabling personalized and competency-based instruction, and expanding access to diverse learning resources. However, their effectiveness may depend on implementation quality (Tamim et al., 2022).

1.1.3 Public Primary Schools in Kajiado North

The term Public primary schools refer to schools established by the government in Kajiado North Sub-County. These schools provide free and compulsory education in accordance with the Basic Education Act of 2013. Ownership of the schools is purely by the Government of Kenya, administration is by Boards of Management, and the supervisory role is done by the Ministry of Education through the Teachers Service Commission (TSC). These schools are funded from the consolidated fund through capitation grants which are used to support acquisition of learning materials, day to day operations and simple infrastructure. (Ministry of Education, 2022). As Ngware *et al*. (2021) observes, public primary schools are the main pillar of basic education in Kenya. This is mainly true for marginalized and semi-arid regions such as Kajiado, since it ensures equity and access to education.

According to the Kajiado County Government (2024), adoption of digital infrastructure in Kajiado North Sub-county public schools is still wanting since approximately 60% of peri-urban schools found in areas such as Ngong and Ongata Rongai have access to electricity and some

form of internet connectivity, compared to less than 40% of rural schools, many of which still rely on unstable internet and power connection. The availability of digital devices also varies, with peri-urban schools more likely to have functional tablets from the Digital Literacy Programme (DLP), while rural schools still grapple with hurdles such as shortage and maintenance of digital devices. The above disparities serve as the primary reason for lack of equity in CBE implementation with regard to digital learning aspects. To address this, local initiatives such as county-led ICT support programs, partnerships with NGOs to provide solar power solutions, and teacher capacity-building workshops have been introduced to enhance digital integration and improve learning outcomes across the sub-county (Ministry of Education, Kenya, 2024; Kajiado County Government, 2024).

1.2 Research Problem

School preparedness refers to the extent and capability of a school to affectively adopt and utilize digital technologies in order to support implementation of CBE education (UNESCO, 2023). This preparedness may be exhibited in the form of availability of digital infrastructure, adequate and appropriate teacher training and top management support (Tondeur *et al.*, 2017; Ertmer & Ottenbreit-Leftwich, 2019). In CBE contexts, where learner-centered approaches, formative assessment, and personalized learning are central, inadequate preparedness undermines the very principles the curriculum seeks to advance, leading to superficial technology use that fails to enhance competencies, creativity, and problem-solving skills (Petko *et al.*, 2021).

Iintegration of digital technologies in CBE implementation in Kenya is constrained by inadequate ICT infrastructure, limited internet connectivity, insufficient teacher digital skills, unreliable electricity supply and high technology costs, especially in rural based schools. A survey by Kenya National Bureau of Statistics (2024) showed that only 38% of public primary

schools had reliable internet connectivity, while the Teachers Service Commission (2023) reported that over 45% of teachers required further training in digital pedagogy and technology integration.

Studies conducted have confirmed existence of these challenges. A study that was conducted by Mwangi and Kinyua (2021) established that many Kenyan public primary schools possessed ICT equipment but lacked the instructive capacity to assimilate it meaningfully into the classroom environment. Another similar study by Ngigi *et al*. (2022) established that teacher preparedness and school leadership support were significant in influencing the use of digital technology for CBE learning environments but there are still serious gaps relating to infrastructure. Comparison from the Sub-Saharan African environment, Kafyulilo, Fisser, and Voogt (2021) established that inadequate institutional readiness. What we observe from the above studies is that digital integration challenges are not merely technical but deeply institutional and instructional. Even with the studies mentioned herein, there still exists limited empirical evidence focusing on Kajiado North Sub-county. The purpose of this research is to fill this gap by providing context-specific evidence on school preparedness for digital integration in CBE, thereby informing policy, targeted capacity-building, and equitable digital transformation in public primary schools.

1.3 Research Objectives

1.3.1 General Objective

The overall objective is to assess school preparedness for integration of digital technologies in CBE implementation among public primary schools in Kajiado North Sub-County.

1.3.2 Specific Objectives

The study seeks to achieve the following specific objectives:

i. To evaluate the extent to which digital technology has been integrated in CBE implementation.
ii. To examine the level of teacher preparedness with regard to integrating digital technologies in CBE implementation among Kajiado North public primary schools.
iii. To determine how school leadership influences integration of digital technology in CBE implementation.
iv. To identify challenges affecting school preparedness for digital technology integration in CBE implementation.

1.4 Research Questions

The study seeks to answer the following research questions:

i. What is the extent of digital technology integration in teaching and learning for CBE implementation?
ii. What is the level of preparedness among teachers in integrating digital technologies for CBE implementation?
iii. What influence does school leadership have on digital technology integration for CBE implementation?
iv. What challenges affect school preparedness for digital technology integration in CBE implementation?

1.5 Significance of the study

This study is important to knowledge creation because it provides empirical insights into the level of preparedness of public primary schools in Kajiado North Sub-County for digital integration in Competency-Based Education (CBE). Through documenting the availability of digital infrastructure, teacher capability, policy support, and challenges faced by schools, the research expands the understanding of how digital technologies are being adopted in CBE implementation. In addition, the findings from this study will be crucial in informing future studies on digital education integration specifically in situations where resources are a major constraint.

In terms of theory, this study will be a crucial contribution to development and subsequent refining of the theories associated with education and technology integration. Since the main focus is on school preparedness in a peri-urban environment, it makes it possible to for the study to test suitability of existing theories such as Technology Acceptance Model and Diffusion of Innovations Theory. Discernments from this research may assist in proposing important adjustments or additions to the present theories.

With regard to practice, this study provides very important recommendations which shall influence action at both the national and county governments during formulation of policies dealing with integration of digital technologies into the CBE curriculum. Administrators of schools shall also benefit from the research in as far as development of their strategic plans for improvement of digital readiness is concerned. Results may as well inform resource allocation decisions made by the Ministry of authorities.

1.6 Scope of the study

This study focuses on assessing the preparedness of public primary schools for digital integration in Competency-Based Education (CBE) in Kajiado North Sub-county, Kenya. The content scope includes the availability and use of digital technologies, teacher competence and digital literacy, infrastructural readiness, policy support, and challenges affecting the integration of technology in teaching and learning. Geographically, the study is limited to all the public primary schools in Kajiado North Sub-county. In terms of time, the study examines the current status of digital integration and school preparedness within the academic year 2026.

1.7 Limitations of the study

One limitation of this study is its geographic focus on Kajiado North Subcounty, which may limit the generalizability of the findings to other counties or regions in Kenya. Although the study provides insightful information regarding semi-urban schools in this subcounty, the different infrastructure, resources, and policies in other environments can bring about different results. Therefore, much caution must be used when applying the results of these findings in other settings.

Another limitation of this study is the fact that it relies on data collected from teachers, headteachers, and ICT coordinators, whose opinions and guesses can greatly influence the outcome of the research. To minimize this effect, the researcher compared the data collected from the respondents with the existing records. It is also quite possible that some respondents exaggerated the extent to which they were prepared or that of the level of digital integration in their respective schools, which could affect the accuracy of this study. Although the researcher considered using observation and document analysis as methods of collecting data, it would have been too expensive since it would have required much time and effort.

Another limitation encountered by the researcher while carrying out the study was the dynamic nature of both technology and education. Technology and policies regarding education are changing at an extremely rapid rate; therefore, some results of this research might become

irrelevant after a certain period. This study focuses on the infrastructural, teachers' preparedness, and policy aspects of CBE readiness. Although this study tries to capture the readiness status at the time of data collection for the year 2025, future changes in the aforementioned aspects of CBE might affect digital integration in these schools. There is also the possibility that some schools may choose not to respond. To address this, the researcher will guarantee the respondents that their answers will remain confidential.

1.8 Theoretical Framework

1.8.1 Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) was initially developed by Fred Davis in 1989. According to Davis (1989) and Venkatesh & Davis (2000), TAM views perceived usefulness and perceived ease of use as critical constructs required to predict acceptance and usage intention of technology by individuals. TAM is based on the premise that users' positive attitudes towards technology, beliefs, and intentions influence their likelihood of adopting and integrating it into their practice, including professional activities such as teaching and learning (Davis, 1989; Venkatesh & Davis, 2000). Various researchers have both theorized and tested TAM's constructs to establish the influence of teachers' perceptions of the usefulness and ease of use of information communication technologies (ICT) on their intentions to use it to support instruction (Teo, 2011; Marangunić & Granić, 2015). These studies demonstrate that TAM's constructs can be used to explain organizational and individual readiness to utilize digital technologies, including in the context of school preparedness for CBE.

The Technology Acceptance Model (TAM) is relevant to this study as it provides an understanding of how teachers' attitudes, beliefs, and intentions can influence schools'

preparedness for CBE implementation (Teo, 2011; Marangunić & Granić, 2015). As discussed by Teo (2011) and Marangunić & Granić (2015), TAM can be applied to explore the criticality of teachers' beliefs about the use of technology in schools, including their level of self-efficacy and readiness for its effective utilization in instructional practice. In addition, since CBE emphasizes the importance of using technology in teaching to support learner-centered education, TAM can be applied to determine how readiness of schools for its implementation can be improved (Teo, 2011; Marangunić & Granić, 2015).

1.8.2 Diffusion of Innovations Theory (DOI)

DOI was pioneered by Everett Rogers in 1962 to explain how new ideas, concepts, and technologies spread amongst members of a society (Valente, 1995; Rogers, 2003). According to Rogers (2003) and Valente (1995), adoption of an innovation is determined by its relative advantage, compatibility, complexity, trialability, and observability. DOI also recognizes innovators, early adopters, early majority, late majority, and laggards as segments of the population that can have varying speeds of technology adoption and influence the process (Rogers, 2003; Valente, 1995). Moreover, DOI highlights the importance of organizational and social factors in the rate at which an innovation can be adopted and diffused amongst members of a society.

Various researchers have demonstrated the applicability of DOI in understanding how schools and teachers can adopt and utilize digital technologies for instructional purposes (Zhao & Frank, 2003; Ifenthaler & Schweinbenz, 2013). For instance, Zhao & Frank (2003) and Ifenthaler & Schweinbenz (2013) demonstrate that technology diffusion in education occurs at different rates amongst teachers, with some being more likely to adopt and utilize it for instruction than others.

These differences can be attributed to the influence of peers, colleagues, and the availability of support structures to facilitate technology adoption and utilization for instructional purposes (Zhao & Frank, 2003; Ifenthaler & Schweinbenz, 2013). Overall, this theory can be used to determine how digital technologies can be diffused in schools to improve the CBE adoption process.

The DOI is applicable in this study as it can be used to determine how different schools and teachers can adopt and diffuse digital technologies for instructional purposes (Zhao & Frank, 2003; Ifenthaler & Schweinbenz, 2013). As discussed by Rogers (2003) and Zhao & Frank (2003), the DOI can be used to identify how the process of innovation can be promoted amongst teachers, school administrators, and other stakeholders to accelerate the rate at which it will be adopted and utilized to support learners' competency development in the context of CBE implementation.

1.8.3 Constructivist Learning Theory (CLT)

This theory is based on the ideas of Jean Piaget, who emphasized the importance of constructing knowledge and interacting with the environment to gain understanding and develop cognitive competencies (Piaget, 1972). Constructivism views learning as an active process whereby learners interact with the environment, including various instructional materials, to facilitate cognitive development and gain knowledge (Piaget, 1972; Vygotsky, 1978). Various researchers have demonstrated the applicability and effectiveness of CLT and its relevance in the context of digital technology adoption and utilization to support instruction (Jonassen, 1999; Hmelo-Silver et al., 2007). For instance, Jonassen (1999) and Hmelo-Silver et al. (2007) discuss how the use of technology can support constructivist-based teaching and learning, which emphasizes the

importance of constructing knowledge through discovery, social learning, and other related processes. Overall, the CLT is relevant to this study as it can be applied to assess how the use of technology can be leveraged to support competency-based education.

Constructivist theory is critical in this study as it recognizes the importance of constructing knowledge and leveraging technology to support constructivist-based instruction, which is the basis of CBE (Piaget, 1972; Jonassen, 1999). As discussed by Piaget (1972) and Jonassen (1999), CLT can be used to determine how knowledge can be constructed using digital technologies to support CBE implementation in schools.

1.9 Conceptual Framework

A conceptual framework is a diagram that illustrates how studies variables relate to each other. In this study, there are two sets of variables. The first set are the independent variables which constitute extent of digital technologies integration, teachers' preparedness and leadership support. The second category is the dependent variable which is CBE implementation. The assumption made in this framework is that adoption of appropriate digital technologies and adequate training lead to successful implementation of CBE.

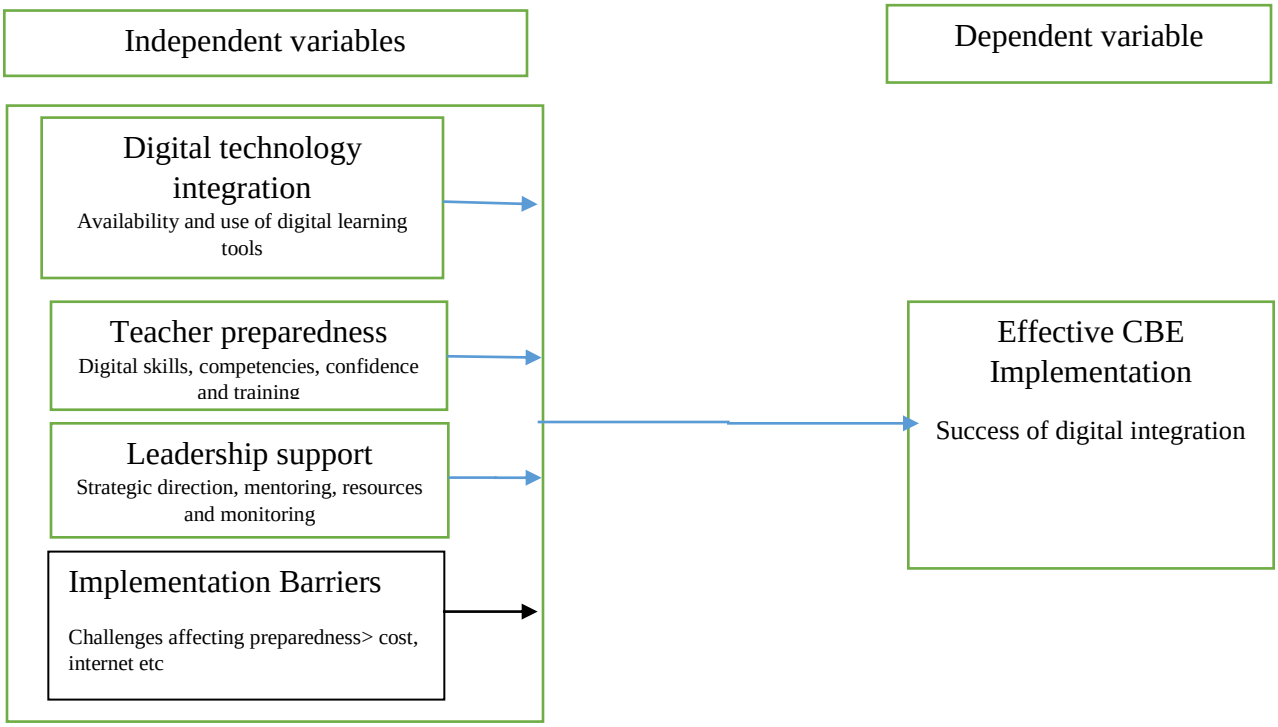

Figure 1. 1 **Conceptual Framework**

From the above conceptual framework, it is assumed that digital technology integration, teachers' preparedness, and leadership support influences the implementation of Competency-Based Education (CBE) in public primary schools**.** In particular, it is subsumed that when appropriate digital technologies are deployed with adequate teacher preparation and having a supportive school leadership, there will be effective CBE implementation.

1.10. Operational Definition of Terms

The following terms are used in the context of this study and have the assigned meanings as follows:

Digital Technology Integration: Refers to the extent to which teachers and schools incorporate digital technologies into teaching, learning, assessment, communication, and other activities that support the implementation of Competency-Based Education (CBE).

Teachers' Preparedness: Refers to the extent to which teachers possess the knowledge, skills, competencies, confidence, and training required to effectively implement CBE using appropriate teaching approaches and digital technologies.

Leadership Support: Refers to the extent to which school leaders provide the administrative, technical, financial, and professional support necessary for teachers to effectively implement CBE and integrate digital technologies into teaching and learning.

CBE Implementation: Refers to the extent to which the principles and practices of Competency-Based Education are put into practice in teaching, learning, assessment, and learner development.

Public Primary School: Refers to a primary school that is established, funded, managed, and regulated by the government through the relevant education authorities and provides basic education to learners at the primary school level.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents a comprehensive review of literature related to the preparedness of public primary schools for digital integration in Competency-Based Education (CBE). Key among the items of focus in this chapter are the extent of digital technology integration in teaching and learning for CBE implementation, Teachers' preparedness for integrating digital technologies in CBE implementation, leadership support and challenges affecting school preparedness for digital technology integration in CBE implementation.

2.2 Digital Technology Integration in Teaching and Learning for CBE Implementation

There are several technologies that have been integrated in teaching and learning for CBE implementation. Ally (2021) emphasizes that Learning Management Systems (LMS) facilitate curriculum delivery, learner tracking, and assessment, while Ifenthaler and Yau (2021) argue that LMS platforms allow teachers to design flexible learning paths that match students' competencies. Digital Learning Management Systems (LMS) enable personalized learning and support the development of competency-based education (CBE) by providing various tools to facilitate instruction and enhance learning.

The LMS tools can be utilized to provide learners with immediate feedback after completing specific tasks, such as assignments, to support their learning and competence development (Kafyulilo et al., 2021). In addition, the communication tools can also be used to facilitate collaboration and interaction between the learners and educators, thereby supporting learning in line with the principles of CBE. Finally, it is possible to integrate the various tools, including the

one that provides feedback on learners' performance, in the LMS to monitor and report on the development of competency. Therefore, the LMS can support the effective implementation of CBE in schools.

One of the important digital technologies is E-assessment which enables teachers to monitor, track, and report on the level of competency attained by the learners. This technology facilitates the provision of instant feedback to the learners about their performance, which can motivate them to improve (Kafyulilo et al., 2021). In addition, it can also be used to reduce the amount of time spent grading the assignments (Kumi-Yeboah et al., 2021). Therefore, e-assessment can be utilized to help teachers provide feedback and monitor the progress of the learners and make the necessary adjustments. Moreover, this tool can be used to ensure the objective and accurate measurement of the level of competence attained by the learners. The use of this technology can support effective implementation of the CBE in schools.

Another equally important technology is simulation and virtual laboratories which can be utilized to support the development of competency-based education by providing learners with practical experiences that can enable them to acquire knowledge. According to Lee, Wong & Looi (2021) and Bozkurt et al. (2021), these tools can be used to enhance critical thinking and skill development, including decision-making, amongst the learners. In addition, it can also be used to support practical learning and complement theoretical skills gained in the class. Therefore, the use of this technology is essential as it provides learners with the opportunity to develop skills, which, in turn, supports their competency development. This tool can be used to provide assessment, feedback, and instruction, which can be useful in implementing the CBE.

Adaptive learning technologies can be used to improve the level of competencies attained by learners by allowing them to master knowledge at their own pace. These technologies can be

utilized to help learners develop various cognitive competencies, including problem-solving, decision-making, and learning how to acquire and apply new skills (Chen et al., 2021). Moreover, these technologies can provide learners with feedback and focus on areas where they are weak to help them become competent in all aspects and acquire the necessary skills. Therefore, adaptive learning can support the effective implementation of the CBE by enabling the learners to attain a higher level of competencies.

Mobile learning tools can be used to ensure that learners acquire the appropriate knowledge and competencies to become better learners by providing them with access to learning resources anytime and anywhere. This can facilitate self-paced learning among the learners, who can choose how to interact with the learning resources to ensure they attain their learning objectives (Ally, 2021). In addition, mobile technologies can be utilized to allow the educators to provide feedback to the learners about their progress during the self-paced learning. Therefore, this tool can be integrated into the process of implementing the CBE to ensure effective learning takes place. It can also be utilized to provide a competitive advantage, especially to learners in remote areas, who can gain access to resources to support their learning and competence.

It is also argued that collaborative digital tools can be used to support the development of competency-based education by facilitating collaboration between learners and educators. These tools enable learners to interact, communicate, and collaborate to gain new perspectives and viewpoints on a topic or a skill (Ifenthaler & Yau, 2021). In addition, they can be used to allow the learners to provide feedback to each other on their strengths and areas that require improvement. Therefore, these tools can support the process of competency development by allowing the learners to collaborate and learn from each other. They can also be used to support effective communication between the educators and the learners to allow the former to monitor

the progress of the latter and provide the necessary support. Thus, the use of collaborative digital tools is essential in the process of developing CBE.

Educational video content can be used to support competency-based education by providing learners with materials that can be utilized to gain new knowledge and develop new skills. This technology can be used to enable the learners to master a topic and can be used to promote the competency-based education framework. Moreover, it can be used to provide feedback to the learners on their performance to ensure they develop competencies, including decision-making (Bozkurt et al., 2021). Additionally, it can be used in conjunction with the other digital tools to facilitate the implementation of CBE. Thus, this tool can be integrated into the process of implementing the CBE.

Another critical digital tool is gamification which can be utilized to support the development of competency-based education by motivating and encouraging the learners to participate in the learning process through reward systems. According to Lee *et al*. (2021) and Holmes *et al*. (2021), the use of gamification in education can be helpful in promoting mastery learning by allowing the learners to repeat an activity for a long time until they understand it. In addition, this technology can be used to ensure that learners develop competencies, including social skills, through team-based activities. Therefore, gamification can be integrated into the process of implementing the CBE to ensure that the learners are motivated and acquire the necessary skills.

Artificial Intelligence (AI) can be utilized to support the development of competency-based education by providing each learner with an opportunity to gain knowledge at his or her own pace. This technology can be used to ensure that learners develop competencies, including problem-solving, decision-making, and learning how to acquire and apply new skills (Kumi-

Yeboah et al., 2021). In addition, it can be used to provide learners with feedback on their weaknesses and areas that require improvement to ensure that they become competent in all aspects of a topic. Thus, AI can be integrated into the CBE process to help the learners gain and apply new skills to become competent in all aspects of the topic.

Ally (2021) assert that cloud computing can be used to ensure that the process of implementing the competency-based education takes place effectively by providing storage space for learning materials and supporting collaboration between the educators and the learners. It allows the integration of the various digital tools, including the ones that provide feedback on the performance of the learners, to facilitate the process of learning. In addition, it can be used to provide support to the learners and educators in the CBE process. This is possible since it allows the learners to access learning materials from anywhere and at any time, it can be useful in facilitating self-paced learning. Therefore, cloud computing can be applied to ensure that the CBE process is effective and efficient.

Virtual and augmented reality can be used to ensure that the learners are able to perform a particular task competently by providing them with a virtual environment in which they can gain practical experience. According to Bozkurt et al. (2021) and Holmes et al. (2021), this technology can be used to ensure that the learners develop competencies, including critical thinking and decision-making skills, through practical experience. In addition, it can be used to support the learners in acquiring skills and gaining confidence in performing tasks. Therefore, the use of this technology is essential in the CBE process since it allows the learners to develop competencies by gaining practical experience. The virtual reality tool can be used together with the assessment tools to provide feedback on the performance of the learners.

Summing up the list of digital technologies is data analytics which can can be utilized to support the development of competency-based education by helping the educators to monitor and determine the progress of the learners and provide suitable support. This technology can be used to provide feedback to the educators on the performance of the learners to allow them to make the necessary adjustments and provide specific learners with the required support. In addition, it can be used to ensure that the educators maintain a high level of professionalism when dealing with the learners and determining their progress. Moreover, it can be used together with the other digital tools to facilitate the process of learning and allow the educators to monitor the progress of the learners. Therefore, it can be integrated into the CBE process to support the effective teaching and learning of the topics being covered.

2.3 Teachers' Preparedness for Integrating Digital Technologies in CBE Implementation

The effectiveness of Competency-Based Education (CBE) is mainly determined by the preparedness of teachers to utilize digital technologies to support the process of learning. Teacher preparedness refers to the ability and willingness of the teachers to implement the strategies and approaches that can be used to support the development of competency-based education. In the context of CBE, technology can be used in various ways, including to provide feedback to the learners and to monitor their competence development. According to UNESCO (2023), teachers play a critical role in ensuring that the appropriate digital technologies are utilized to enable the learners to gain knowledge and become competent rather than simply digitizing the learning process to support teaching.

In addition to the role of teachers in determining how effectively and efficiently the CBE process will take place, they also play a role in ensuring that the process meets the learners' needs and expectations, as well as the requirements of the educational system. For instance, the need for

teachers who are competent in using digital technologies and instructional strategies was identified in Kenya as the country transitioned to the Competency-Based Curriculum (CBC). According to Tondeur et al. (2024), teachers who are prepared can support the development of competency-based education through their ability and willingness to implement technologies and strategies that are aimed at helping the learner reach their full potential and develop competencies.

Professional development and training are essential in ensuring that teachers gain the appropriate skills and knowledge and become confident in utilizing the digital technologies and approaches that can be used to support the development of CBE. Teachers must obtain technical and pedagogical knowledge that can help them implement an effective learning strategy. Various education systems have acknowledged the significance of professional development and have invested in providing teachers with the necessary resources to facilitate their growth. The Republic of Kenya (2023) discusses the role of the Kenya government in ensuring that the country achieves quality education by supporting the digital literacy of the educators and providing the necessary training to support them. However, there is a disparity in training opportunities, which impacts the pace and efficacy of CBE implementation.

The infrastructure and support provided in the education sector influence the probability of teachers using digital technology to facilitate CBE. While the technologies play a critical role in ensuring the CBE process is efficient and effective, the absence of relevant infrastructure constrains the teachers' ability to fully implement the strategies that can help the learners gain knowledge and become competent. For instance, in the developing world, schools face challenges regarding the availability of the technological infrastructure, including internet. The Communication Authority of Kenya (2024) discusses inadequacy of broadband penetration of Kenyan schools that limits the accessibility and availability of digital tools impeding on the effective implementation of the CBE. In addition, the World Bank (2024) highlights the

relevance of infrastructure and the role that it plays in the digitalization of the education system in Africa. The availability and adequacy of the infrastructure are significant predictors of the teachers' confidence and ability to implement CBE effectively.

Attitudes and perceptions have an impact on the extent to which the teachers can embrace and implement the digital technologies that are meant to support the CBE process. Teachers who have positive beliefs and attitudes towards technology will be more likely to use it to support the learning process. In contrast, those who believe that technology is a threat and will result in additional stress and workload are less likely to use it in the education process. Ertmer & Ottenbreit-Leftwich (2023) discuss the effect of the beliefs and attitudes of teachers towards technology on their ability to effectively integrate it into the teaching process. In addition, Redecker (2024) explains the influence of positive perceptions of technology on the likelihood that the teachers will utilize it to support the education of the learners. Therefore, the attitudes and beliefs of the teachers regarding the benefits and application of technology in education are significant predictors of their readiness to implement it to support the CBE.

The process of implementing competency-based education requires the consideration of a range of factors, including those that affect teacher competence. The teachers play a critical role in the CBE process as they are the ones who implement the strategies that will enable the learners to gain knowledge. Thus, it is essential for the education stakeholders to continuously invest in their professional development and provide them with appropriate support to ensure that they are competent, confident, and capable of effectively implementing the CBE program. According to UNICEF (2024), it is paramount that the education systems support the empowerment of the teachers to meet the demands of the digital age. Moreover, UNESCO (2023) discusses the role of

teachers in digital transformation and emphasizes the need for appropriate support to help them respond to the changing education needs and meet their expectations.

2.4 Leadership support and Integration of Digital Technologies in CBE

Leadership plays a vital role in the context of education, including in the implementation of Competency-Based Education (CBE). As the driving force of any educational process, leadership influences a wide-range of aspects, including the direction and strategies that can be used to support the CBE implementation and the resources that can be invested in supporting the process. Thus, it is essential for leadership to acknowledge the importance of technology and its application in the CBE process. Various leadership studies have demonstrated that strategic support from leadership is a key determinant of successful technology adoption and utilization amongst the teachers (Fullan et al., 2023). In addition, leadership support increases the likelihood that the teachers will utilize digital technology to support the CBE implementation and promote the attainment of the learning objectives (OECD, 2022). Moreover, leadership support is essential in facilitating an effective and efficient CBE implementation through the provision of appropriate resources to the teachers and ensuring that the CBE process is aligned with the learning requirements and expectations of the learners. Therefore, leadership support plays a critical role in the successful CBE implementation.

Apart from the influence of leadership support on the direction and resource availability for the CBE implementation, it also plays a significant role in ensuring that the teachers are competent and equipped with the skills and knowledge needed to effectively integrate technology into the teaching process. Leaders play a critical role in supporting and guiding the educators through the CBE implementation. Thus, it is essential for them to invest time and effort in developing and supporting the professional growth of the teachers to ensure they have the necessary skills and

knowledge to support the CBE implementation, including the effective utilization of technology (Darling-Hammond et al., 2022). Moreover, leadership involvement in capacity building and professional development increases the level of confidence, motivation, and support that the teachers require to successfully adopt and implement technology in the CBE process (Leithwood et al., 2023). Therefore, in addition to the influence of leadership support on the direction and resource availability for the CBE implementation, it also plays a significant role in ensuring that the teachers are competent and equipped with the skills and knowledge needed to effectively integrate technology into the teaching process.

2.5 Critique of Literature and Research Gaps

Expansive literature has been reviewed in regard to the topic under investigation. It is clear that a comprehensive overview of overview of digital technologies used in CBE has been provided as well as the challenges associated with their integration. Deliberations on these technologies are deep enough and cover several types of relevant technologies which have been useful in implementation of CBE curriculum globally. The depth of this discussion is a proof that digital integration is multifaceted with regard to contemporary education (Ally, 2021; Bozkurt *et al.*, 2021). What particularly emerges out of the review is the emphasis on aligning the said technologies with learner focused methodologies. However, it is evident that a significant portion of the literature dwells on global trends without providing any realities relating to the Kenyan context.

Literature relating to the challenges also captured critical shortcomings which include scarcity of devices, poorly developed infrastructure, issues bordering competence of the teachers, curriculum misalignment, shortage of financial resources, challenges in conducting assessment among others (Mwangi & Kinyua, 2021; Ngigi *et al.*, 2022). This collection of challenges is

comprehensive since it provides a holistic view of the barriers associated with integrating these technologies in CBE curriculum. Nonetheless, there is a serious shortcoming observed from this discussion, in that there is overreliance on secondary data and studies from largely urbanized Western contexts without considering evidence from the Kenyan context.

Insights from the literature also reveal that it score strongly in regard to pedagogical and technological integration. Examples of studies that bring out this integration are Ifenthaler and Yau (2021) and Holmes *et al.* (2021). On the flipside, there is very minimal coverage of economic and socio-cultural context of learners and schools which are essential in comprehending how feasible technology adoption is as well as digital preparedness.

It therefore suffices to conclude that despite the large body of literature relating to digital technologies and their integration in CBE, there is a serious gap that remains unaddressed on empirical findings relating to school preparedness in rural Kenyan contexts. A huge number of studies are those originating from the Western and highly urbanized environments and thus fail to address the rural challenges of digital integration in CBE in an area such as Kajiado North Subcounty with different socio-economic, infrastructural, and cultural realities.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

Covered in this section of the study is the methodology that was employed by the researcher in conducting the study on school preparedness for digital integration in Competency-Based Education (CBE) in Kajiado North Sub-county, Kenya. Details presented in this chapter relate to the appropriate research design and justification for its selection and suitability, the population targeted by the researcher, the methods employed in picking the sample, the tools used in data collection, techniques used to analyze the data and ethics observed during the research.

3.2 Research Design

The researcher considered descriptive survey as the most appropriate research design to facilitate collection of data on existing realities, perceptions and stakeholder opinions regarding digital integration in CBE. As asserted by Creswell and Creswell (2021), this type of design is very effective especially where it is necessary to get a comprehensive understanding of the characteristics, preparedness, and challenges in a distinct population. The other reason why this design was selected was its suitability in enabling the gathering of both quantitative and qualitative data. The flexibility and cost-effectiveness of the design compared to other designs was also a major boost in its selection. The researcher further considered its suitability in facilitating the analysis of relationships between the study variables.

3.3 Population of the Study

This investigation targeted public primary schools in Kajiado North Subcounty. Records available from the Education office of the County government of Kajiado (2024), Kajiado North Subcounty had 78 public primary schools as at the end of the year 2024. The breakdown in terms of the various categories of personnel in the 78 schools includes 78 heads of Institutions, 78 ICT coordinators, and approximately 468 teachers. The mentioned population was ideal since the people considered were the implementers of CBE and thus have deeper knowledge and understanding of various issues under investigation.

3.4 Sample Size and Sampling Method

In order to conduct an objective investigation, a probability sampling method was preferred. The researcher settled on stratified random sampling in selecting the schools and respondents who participated in the study from each school. The criteria for stratification were the size of the school and there were three categories of schools i.e. small, medium, large. Another factor that was considered in selecting the sample was the geographic location of the school to ensure diversity and inclusivity of the sample selected. The study adopted Krejcie and Morgan's (1970) approach sample determination leading to selection of 50 schools representing approximately 64% of the population. For each school the Head of Institution, ICT coordinator and four teachers each representing a learning area was selected. Table 3.1 below illustrates sample size distributions.

Table 3. 1: Sample Size Distribution

Zone	Number of Schools	Sample selected	No. of Respondents
Kisamis	26	26/78*50= 17	102
Ewuaso	22	22/78*50= 14	84
Magadi	14	14/78*50= 9	54
Ngong	8	8/78* 50 = 5	30
Ongata Rongai	8	8/78* 50 = 5	30
Total	**78**	**50**	**300**

3.5 Data Collection Instruments

A structured questionnaire was the most preferred data collection tool for this research. The questionnaire took the form of a five point Likert scale questions. It will have four sections. The first section contained demographic questions, the second contained questions on types of digital technologies, and third section questions on level of teacher training and fourth the level of leadership support. The instruments were piloted in five schools outside the sample to test clarity, reliability, and validity. Reliability of the data collection instrument was tested using Cronbach's Alpha. The value obtained was 0.81 implying there was high internal consistency of the questionnaire. Validity was tested using content analysis. Experts were engaged in scrutiny of the questionnaire and finally authenticated it. The researcher physically met the respondents to administer questionnaires thus increasing the response rate.

3.6 Data Analysis Techniques

The data collected was quantitative in nature. Data on the level of adoption of digital technologies in CBE was analyzed using descriptive statistics; level of teacher preparedness was analyzed using descriptive statistics and regression analysis was used to analyze the relationship between the study variables. According to Braun & Clarke (2021) descriptive statistics are crucial in providing clear summaries for decision making. The analysis results were presented using tables, graphs, and narrations to provide a comprehensive understanding of the research findings.

3.7 Ethical Considerations

A number of ethics were considered in order to ensure that the study strictly adhered to the standards and guidelines on professionalism. One of the ethical issues that was considered was seeking informed consent from the respondents where they were informed of the voluntary nature of participation as well as the procedures on participation in the research. The researcher further ensured that the study was conducted with a high degree of confidentiality while maintaining anonymity of the respondents. Respondents were only identified using codes and the data collected was stored in filed that were encrypted with passwords. Ethical approval was obtained from university and a permit to conduct the research was obtained from NACOSTI.

CHAPTER FOUR

FINDINGS AND DISCUSSIONS

4.1 Introduction

The purpose of this study was to assess the preparedness of public schools in Kajiado North in terms of integration of digital technologies in CBE implementation. Four objectives formed the main focus for the study and they included evaluating the extent of digital technology integration in teaching and learning for CBE implementation; to examine teachers' preparedness for integrating digital technologies in CBE implementation in Kajiado North public primary schools; to determine the influence of school leadership on digital technology integration in CBE implementation and to identify challenges affecting school preparedness for digital technology integration in CBE implementation. The results are presented next.

4.2 Response Rate

A total of 300 questionnaires were administered to respondents who constituted teachers from public primary schools in Kajiado North. Semi structured interviews involving 10 ICT officers were conducted. The response rate is presented in Table 4.1 below.

Table 4. 1: Response rate

	Frequency	**Percent**
Returned Questionnaires	230	76.67
Questionnaires not returned	70	23.33
Total	**300**	**100.0**

The results as tabulated above reveal that 76.67 percent of the questionnaires administered were successfully returned whereas 23.33 percent were not returned. The response rate of 76.67 percent was considered sufficient to justify generalization of the study findings on Kajiado North.

4.3 Demographic Information Findings

The respondents were required to respond to three questions relating to school information in order to determine their suitability to take part in this study. The responses obtained were analyzed using frequencies and percentages and the results and associated interpretations are presented next.

4.3.1 Duration School had operated

The respondents were requested to indicate the duration the school had been in operation since its inception. The purpose of the question was to ascertain whether the school had operated for a substantial duration covering the period when CBE education was introduced in the country and thus taken part in its implementation from the beginning. The results are presented in Table 4.2 below.

Table 4. 2: Duration school had operated

	Frequency	**Percent**
Less than 5 years	32	13.9
5-10 Years	45	19.6
More than 10 years	153	66.5
Total	**230**	**100.0**

The results as tabulated in the table above reveals that 66.5 present of the public primary schools in Kajiado North have been in operation for more than 10 years since their inception. This was an indication that most of the schools were in existence even before the CBE curriculum was introduced and are currently implementing it.

4.3.2 Number of Teachers with CBE Training

The respondents were further required to indicate the number of teachers in respective schools who had undergone CBE training. The results are presented in Figure 4.1 below.



Figure 4. 1: **Teachers with CBE Training**

The results illustrated in Figure 4.1 above revealed that 94% of teachers in the public primary schools in Kajiado North have gone through CBE training and thus are well acquainted with the CBE curriculum of education whereas only 6% of the teachers had not gone through CBE training. This was an indication that elaborate training on CBE had been conducted to equip the teachers with critical skills and knowledge relating to CBE. Insights from the interviews revealed that among those teachers that have not gone through CBE training are the newly recruited teachers who have not served for a long time and are yet to attend training.

4.3.3 State of CBE Infrastructure

The respondents were requested to indicate the state of CBE infrastructure in public schools within Kajiado North. The responses provided were either adequate or inadequate. The results from the responses obtained are presented in Table 4.3 below.

Table 4. 3: State of CBE Infrastructure

	Frequency	**Percent**
Adequate	80	34.8
Inadequate	150	65.2
Total	**230**	**100.0**

The results concerning state of CBE infrastructure in public primary schools in Kajiado North revealed that 65.2 percent of the schools have inadequate CBE related infrastructure whereas 34.8 percent of the schools have adequate infrastructure. This was an indication that most of the public primary schools in Kajiado North are still struggling with the challenge of inadequate infrastructure required to enhance CBE implementation. Findings from the interviews elaborated that infrastructure such as equipped laboratories, computers, classrooms and other important facilities were not enough among the public primary schools in Kajiado North.

4.4 Extent of Digital Technology Integration

The study sought to establish the extent to which digital technologies had been integrated for teaching and learning in CBE implementation. The respondents were provided with structured questions in the form of five point likert scale and were required to select the most suitable

option. The responses were analyzed using descriptive statistics specifically the mean and standard deviation. The results are presented Table 4.4 below.

Table 4. 4: Extent of digital technology integration

Digital technology adopted	Mean	Std Dev
School has adopted e-assessment technologies to support learner assessment	4.47	0.58
School provides virtual laboratories to support CBE learning	4.38	0.61
School uses adaptive learning technologies that analyze learners' performance and personalize learning according to individual needs.	4.42	0.56
School has adopted mobile learning technologies that enable learning anytime and anywhere.	4.35	0.64
School uses educational videos and interactive multimedia to enhance understanding and improve knowledge retention.	1.43	0.52
School uses cloud computing technologies to enable secure access to learning resources from different devices and locations.	4.51	0.55
School has adopted artificial intelligence (AI) technologies to support teaching and learning.	4.46	0.60
School uses virtual reality (VR) and augmented reality (AR) technologies to help learners safely practice complex concepts and skills.	4.58	0.49

Table 4.4 presents the descriptive statistics for respondents' perceptions of the adoption of digital technologies to support the implementation of Competency-Based Education (CBE). The

questionnaire was measured on a five-point Likert scale where 1 = Strongly Agree and 5 = Strongly Disagree. Consequently, lower mean scores indicate greater agreement with the statements, whereas higher mean scores indicate greater disagreement.

The study results confirmed that majority of the respondents disagreed that their schools had adopted most of the listed digital technologies. This is reflected by the high mean scores for e-assessment technologies (M = 4.47, SD = 0.58), virtual laboratories (M = 4.38, SD = 0.61), adaptive learning technologies (M = 4.42, SD = 0.56), mobile learning technologies (M = 4.35, SD = 0.64), cloud computing (M = 4.51, SD = 0.55), artificial intelligence technologies (M = 4.46, SD = 0.60), and virtual and augmented reality technologies (M = 4.58, SD = 0.49). The implication of the results is that digital technologies availability was still an illusion in most schools.

Educational video content and interactive multimedia were two digital technological that recorded a low mean score (M = 1.43, SD = 0.52), implying that they were commonly utilized by the schools in simplification of complex concepts and improving learner retention. This was a confirmation that the tow technologies were popular among the schools.

The values of the standard deviations were from 0.49 to 0.64 confirming relatively low variability in responses and a high degree of consensus among respondents. Overall, the results suggest that although schools have embraced educational videos and interactive multimedia to support teaching and learning, the adoption of more advanced digital technologies such as artificial intelligence, cloud computing, virtual laboratories, virtual and augmented reality, adaptive learning systems, mobile learning technologies, and e-assessment remains limited. This points to significant gaps in digital technology integration that may hinder the effective implementation of Competency-Based Education.

4.5 Level of Teacher Training

The second objective of this study was to establish the level of teacher training especially with regard to digital technologies essential in implementation of CBE curriculum. The respondents were required to provide their responses to various questions using a scale of 1-5. Analysis of the responses was done using descriptive statistics and the results and presented and interpreted next.

Table 4. 5: Level of teacher training

Level of teacher training	Mean	Std Dev
Teachers have received training on the use of e-assessment tools	1.72	0.68
Training on use of mobile learning technologies has been done	1.39	0.57
Teachers have received training on other digital technologies	1.65	0.73
Teachers attend digital courses sponsored by the government	1.83	0.81
Refresher training on digital technologies is done regularly	3.76	0.94
Training on digital technologies is mandatory for all teachers	4.11	0.89
Training on digital tools is free and available to all teachers	1.57	0.75
Teachers have the ability to use digital tools in teaching CBE	1.46	0.62

The findings reveal that teachers are generally perceived to possess the foundational preparation required to incorporate digital technologies into CBE. This is evidenced by the low mean scores for training on e-assessment tools (M = 1.72, SD = 0.68), mobile learning technologies (M = 1.39, SD = 0.57), other digital technologies (M = 1.65, SD = 0.73), participation in government-sponsored digital courses (M = 1.83, SD = 0.81), the availability of free digital training opportunities (M = 1.57, SD = 0.75), and teachers' ability to use digital tools in classroom

instruction (M = 1.46, SD = 0.62). Collectively, these results suggest that most respondents believe teachers have received adequate exposure to digital technologies and have developed the competencies needed to support technology-enhanced teaching and learning within the CBE framework.

A different pattern emerged for refresher training on digital technologies (M = 3.76, SD = 0.94) and the requirement that all teachers undergo mandatory digital technology training (M = 4.11, SD = 0.89). The comparatively higher mean scores indicate that respondents were less convinced that schools provide ongoing professional development or consistently enforce compulsory digital training. This implies that there is a serious gap between initial preparation of teachers through training and ongoing support needed to keep them at pace with the changing technological environment.

The standard deviations (0.57-0.94) suggest that there is a moderate level of agreement among respondents on the preparedness of teachers in relation to various aspects of teacher readiness to adopt digital technologies in CBE. Taken together, the findings suggest that although teachers possess the basic knowledge and skills that are required to use digital technologies to implement CBE, professional development opportunities are inadequate. Strengthening capacity building and continuous professional development opportunities, especially through refresher programmes and institutionalized training policies will ensure that teachers are confident in using emerging digital technologies to enrich teaching and learning.

4.6 Leadership Support

The third research objective of this study was to determine whether there was adequate leadership support in public primary schools in Kajiado North with regard to digital integration in implementation of CBE. The respondents were asked several questions and were required to

select from a scale of 1 (very small extent) to 5 (very great extent) the most suitable response. Descriptive statistics were used to analyze the responses and the results are illustrated in table 4.6.

Table 4. 6: Leadership support

Critical aspect of leadership support	Mean	Std Dev
School leaders provide a clear vision and strategic direction for integrating digital technologies into CBE.	4.48	0.58
School leaders support teachers through training, mentorship, and professional development in digital technology use for CBE implementation.	4.36	0.67
School leaders allocate and manage resources (devices, internet, and technical support) to facilitate digital integration in CBE.	2.24	0.76
School leaders monitor, evaluate, and provide feedback on the use of digital technologies in teaching and learning within CBE frameworks.	4.42	0.61
School leaders promote a culture of innovation and encourage teachers to adopt and experiment with digital tools in CBE classrooms.	2.57	0.81

Based on the research findings it was revealed that that school leadership is perceived to provide substantial support in several critical aspects of digital technology integration within the Competency-Based Education (CBE) framework. Respondents expressed strong agreement that school leaders articulate a clear strategic vision for technology integration (M = 4.48, SD = 0.58), offer meaningful professional support through training and mentorship (M = 4.36, SD =

0.67) and provide feedback on its implementation in the classroom (M = 4.42, SD = 0.61). The relatively high values for the former two aspects indicate that the participants share rather positive perceptions about how school leadership can promote digital transformation via CBE. However, the same participants believe that the leadership support is less sufficient in providing resources and managing their use effectively (M = 2.24, SD = 0.76) and promoting an innovative culture with regard to technology use (M = 2.57, SD = 0.81). Overall, the mean equals 3.61 (SD = 0.69), which implies that the leadership support for CBE integration is moderately positive. In particular, the school leaders are rather supportive in terms of strategic guidance, professional development, and pedagogical supervision but insufficient in terms of providing resources and fostering innovation.

4.7 Challenges of Digital Integration in CBE Implementation

The fourth research objective the study sought to achieve was to establish the challenges facing digital integration in CBE implementation among public primary schools in Kajiado North. The respondents were provided with several statements which were perceived common challenges from previous studies and were required to rate them on a scale of 1 (not significant) to 5 (very significant). Descriptive statistics were obtained and the results are tabulated in 4.7 below.

Table 4. 7: Challenges of digital integration

	Mean	Std Dev
Inadequate ICT infrastructure affects digital integration in CBE implementation.	4.58	0.57
Limited internet connectivity affects the use of digital technologies in CBE.	4.44	0.63
Insufficient teacher ICT skills hinder digital integration in CBE implementation.	1.18	0.39
High cost of digital devices affects technology integration in schools.	4.67	0.50
Inadequate technical support limits effective use of digital technologies in CBE.	4.39	0.71
Unreliable electricity supply affects digital learning in schools.	1.84	0.46
Resistance to change among teachers affects digital integration in CBE implementation.	1.12	0.81

The study findings reveal that respondents considered several infrastructural and technological factors to be the principal obstacles to effective digital integration within the CBE framework. Inadequate ICT infrastructure recorded a high mean score (M = 4.58, SD = 0.57), indicating that respondents regarded it as a very significant challenge. Likewise, limited internet connectivity (M = 4.44, SD = 0.63), the high cost of acquiring digital devices (M = 4.67, SD = 0.760), and inadequate technical support (SD = 0.761, SD = 0.762) were all perceived as substantial barriers

to successful technology integration. The relatively low standard deviation for these items suggests respondents agreed that the constraints were significant. The survey also revealed that insufficient ICT skills of teachers (SD = 0.763, SD = 0.764) and teachers' unwillingness to adopt new approaches (SD = 0.765, SD = 0.766) were not significant issues as most respondents selected the lowest response option. This implies that teachers had the adequate skills to use digital technologies for instruction and were willing to adopt them. The inconsistent supply of electricity was a minor concern according to respondents who selected the lowest option (SD = 0.767, SD = 0.768). Overall, the mean score was 3.46 (SD = 0.769), suggesting that adoption of digital technologies was moderately challenging. The analysis reveals that the main barriers to learning were primarily infrastructural. The survey results further indicate that teachers lacked skills and were unwilling to adopt new methods.

4.8 Discussion of Findings

Findings from the study reveal that the extent to which digital technology supports competency-based education in public primary schools is determined by the availability of infrastructure, teacher readiness, leadership support, and resources. The study established that the majority of the schools in Kajiado North lack adequate computer laboratories, ICT equipment, and other related facilities to facilitate technology-based education. This observation is consistent with UNESCO (2023), which reports that the lack of adequate digital infrastructure is among the primary challenges hindering technology integration in most developing countries. In addition, World Bank (2023) agrees that the problem of limited access to ICT facilities is prevalent in most Sub-Saharan African countries, thereby hindering the adoption process of technology in education.

Regarding the level of technology integration, the findings indicate that the use of educational videos and multimedia is the highest, while the application of artificial intelligence, cloud computing, smart learning systems, virtual labs, e-assessment, and virtual and augmented reality, is minimal. This observation resonates with the reports by OECD (2023), which reveal that while many educational institutions have started adopting digital instructional resources, the use of advanced technologies in teaching and learning is uneven across different economies. Similarly, UNESCO (2023), reports that schools are still reliant on conventional digital resources because of insufficient funds and lack of infrastructure.

The research findings also demonstrated that teachers are generally competent in most areas related to adopting digital technology in teaching competency-based education. Respondents noted that teachers had received adequate foundational training and were able to apply the acquired skills in facilitating instruction. However, the survey also reveals that opportunities for teachers to engage in continuous professional development and refreshers are limited. This observation is consistent with the findings of Tondeur et al. (2021), who argued that initial teacher training is not sufficient for integrating technology in education, but rather, there is a need for continuous professional development. Additionally, Darling-Hammond, Schachner, and Edgerton (2023) emphasized that professional development supports teachers to acquire the necessary skills to adopt a range of digital instructional resources and strategies with ease and confidence.

Results on the role of school leaders in enabling digital technology in education revealed that they provide guidance and support to teachers, including mentoring and monitoring of the implementation process. However, the study further demonstrated that leadership support is limited in terms of mobilizing resources and promoting a culture of innovation and creativity in

the teaching-learning processes. These findings align with the arguments of Fullan (2020), who asserts that effective school leadership goes beyond providing policy guidelines and involves influencing the organizational environment, as well as mobilizing resources for sustainable implementation of new initiatives. Similar sentiments are presented by Leithwood, Harris, and Hopkins (2020) who agreed that transformational school leadership plays a critical role in promoting teacher engagement in adopting technology in education by promoting an enabling organizational culture and ensuring that teaching and learning materials are available.

Finally, findings herein demonstrate that inadequate ICT infrastructure, lack of internet connection, high costs of acquiring digital resources and insufficient technical support are the leading factors hindering effective technology integration in education. Lack of proper electricity connections, insufficient teacher ICT competency, and a negative attitude towards the adoption of technology in education were not identified as a major challenge. These findings are consistent with Technology in Education Report by UNESCO (2023), which reveals that the main hindrances in implementing education technology are related to infrastructure and finances. Overall, it is evident that the role of organizational capacity building and investment in digital infrastructure will have a more significant impact on successful CBE implementation than continuous teacher training if the former does not exist. Moreover, the study reveals that teachers have minimal skills in utilizing digital technology to facilitate instruction and therefore, require continuous professional development.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the findings of the study which was carried out to address the four specific objectives that guided the study. The research objectives sought to establish the status of Competency-Based Education (CBE) infrastructure in public primary schools in Kajiado North Sub-County, assess the level of use of digital technology in CBE implementation, determine the readiness level of teachers in embracing digital technology, examine the extent to which school leaders facilitate the use of digital technology in CBE, and evaluate the challenges faced in the full implementation of digital technology in CBE.

5.2 Summary of Findings

5.2.1 State of CBE Infrastructure

The study established that most public primary schools in Kajiado North lack the required infrastructure to facilitate the Competency-Based Education curriculum. More than half of the respondents indicated that their schools lack the required infrastructural facilities to host the program competencies.

Conclusively, only a third of the respondents were satisfied with the infrastructural facilities in their respective institutions. Interviews also revealed that most schools report deficient facilities

such as inadequately furnished classrooms, computer laboratories, and learning materials to effectively host the new CBE curriculum and promote its successful implementation.

5.2.2 Extent of Digital Technology Integration

The research results indicate that the utilization of digital technologies in public primary schools remains limited. Although the use of educational videos and multimedia tools is widespread, embracing advanced technologies is still far away. Educational institutions are yet to fully incorporate such digital technologies as e-assessment platforms, adaptive learning systems, cloud computing, m-learning applications, artificial intelligence, virtual laboratories, and virtual or augmented reality. In other words, schools still rely heavily on digital technologies and have not yet moved towards adopting more innovative and smart solutions to engage learners and enhance their outcomes.

5.2.3 Level of Teacher Training

The study revealed that the majority of teachers had the ability to use digital technologies in instruction to the learners since they were trained to use such tools as e-assessment software, mobile technologies and other digital techniques during the foundational digital training. The participants mentioned that government-sponsored training and access to free educational programs contributed to developing the teachers' digital competence.

However, the research also discovered that teachers do not get enough further training to keep using various emerging digital tools in education. Schools do not provide the required instruction for the proper use of new technologies in the learning process. Thus, these professionals have

enough theoretical background knowledge but lack experience in using new digital technologies and pedagogy.

5.2.4 Leadership Support for Digital Technology Integration

The findings indicated that school leaders were generally supportive of incorporating technology into the educational system. Among the areas of support included providing direction for teachers through mentoring and training and monitoring technology usage in the classroom, which demonstrated that schools were committed to ensuring the CBE curriculum was successfully implemented. However, the level of leadership support was not strong especially in providing resources and encouraging innovation. The teachers reported that schools still struggled to provide devices, access to the Internet, and technical assistance, and there that there were limited opportunities for experimenting with pedagogical approaches. This implied that although school leaders had a positive attitude towards technology, they lacked the necessary resources and infrastructural support that would enable them to encourage instructional innovation.

5.2.5 Challenges Affecting Digital Technology Integration

The study established that the main hindrance to the adoption of digital technologies is not related to individuals but rather the tangible and monetary limitations. In particular, the respondents suggested that inadequate information and communication technology (ICT) infrastructure, insufficient access to the Internet, and the inability to afford equipment were the core challenges facing various public primary schools. These challenges issues were perceived to

be a serious obstacle to the integration of the digital technologies into the Competency-Based Education model in the majority of the public primary schools.

By contrast, the study did not identify teachers' digital competency or their willingness to embrace the new technology as a significant hindrance. Moreover, the participants asserted that unreliable electricity was not a major impediment to adopting digital learning in the region. Overall, the research highlights that addressing the built environment and investing in the necessary tools and technical support will yield better results than trying to improve the readiness of education professionals through training initiatives.

5.4 Conclusion

The study revealed that digital technology integration into the implementation process of CBE curriculum at the level of primary schools in Kajiado North Sub-County was still in its infancy. Teachers were found to be aware of the existence of tools and school leaders were also willing to give directions through mentoring and supervision. However, the real and potential benefits of integrating digital technology were yet to be fully unlocked in most public primary schools due to limited infrastructure, internet access, cost of devices and inadequate technical support. These challenges hinder the utilization of technology in competency-based education.

It was found that most of the public primary schools in Kajiado North Subcounty were utilizing digital tools such as educational videos and interactive media in teaching and learning processes. Advanced technologies such as intelligence, cloud computing, adaptive learning systems, virtual laboratories, virtual and augmented reality and e-assessment were not available and thus rarely utilized. This was an indication that there was need for conceptual and infrastructural digital transformation.

It was further concluded that lack of teacher knowledge and willingness was not a major barrier. The main impediments to effective adoption of digital tools in CBE implementation were infrastructural, institutional and funding related. There was need for partnerships among county education departments, school leaders and other education partners to promote the integration of digital technologies in education. Capacity building activities should thus be prioritized.

5.5 Suggestions for Research

The results of this study can help shape and direct future research especially with regard to integration of digital technologies into CBE. There will be need to conduct future similar studies focusing on other counties in the Republic of Kenya in order to establish whether the results are generalizable within different socio-economic and geographical settings.

Secondly, future studies should evaluate the influence of enhanced digital technology utilization in achieving positive results on students' academic performance, competency attainment and overall learning outcomes within the Competency-Based Education model.

Lastly, more research should be done to determine the effectiveness of government policies and provisions in promoting transformation in public primary education. This will focus on issues concerning the sustainability of ICT infrastructure and the maintenance of continuous teacher training programs. In addition, future researchers can conduct long-term studies or use mixed methods to experiment to determine how the use of digital technology can progress and how its investment can yield greater results in the field of CBE.

5.6 Recommendations

Informed by the research findings, the following recommendations were proposed to enhance digital technology application in implementing Competency-Based Education curriculum in primary schools. The first recommendations proposes a collaboration among various stakeholders such as The Ministry of Education, county governments and development partners to invest in infrastructure in public primary schools to facilitate effective implementation of CBE. This may include provision of computer labs equipped with adequate software and internet connection, provision of adequate digital devices and upgrading classrooms to be more technology friendly. Improved infrastructure will provide an enabling environment for CBE to take root.

Schools are encouraged to diversify the use of digital technologies beyond the use of videos and interactive media. For this to be achieved, more funds should be allocated to purchase e-assessment tools learning platforms cloud services artificial intelligence virtual laboratories and virtual and augmented reality to promote learner-centered education, personalized learning and acquisition of competencies. Despite having the technological skills, professional development for teachers should be made mandatory and should include continuous in-service training on the new technological developments.

I is further recommended that education partners should develop technical support structures to ensure there is proper installation and maintenance of the digital technology infrastructure. Public primary schools should have adequate staff to provide maintenance and technical support to the core system, infrastructure, and applications. Appropriate Technical support ensures minimal disruptions in the learning process and promotes the use of the digital tools. Sustaining

digital infrastructure in education requires deliberate action by the government and education partners. The government should include budget lines for digital literacy and competency-based education. The budget should be allocated to purchase devices, support infrastructure, provide licensing of internet services, and software acquisition. Additionally, the government should continuously train teachers in technology-related skills. The provision of adequate funds will enable the process of adopting the new education curriculum be slow and seamless.

School administrators should be encouraged to build school cultures that support creativity, teamwork and sharing ideas about digital teaching. Teachers should be given chances to join learning groups take part in peer mentoring and work on projects, with other teachers. These kinds of environments will boost confidence, spark creativity and help teachers use digital tools more effectively in CBE.

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APPENDICES

Appendix I: Research Questionnaire

Introduction

This questionnaire is designed to assist in collection of data relating to school preparedness for digital integration in competency based education implementation in Kajiado North public primary schools. The data collected will be confidential and meant for academic purposes only. Kindly tick the most appropriate responses for each question.

Section A: School Information

1. For how long has the school been in operation since its inception?

   Less than 5 years

   5-10 years

   More than 10 years

2. How many teachers have undergone training in CBE?

   All teachers

   Few teachers

   None

3. What is the state of CBE related infrastructure in the school?

   Inadequate

   Adequate

Section B: Extent of digital technologies integration for teaching and learning in CBE implementation

Kindly indicate the extent to which you agree with the following statements relating to the extent of digital technology integration for teaching and learning in CBE. Use the scale of 1-5 where 1=strongly agree, 2= agree, 3= not sure, 4=disagree and 5=strongly agree.

No.	Types of digital technologies adopted	1	2	3	4	5
1.	The school has adopted e-assessment technologies					
2.	Virtual laboratories are available to assist in CBE delivery					
3.	There are adaptive learning technologies that analyze learner performance and adjust learning according individual needs					
4.	The school has mobile learning technologies to support remote learning any time and from any place.					
5.	School uses educational video content and interactive multimedia to simplify complex content and increase retention.					
6.	The school has embraced cloud computing to facilitate easy access to content any time and from any gadget.					
7.	School uses artificial intelligence to support learning					
8.	School uses virtual and augmented reality to assist learners practice complex tasks safely and repeatedly.					

Section C: Level of teachers' preparedness for integrating digital technologies in CBE implementation

Indicate the extent to which you agree with the following statements concerning teachers' preparedness for integrating digital technologies in CBE implementation. Use the scale of 1-5 where 1=strongly agree, 2= agree, 3= not sure, 4=disagree and 5=strongly disagree.

No.	Level of teacher training	1	2	3	4	5
1.	Teachers have received training on the use of e-assessment tools					
2.	Training on use of mobile learning technologies has been done					
3.	Teachers have received training on other digital technologies					
4.	Teachers attend digital courses sponsored by the government					
5.	Refresher training on digital technologies is done regularly					
6.	Training on digital technologies is mandatory for all teachers					
7.	Training on digital tools is free and available to all teachers					
8.	Teachers have the ability to use digital tools in teaching CBE					

Section D: Leadership Support

The following statements relate to leadership support in integrating digital technologies to the CBE curriculum. Indicate the extent to which you agree with each of them. Use the scale of 1-5 where 1=Very small extent, 2= small extent, 3= moderate extent, 4=great extent and 5=very great extent.

No.	Level of Leadership support	1	2	3	4	5
1.	To what extent do school leaders provide a clear vision and strategic direction for integrating digital technologies into Competency-Based					

	Education (CBE)?					
2.	How effectively do school leaders support teachers through training, mentorship, and professional development in digital technology use for CBE implementation?					
3.	To what degree do school leaders allocate and manage resources (e.g., devices, internet, technical support) to facilitate digital integration in CBE?					
4.	How actively do school leaders monitor, evaluate, and provide feedback on the use of digital technologies in teaching and learning within CBE frameworks?					
5.	To what extent do school leaders promote a culture of innovation and encourage teachers to adopt and experiment with digital tools in CBE classrooms?					

Section E: Challenges of digital integration in CBE implementation

The following statements relate to challenges on digital integration in CBE implementation. Kindly rate them using the following scale: 1= not significant, 2= Slightly significant, 3= Moderately significant, 4= significant, 5=Very significant.

No.	**Challenges of digital integration in CBE implementation**	**1**	**2**	**3**	**4**	**5**
1.	Inadequate ICT infrastructure affects digital integration in CBE implementation					
2.	Limited internet connectivity affects the use of digital technologies in CBE					

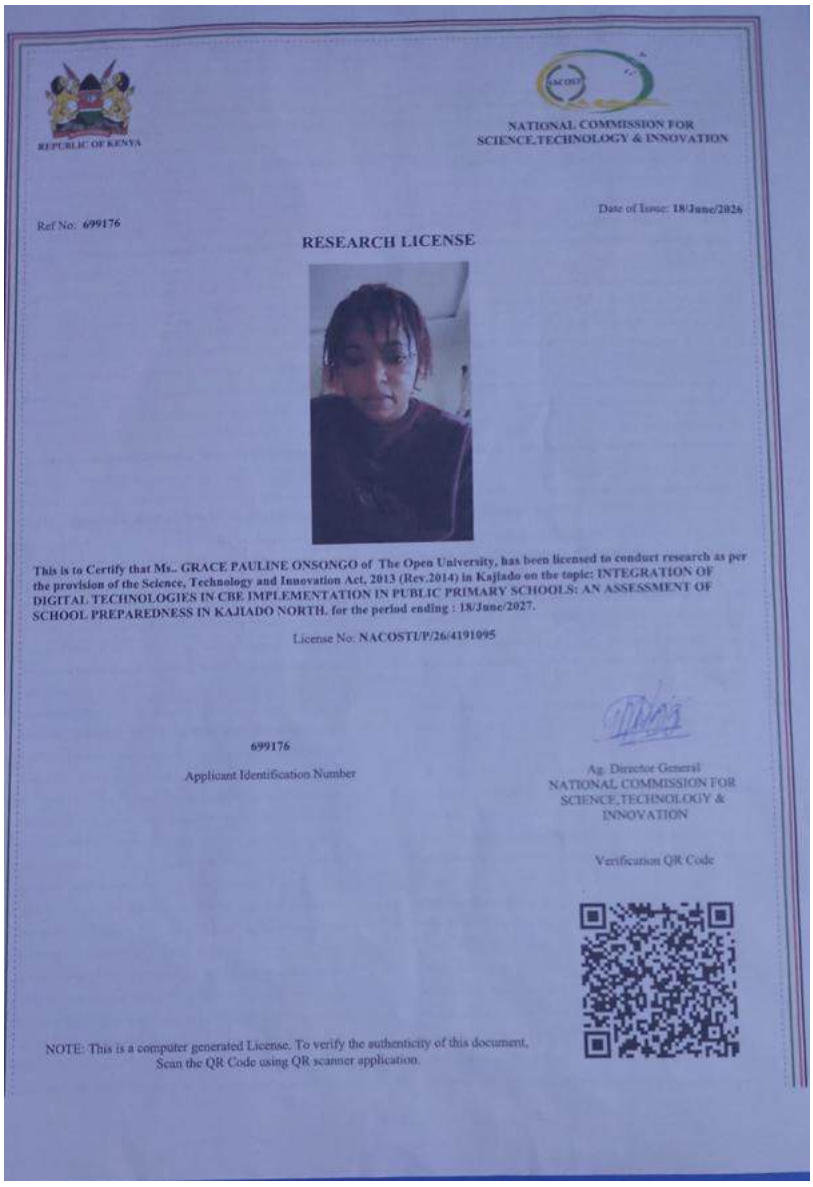
3.	Insufficient teacher ICT skills hinder digital integration in CBE implementation					
4.	High cost of digital devices affects technology integration in schools					
5.	Inadequate technical support limits effective use of digital technologies in CBE.					
6.	Unreliable electricity supply affects digital learning in schools					
7.	Resistance to change among teachers affects digital integration in CBE implementation					
8.	Large class sizes hinder effective use of digital technologies in CBE					
9.	Lack of support from leadership hinder digital integration					

Section E: Successful implementation of CBE

Indicate the extent to which you agree with the following statements relating to successful implementation of CBE. Use the scale of 1-5 where 1=strongly agree, 2= agree, 3= not sure, 4=disagree and 5=strongly agree.

No.	**Successful implementation of CBE**	**1**	**2**	**3**	**4**	**5**
1.	The school has achieved significant progress in CBE implementation					
2.	Tools and facilities required for CBE implementations are in place and being utilized					
3.	Overall CBE implementation has been successful					
4.	Digital preparedness has boosted CBE integration					

Appendix 2: Research Permit



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