Teacher Digital Competency and Implementation of Science, Technology, Engineering, and Mathematics Curriculums. A Case of Public Junior Schools in Kenya.

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ABSTRACT

This article is an extract of a PhD thesis that investigated the influence of Digital Resource Integration and the Implementation of Science, Technology, Engineering and Mathematics Subjects in Junior public Schools in Kitui County, Kenya. Digital resources have gradually become important in enhancing curriculum implementation in all educational levels, and their integration plays a key role in implementing the STEM curriculum. The study investigated the influence of teachers' digital competency and the implementation of STEM subjects in junior public schools in Kitui County, Kenya. The study was guided by the Technological Pedagogical Content Knowledge (TPCK) theory of digital integration by Mishra and Koehler (2006). The study adopted the embedded mixed-method research design. The study target population was 3661 junior school teachers, 1102 headteachers, and 19 Sub-County Quality Assurance and Standards Officers (SCQASOs). A sample of 670 respondents, including 294 headteachers, 360 teachers, and 16 SCQASOs, was sampled. The researcher established face validity by ensuring that all questions and interview schedules were developed from the study objectives and relevant literature and content validity through piloting selected schools across the county by choosing participants with similar characteristics to the target population. Schools that were piloted were not included in the sample of the research instruments. To establish the reliability of the research instruments, the researcher used the test–retest method. The questionnaires were administered to the pilot group of respondents drawn from public junior schools outside the main study sample. After a two-week interval, the same instrument was re-administered to the same respondents. The two sets of scores were correlated using Pearson’s Product Moment Correlation Coefficient to determine the stability of the instrument over time. A reliability coefficient of 0.81 for the headteachers’ questionnaire and 0.84 for the teachers’ questionnaire. The overall reliability coefficient for the instrument was 0.83 Data was collected by use of structured questionnaires for headteachers and teachers, while interview schedules were used to collect data from Sub-county Quality Assurance and Standards Officers. Quantitative data was analysed using the Statistical Package for Social Sciences (SPSS) software program version 28. The study also noted that teachers' capacity-building activities, including CEMASTEA training, Re-tooling workshop, Virtual laboratory training, and training on the use of AI tools, had been conducted, but there was a need for regular training. The study further found that digitally competent teachers were more confident integrating digital tools in the classroom, navigating learners through a digital platform and Learning Management Systems (LMS) and creating interactive STEM learning experiences. The study findings showed a low positive correlation of 0.281 between the adequacy of teachers' digital competency and the implementation of STEM subjects in public junior schools of Kitui County. Based on these inferential statistics, the study concluded that there was a weak positive correlation between teachers’ digital competency and STEM implementation in public junior schools ($r = 0.281$). This implies that improvements in teachers’ digital skills are associated with modest improvements in the implementation of STEM subjects; however, the influence is relatively limited. Therefore, while teacher competency is an important factor in determining STEM curriculum implementation, it is not significant and does not explain the reason for poor implementation of STEM in Kitui County of Kenya. Based on these findings, the study recommends that the government should develop a policy framework and manuals that will enhance teacher training capacity on digital resources in the teaching of STEM subjects. The need for a comprehensive approach that combines enhancement of teachers' digital competencies with improved infrastructural and administrative support to strengthen STEM implementation in schools is core.

BACKGROUND TO THE STUDY

Education plays a central role in skills development by equipping individuals with the knowledge, competencies, and attitudes necessary for personal empowerment, employability, and lifelong learning. According to UNESCO (2023) quality education fosters both foundational skills such as literacy, numeracy and problem-solving while technical and vocational skills needed for work and sustainable livelihood. This means that education is the foundation for developing the skills people need to succeed in life and work as it prepares them for employability and productivity in the society. Education policies worldwide have geared towards Competence-Based Education (CBE) with much emphasis on Science, Technology, Engineering and Mathematics (STEM). One of such policies that anchors the need of STEM in schools is the Sustainable Development Goal (SDGs), goal number 4 which emphasizes promoting quality education and lifelong learning opportunities for all by 2030 (UNESCO,2015).

In order to achieve this plan, educational institutions are required to provide resources to ensure quality teaching and learning. Sessional paper No.1 of 2019 emphasizes the need of STEM through a policy framework that seeks to modernize education for sustainable development by improving the acquisition of knowledge and skills in STEM fields. The Information, Communication and Technology (ICT) policy, Republic of Kenya (2020) explains that digital inclusion and accessibility should be provided for all learners, particularly in the teaching of science and technology subjects. Digital integration supports the teaching of STEM subjects as it enhances the visualization of abstract concepts in science and the real-world application of STEM to practical use in industries. While there are several ways digital tools can be used in teaching, this study concentrated on digital infrastructure, digital content, teachers' digital competency and the influence of the technical support team and the implementation of STEM subjects in junior public schools in Kitui County, Kenya.

According to UNESCO (2020) digital resources are materials or any electronic materials, tools and services in digital form that are used to support teaching, learning, or research and educational management. These resources may include digital documents, e-books, online journals, databases, educational websites, multimedia content (audio, video, simulations), and interactive tools that are accessible via digital devices such as computers, tablets, white boards, projectors and LCD screens.

The concept of STEM education, an acronym for Science, Technology, Engineering and Mathematics which originated in the United States through the National Science Foundation (NSF) in the early 2000s. It was introduced to address the growing demand for a skilled workforce capable of driving innovation and technological advancement in a rapidly changing world (National Science Foundation, 2000). Initially referred to as Science Mathematics Engineering and Technology (SMET)**,** the term further evolved into STEM to promote an integrated, interdisciplinary approach to teaching and learning. STEM education emphasizes hands-on, inquiry-based learning**,** critical thinking and the application of knowledge to real-world problems (UNESCO, 2023).

Digital implementation refers to the systematic adoption, integration, and use of digital technologies to enhance the effectiveness of teaching and learning processes (UNESCO, 2021). In education, digital implementation goes beyond the provision of digital devices and infrastructure to include teacher capacity building, integration of digital content into pedagogy, and supportive institutional policies. Effective digital implementation in schools requires alignment between technology use, curriculum objectives and instructional practices that positively influence learning outcomes (OECD, 2015) In this study, STEM implementation will be measured through, quality of instructional practices such as the use of inquiry-based, problem-solving, and learner-centered teaching pedagogies aligned to Competency-Based Education (CBE), curriculum coverage and integration, learner engagement in STEM lessons such as active participation, collaboration, experimentation, project based learing, problem based learning that sustain interest in STEM learning activities, learner performance, skills development and acquisition of STEM competencies such as critical thinking, creativity, problem-solving, and application of knowledge.

According to a study carried by Fahadi et al. (2022) in Chicago, on technology enhanced teaching in engineering education in senior schools and colleges, it found that teachers' knowledge construction used Technological Pedagogical Content Knowledge (TPACK) framework which was purposeful integration of digital tools, platforms, and resources. When the framework was integrated in instructional practices it improved teaching effectiveness and student learning outcomes. The study further found that in science teaching, digital tools aroused students' interest not only in acquiring learning outcomes, but also on interacting and collaborating with their friends or peers more freely. The study concluded that, the use of digital tools in teaching science education had imparted general knowledge, a broad-minded attitude and enhanced creativity among learners in schools in Chicago. This meant that the use of digital tools was a better way of motivating students and that it contributed to effective teaching and learning of sciences. This implies that using digital resources is very important in teaching STEM subjects in public junior schools. While this study focused on the engineering education in senior schools and colleges in Chicago, this study was to establish whether junior school teachers in Kitui county of Kenya use any digital tools or platforms and how such use has imparted on the teaching and learning of science and technology subjects in schools.

In Nigeria, Alaku et al. (2023) found that digital resource implementation in schools enhanced effective science curriculum delivery. The study revealed that digital tools enabled teachers to deliver curriculum more effectively especially in monitoring and assessment of learning activities. Nigeria's introduction of ICT and digital resources in education had been gradual, starting in the 2000s with donor and partner pilots such as laptop donations and teacher training pilots and formal policy development following that. Large-scale, coordinated policy work was consolidated more recently when the National Policy on ICT in Education revised and approved 2019 and accompanying National Implementation Guidelines 2019 were the clearest formal signals of when Nigeria moved from scattered pilots toward a national roll-out strategy. The study further found typically improvements in access, engagement and sometimes procedural skills on the use of simulations, virtual labs, but robust nationwide learning gains in STEM are not consistently documented. Positive STEM imparts outcomes are concentrated where virtual labs, blended learning and teacher support programs were implemented well otherwise, constrained by poor labs, lack of devices, weak connectivity and limited localized digital content. The findings were applicable to the current study since it showed that digital tools and teacher's digital competency had greater influence in implementation of STEM subjects in public junior schools in Kitui county, Kenya.

The Kenyan Government, through its Bottom-up Economic Transformation Agenda (BETA) which is a National blueprint for Kenya, emphases that education should provide manpower for development in housing, agriculture, health and digital super highway. This draws its strength in the teaching and learning of STEM subjects in Junior schools, Senior schools and Technical Vocational and Educational Training (TVET) institutions (Republic of Kenya, 2019). The National ICT Policy Guidelines, Republic of Kenya (2020) revealed the need of integrating ICT in education through digital literacy programs, e-learning and ICT centers in schools. The policy further proposed the deployment of a nationwide e-education system, interconnecting schools, higher educational institutions, training facilities and knowledge centers into one. The National Education Sector Support Programme, NSSP (2018 – 2022) further emphasized the use of digital resources in education improved teaching and learning, and further improved education management outcomes. The policy further encouraged the development and use of digital content to supplement textbooks and other traditional learning resources that supported the introduction of e-learning platforms in schools, teacher training colleges and universities. According to KICD (2023) ICT is a core subject in the national CBE curriculum from junior school to senior school. The curriculum further required learners to infuse digital skills as a core competency such as creativity, critical thinking and learning to learn. This implied that digital resources were key determinant in the implementation of CBE and particularly the STEM pathway.

According to Benita et al. (2021) digital infrastructure for schools is referred to as foundational technologies, systems and facilities that support the use of digital tools and online learning in educational institutions for teaching and learning. They included hardware such as computers, tablets, interactive whiteboards, and projectors, Connectivity such as internet access, Wi-Fi networks, mobile data, Software and platforms such as learning management systems (LMS), digital content, educational apps, and data storage systems, and technical support systems such as power supply, ICT maintenance and cybersecurity measures. According to Kachope et al (2025) digital resources play critical roles in STEM education such as enhancing practical learning through simulations, the use of virtual labs, and modeling software that allow learners to conduct experiments digitally, especially where physical laboratories or materials are limited. It promotes Inquiry-Based learning (IBL) and experiential learning where digital tools help learners in collecting, analyzing and visualizing data, fostering critical thinking and problem-solving skills. It also fosters collaboration and innovation through online platforms such as One Note which enables students to collaborate on STEM projects, share ideas and work on global challenges and lastly it expands access to learning resources where teachers and learners have a wide poll of online materials, open educational resources (OER) and video tutorials that enrich classroom learning and improves assessment and feedback through use of digital systems that make it easier for teachers to track learners' progress through quizzes, e-portfolios and automated feedback tools such as Kahoot.

Keywords: Digital resources, STEM subjects, digital Implementation, digital Competency, Competence-Based Education (CBE), Virtual labs

Statement Of The Problem

Digital resources have gradually become important in enhancing curriculum implementation in all educational levels. The integration of digital resources plays a key role in implementing STEM as it enhances the teaching and learning of STEM subjects by making it more interactive, accessible, and relevant to real-world applications (UNESCO,2020). The Kenyan government has emphasized the need for STEM in its national BETA agenda at all levels of education. Despite national policies promoting ICT and STEM integration in Kenya's CBE curriculum, many public junior schools in arid and marginalized counties like Kitui county still face challenges related to integration of digital resources. According to data from the Kitui County Education Office (2024) some schools reported low levels of effective STEM teaching, limited use of digital resources and uneven teacher readiness in digital skills acquisition. In order to utilize digital tools in teaching and learning, schools should have adequate internet, computer laboratories, electricity and other technology rooms in order to effectively implement STEM. The County Quality Assurance and Standard Officer (2024) on teachers' capacity building report showed that about 30 percent of junior school teachers had undertaken the ICT course, leaving a larger number of untrained teachers who are mandated to implement STEM. The government of Kenya has made efforts to address these challenges through initiatives such as the Digital Literacy Program where teachers have had to undertake a mandatory course on ICT to enable them to effectively integrate use of digital resources into their teaching (KICD, 2017). Despite these efforts, the implementation of STEM subjects' curriculum is still a challenge, yet STEM accounts for 60 percent of learners transiting to Senior School (MOE,2025). Studies have been done in Kitui County on other aspects of the curriculum implementation, but none have focused on STEM implementation in junior schools. Whereas digital resources are recognized as key determinants of STEM curriculum implementation by KICD, their tangible integration into teaching and learning is still understudied in Kitui County. This study investigated the influence of digital resource integration and the implementation of STEM subjects in public junior schools in Kitui County, Kenya.

Study Objective

To establish the influence of teachers' digital competency and the implementation of STEM subjects in public junior schools in Kitui County, Kenya.

Study Hypothesis

$H_0$3: There is no statistically significant influence between teacher's digital competency and the implementation of STEM subjects in public junior schools in Kitui County, Kenya.

Study Theory

This study was anchored on the Technological Pedagogical Content Knowledge (TPACK) theory which was developed by (Mishra & Koehler, 2006). The theory states that effective teaching with technology requires teachers to integrate the three types of knowledge that is technology, pedagogy and content together rather than treating them separately. The theory relates to this study since it showed that effective teaching of STEM education required integration of technology, understanding of the tools and how they connect with pedagogy and STEM content to foster deep learning and engagement. The theory showed that successful digital resource integration in STEM and other disciplines is influenced by teacher technological proficiency, availability of digital technology to enhance pedagogy and digital content to enable effective classroom curriculum delivery. The theory has three components which include Technology Knowledge (TK), Pedagogical Knowledge (PK) and Content Knowledge (CK). The TK aligns with this study such that it enhances mastery of various digital tools and platforms relevant to STEM education, such as simulations, coding environments, virtual labs, AI-driven tutors and collaborative online platforms. These tools enhance interactive and personalized learning experiences for students. The Pedagogical Knowledge (PK) one aligns to the understanding of how to design and implement instructional strategies that incorporate technology effectively. This includes blended learning, flipped classrooms, active learning strategies, project-based, collaborative learning and formative assessment using digital resources. Finally, Content Knowledge (CK), which is a solid grasp of STEM subjects' content, ensures that digital resources align with curriculum goals and promote critical thinking, creativity, problem-solving and real-world application of STEM principles. The framework advocated using technology to create engaging, student-centered learning environments that supported diverse learning styles and encouraged collaboration. It supported the use of digital tools for visualization, simulation, modeling, data analysis, and peer interaction.The theory had been widely used to develop teacher educational programs in developed countries like the United States, Australia, and Finland to prepare educators for technology-rich classrooms (Mishra & Koehler ,2006). One of the major strengths of the theory is that it provided a comprehensive framework that helped educators integrate technology effectively with content knowledge and pedagogical skills, enhancing student engagement and learning outcomes, hence making it the most suitable for this study. However, a major limitation is the access to appropriate resources and technologies that can limit the implementation of TPACK, contributing to inequalities in educational standards. Despite this weakness, it was the best-suited theory for this study as it looked at digital resource integration not as an add-on but as intertwined deeply with STEM content delivery and pedagogy to prepare students with the necessary skills required for the 21st-century learner and technology-rich future STEM workforce.

LITERATURE REVIEW

Teachers' digital competency and the implementation of STEM subjects in public junior schools in Kitui County, Kenya

Digital competency refers to a set of knowledge, skills, attitudes and ethical awareness that enable individuals, teachers and students to effectively use digital tools, resources and platforms in learning and problem-solving**.** According to Krumsvik (2023) digital competency encompasses not only the technical ability to use digital tools but also pedagogical and critical capacities such as integrating digital resources into subject teaching, evaluating online information, and fostering innovation in learners. Without adequate digital competency among teachers, the implementation of STEM subjects often remains limited to theoretical instruction, neglecting a practical, technology-driven and problem-solving approach. In STEM curriculum implementation**,** digital competency is critical since the subjects taught increasingly rely on simulations, coding, digital laboratories and online collaboration to enhance inquiry-based and practical learning. This implied that a teacher whose digital competency is inadequate will hinder his or her preparedness to teach STEM subjects thus affecting learners' motivation levels.

A study conducted by Ocak and Karafil (2021) on the in-service teachers' perceptions of their technological competence in learning and teaching process in Turkey. The study sampled 23 teachers and questionnaire was used to collect data. The findings showed that most of the teachers used technology in the preparation of the

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course content and presentation to students in-class and out of class activities. It was also reported that most of the teachers felt inadequate in integrating technology in education. The use of online systems during covid -19 pandemic enabled the continuity of education and provided an opportunity for teaching despite most schools being out of session. This implied that the use of technology by teachers was critical for the learning process to continue uninterrupted even under emergencies. The study relied on questionnaires as the only way of data collection while the current study used questionnaires and interview guides to collect its data. The study also sought to establish the level of teachers' digital competency in preparing course content and the implementation of STEM curriculum in public junior schools in Kitui County.

Another study carried out by Montilla et al (2023) on the impact of teachers' pedagogical digital competence on performance in the context of physical education in the Philippines. The study adopted a descriptive correlational design and sampled 60 junior high school students from a private school in San Pablo City, Philippines. The research found that teachers possessed a high level of proficiency in their pedagogical digital competence that included technical knowledge, content knowledge, and pedagogical knowledge. This made the teaching of technical subjects more interesting, leading to high learner motivation levels and good performance in sciences and technical subjects. Additionally, the study revealed that there was a strong correlation between teachers' pedagogical digital competence and students' academic motivation levels. This showed that when teachers are equipped with strong digital competencies, they are better able to engage and motivate their students. The findings further highlighted that there was need to integrate technology and digital tools effectively into the teaching and learning process. This implied that teachers' levels of digital competency were key for teachers in Kitui implementing technical subjects which is part of STEM curriculum. The study adopted descriptive correlational design while the current study adapted the embedded mixed method design. This study also sought to establish whether there is a direct correlation between pedagogical digital competency among teachers in public junior schools of Kitui county and the implementation of STEM curriculum.

A study by Purnamawati (2019) aimed at describing the understanding and ability of teachers at Vocational high schools to use ICT in teaching and learning in South Sulawesi Province, Indonesia. The study adopted a survey research design and targeted 142 Vocational teachers. Data was collected using questionnaires. The results showed that the teachers understood the computer hardware in the form of inputs, processes, and outputs. However, they still lacked knowledge of artificial intelligence. The ability of teachers to utilize offline technology in learning was quietly better but it still needed to be improved in terms of making mind maps, instructional videos and graphic designs. The study further showed that teachers were also familiar with the use of search engines, hotspots, e-mail and LAN-connected online. However, teachers had not optimized the use of databases, online learning, online video, online data storage, and the sharing of digital resources. This meant that the understanding of computer hardware and processes, such as mind maps, was key and critical in implementing STEM subjects in junior public schools. The study targeted vocational teachers in South Sulawesi province, while the current study targeted the junior school teachers, their headteachers and a few QASOs. This study sought to find out whether teachers have sufficient knowledge on artificial intelligence and its influence on the implementation of STEM in public junior schools in Kitui County.

In South Africa, Shuro (2020) studied the role and use of ICT in the teaching and learning of learners in Ekurhuleni North District, University of South Africa. The study adopted qualitative case study and targeted 6 teachers from 3 ordinary primary schools. Data was collected using in-depth interviews and observation checklists. The study revealed that ICT increases learners' motivation and concentration span, helps learners to participate effectively, assists in the grasping of concepts and minimises barriers to learning. However, the teachers were poorly trained on technology and needed the help of ICT technicians to operate some technology devices. The study also found that ICT has an important and positive role in supporting learners with barriers in ordinary primary classrooms. This implied that when ICT is introduced into teaching and learning it will play a positive role in enhancing grasping concepts, making STEM subjects visual, practical and learner centred learning thus enhances motivation levels. While the study targeted teachers from ordinary primary schools in Ekurhuleni North District in South Africa, this study targeted teachers, headteachers and quality officers of Kitui county. The study sought to establish whether digital training and digital tools can be integrated into inclusive education and the implementation of STEM subjects in public junior schools.

In Ghana, Akaadom and Gorni (2023) studied on the effect of teachers' ICT knowledge and skills on teaching and learning in Ghanaian basic schools. The purpose of the study was to explore the relationship between teacher ICT knowledge skills and ICT integration in teaching and learning. The study adopted a descriptive quantitative approach and the sample size was 134 in -service basic teachers. The study revealed that teachers found it difficult to use ICT in teaching and rated their knowledge on computers and their functions as modest. The teachers encouraged pupils in class to search for relevant information on the internet as well as asking students to undertake tasks or follow up class work at home on the computer. The study found that there was a positive relationship between teachers' level of computer knowledge, skills and ICT integration in the teaching and learning process, such that teachers with higher ICT knowledge and better skills tend to integrate ICT more in their classroom teaching and learning as opposed to teachers with moderate ICT knowledge who had gaps. This meant that if teachers implementing STEM had modest knowledge on ICT, then their integration of digitals tools will be limited influencing learning outcomes. The study also sought to find out the digital tools that teachers have limited knowledge and skills on when integrated into teaching and learning and their impact to implementing STEM subjects in junior schools.

A study by Duba (2023) investigated the factors affecting the performances of computer science students in Junior secondary schools in Birnin-Kebbi Local Government Area of Kebbi State, Nigeria. The study sampled 130 teachers from ten schools and data was collected using questionnaires. The results showed that there was shortage of qualified teachers teaching computer science and the government did not provide adequate instructional materials and computer laboratories facilities to schools which affected the learning of computer science in these schools. In addition, the government did not award scholarship to computer teachers who had distinguished themselves in excellent services. Further, there were no standard text books for teaching computer skills in junior schools and all these affected the performance of the computer science students in the junior secondary schools. This implied that if teachers are not provided with instructional materials to teach science and the necessary facilities it would greatly impact teaching of STEM subjects. The study only targeted computer teachers in a Nigeria State, while the current study targeted teachers, headteachers at junior public schools in Kitui County. The study examined whether instructional materials and computer laboratory facilities provided by the government are sufficient in the implementation of STEM subjects in public junior schools in Kitui County.

A study by Kalinga and Ndibalema (2023) on the teachers' technological competencies in enhancing teaching and learning in secondary schools in Tanzania categorised teacher's technological competency into three levels, namely Knowledge acquisition, knowledge deepening and knowledge creation. The target population comprised of secondary school teachers in selected schools in Tanzania. A sample of 139 teachers was drawn from multiple secondary schools using random and purposive sampling. Data was collected from 139 teachers using structured questionnaires. The study found that the majority of teachers were at the first level of technological competence which was knowledge acquisition which entailed basic ICT skills such as using digital devices for general purpose. It was also found that there was significant difference between teachers' level of education and technological competencies. However, the study found that there is no significant difference between teachers' gender, age, working experience and technological competencies. The study further recommended that targeted professional development to elevate teachers from basic ICT use to more advanced, creative, and pedagogically integrated practices. This implied that there was need for the teachers to undergo a professional development course to enhance their digital competences to effectively deliver the STEM curriculum in junior schools. The study only targeted secondary teachers, while the current study targeted junior school teachers, headteachers and QASOs. The study also sought to establish the level of teachers' professional development in digital resource integration so as to effectively implement the STEM curriculum in public junior schools.

In Kenya, a study by Murithi and Yoo (2021) investigated the influence of ICT technology integration into lessons and teacher perceptions towards technology in Kenyan public primary schools. The study target was 351online teachers. Data was collected using online questionnaires. The study used descriptive and inferential statistical techniques to analyze the data. The results showed that ICT facilities were inadequate in schools which posed a challenge in the integration of technology during the implementation of the new curriculum. Most of the teachers had received only basic computer literacy training which would not allow them to apply and integrate digital tools when teaching. Although teachers perceived the use of computers as necessary, they

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faced difficulties integrating technology in their lessons. This implied that more ICT facilities should be made available to schools to enable teachers to effectively integrate the use of digital resources in teaching and learning which would make the STEM lesson interactive. The study focused on teachers from public primary schools in Kenya while the current study focussed on teachers, headteachers from junior schools and quality assurance officers from Kitui county. This study sought to establish the levels of teacher's computer training and ICT integration into teaching and learning influenced the implementation of STEM subjects in Public junior schools of Kitui County.

In Kenya, a study Gesar et al. (2023) investigated the relationship between teacher competency in ICT and the integration of ICT in teaching in secondary schools. The study adopted descriptive research design. Primary data was collected from 23 Principals, 30 Home science teachers and 480 students. The results indicated that teacher competency plays a key role in the efficiency of teaching using ICT as it boosts teacher confidence while integrating ICT. However, majority of teachers were not well equipped with relevant ICT skills for use in teaching giving reasons as lack of computer proficiency, lack of digital content, lack of exposure to ICT facilities among others. This implied that if teachers were provided with the necessary ICT skills, then they would effectively integrate digital resources in their teaching, which would greatly impact the implementation of STEM curriculum in junior schools in Kitui county. Despite the above study adopting descriptive research design our current study adopted embedded mixed method design. The study sought establish whether teacher competency in ICT skills would influence the implementation of STEM subjects in public junior schools in Kitui county.

RESEARCH METHODOLOGY

The study adopted the embedded mixed method research design with the dominant one being the quantitative method and the embedded one being the qualitative one. The target population for this study was 4782 participants comprising of 1102 headteachers of these schools because they are mandated to manage junior schools, 3661 teachers who are involved in the actual implementation of the STEM subjects, drawn from public junior schools in Kitui county. The 19 Sub-County Quality Assurance and Standards Officers (SCQASOs) formed part of the study population since they monitor, assess and evaluate the quality of teaching standards in these schools. From these 22 headteachers and 72 teachers participated in piloting, leaving a population of 1080 junior schools and 3589 junior school teachers. The sub counties were clustered into 19 clusters from which the researcher picked the study sample in proportions to the sub-county's population. This ensured fair representation and unbiases towards larger or smaller sub-counties. Proportionate stratified random sampling was used to determine the number of schools per sub county. The headteachers and SCQASOs were purposively sampled since there was only one headteacher per sampled public junior school and one SCQASOs per sub-county. The Yamane's 1967 formula $n = \frac{\mathrm{N}}{1+\mathrm{N}(\mathrm{e})2}$ was used to determine the numbers of teachers and schools. Where; n=Number of samples, N= Total population and e= Error tolerance (0.05) as shown below: -

$$\frac{3661}{1+3661(0.05)2} = 360 \text{ Teachers}$$

$$\frac{1102}{1+1102(0.05)2} = 294 \text{ Junior schools}$$

From the formula above, 294 junior schools and 360 teachers were sampled for the study. Simple random sampling was used to select a sample of 294 schools from the 1,102 public junior schools from the 19 clusters. A sample of 670 respondents including 294 headteachers, 360 teachers and 16 SCQASOs was sampled. A sample of 670 respondents including 294 headteachers, 360 teachers and 16 SCQASOs was sampled. Data was collected by use of structured questionnaires for headteachers and teachers, while interview schedules were used to collect data from Sub-county Quality Assurance and Standards Officers. Quantitative data was analysed aided by Statistical Package for Social Sciences (SPSS) software program version 28. Data was presented in descriptive statistics such as frequencies, tables, percentages, graphs, means and Standard deviation. Qualitative data from open ended questions, opinions and interviews was analysed using content analysis technique. The findings from interviews were reported and transcribed into themes and presented in narrations and direct quotes. A Pearson product-moment correlation was conducted to examine the relationship between independent and dependent variables, while regression was used to test the hypothesis.

STUDY FINDINGS

The study objective sought to establish the influence of teachers' digital competency and the implementation of STEM subjects in public junior schools in Kitui County, Kenya.

Response Rate

The study's research instruments were questionnaires given to headteachers and teachers, while interview guides were provided for the Sub-County Quality Assurance and Standards Officers (SCQASOs). A total of 670 respondents were sampled. The response rate is presented in Table 1

Table 1: Return Rate of Research Instruments

Respondents	Sample size	Number Collected	Return rate (%)
Headteachers	294	290	98.6
Teachers	360	305	84.7
SCQASOs	16	16	100.0
Total	**670**	**601**	**Average 94.4**

The head teachers' return rate was 98.6 %, teachers at 84.7 %, and SCQASOs was 100 %. The average response return rate was 94.4 %, which was considered adequate and acceptable for a social sciences study. Mugenda and Mugenda (2019) indicated that a response rate of 60% is good, a response rate of 70% or above is very good for descriptive survey research, and a response rate of 50% is sufficient for reporting and analysis. Since more than 90 % of the population participated, the response rate was high and considered excellent. The feedback improved sample representation and sincere generalization by providing the necessary information for data analysis. The relatively higher response rate of 100 % SCQASOs indicated stronger institutional participation as well as the willingness of the educational officials to participate in the study.

The headteachers and teachers were asked to indicate whether they had been trained on digital literacy skills. The results were presented in Table 2

Table 2: Responses of Headteachers and teachers on Digital Literacy Skills Training

Responses	Head teachers (n=290)		Teachers (n=305)	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Maybe	17	5.9	17	5.6
No	92	31.7	55	18.0
Yes	181	62.4	233	76.4
Total	290	100	305	100

The results showed that headteachers who had been trained on digital skills indicated Yes at 62.4%, No at 31.7 %, and " Maybe " at 5.9 %. The teachers reported that 76.4 % had been trained on digital literacy, 18.0 % responding not been trained, while 5.6 % reported maybe.

The head teachers and teachers were asked to indicate the types of training undertaken on digital content and ICT integration in STEM teaching. The results were presented in Table 3

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Table 3: Responses of Headteachers and Teachers on the Types of Training Undertaken on Digital Content for STEM Teaching

Training	Head teachers (n=290)		Teachers (n=305)	
	Frequency	**Percentage**	**Frequency**	**Percentage**
CEMASTEA Training (e Virtual Labs)	115	39.7	50	16.4
Retooling / TSC Workshops	48	16.6	28	9.2
Basic Computer Skills / Packages	37	12.8	22	7.2
Virtual Laboratories Training	30	10.3	23	7.5
AI Tools Training	20	6.9	13	4.3
General Digital Literacy / Integration	14	4.8	14	4.6

The results showed that headteachers undertook digital training from CEMASTEA workshops on virtual laboratories at 39.7%, and TSC retooling at 16.6 %, on basic computer skills and packages at 12.8 %, AI tools training at 6.9 %, and general digital literacy/integration at 4.8 %. The teachers on the other hand, reported having been trained by CEMASTEA at 16.4 %, retooling/TSC workshops at 9.2%, basic computer skills training at 7.2 %, AI tools training at 4.3%, and general digital literacy integration at 4.6 %.

The headteachers and teachers were asked to tick on the extent to which they agree with statements on the digital competency of teachers. The results were presented in Table 4.

Table 4.: Responses of Headteachers and Teachers on Perceptions of Teachers' Digital Competency

Statements	Head teachers (n=290)		Teachers (n=305)	
	M	**Std.**	**M**	**Std.**
Trained teachers in ICT have the confidence to use digital devices as compared to those without	3.72	1.52	3.73	1.47
I use a computer as a tool for demonstrating workings/procedures with presentations that I have made myself (e.g., PowerPoint)	2.69	1.41	3.02	1.45
I use digital devices for demonstration working with existing presentations, or those someone else has made for me.	2.88	1.46	3.05	1.44
I use digital devices to teach new subject knowledge in STEM	2.84	1.41	3.09	1.42
I believe my digital competency and resource use directly impacts students' performance in STEM.	3.30	1.45	3.50	1.43
I can guide learners in class to search for relevant information on the Internet using a digital device.	3.35	1.44	3.67	1.48
I can easily undertake tasks or follow up class work at home through the internet and LMS	2.71	1.47	3.20	1.55
I can easily monitor learners progress online during a STEM simulation lesson.	2.66	1.44	3.12	1.52
The school organizes ICT training for the staff/teachers	2.57	1.43	2.06	1.42
Average	2.97	1.44	3.16	1.46

The results showed the means and standard deviation for the various statements from the headteachers as: those trained teachers in ICT and have the confidence to use digital devices as compared to those without (M=3.72, Std. =1.52), those that use a computer as a tool for demonstrating workings/procedures with presentations and have made themselves (e.g., PowerPoint) (M=2.69, Std. =1.41), those that use digital devices for demonstration working with existing presentations, or those someone else has made for them (M=2.88, Std. =1.46), those that use digital devices to teach new subject knowledge in STEM (M=2.84, Std. =1.41), those that believe their digital competency and resource use directly impacts students' performance in STEM (M=3.30, Std. =1.45), those that can guide learners in class to search for relevant information on the Internet using a digital device (M=3.35, Std. =1.44), those that can easily undertake tasks or follow up class work at home through the internet and LMS with (M=2.71, Std. =1.47), those that can easily monitor learners progress online during a STEM simulation lesson with (M=2.66, Std. =1.44) and those that the school organizes ICT training for the staff/teachers (M=2.57, Std. =1.43).

For the teachers the means and standard deviation for the various statements were as follow: those trained teachers in ICT and have the confidence to use digital devices as compared to those without (M=3.73, Std. =1.47), those that use a computer as a tool for demonstrating workings/procedures with presentations and have made themselves (e.g., PowerPoint) (M=3.02, Std. =1.45), those that use digital devices for demonstration working with existing presentations, or those someone else has made for them (M=3.05, Std. =1.44), those that use digital devices to teach new subject knowledge in STEM (M=3.09, Std. =1.42), those that believe their digital competency and resource use directly impacts students' performance in STEM (M=3.50, Std. =1.43), those that can guide learners in class to search for relevant information on the Internet using a digital device (M=3.67, Std. =1.48), those that can easily undertake tasks or follow up class work at home through the internet and LMS with (M=3.20, Std. =1.55), those that can easily monitor learners progress online during a STEM simulation lesson with (M=3.12, Std. =1.52) and those that the school organizes ICT training for the staff/teachers (M=2.06,Std. =1.42)

The headteachers and teachers were asked to suggest areas of digital literacy programs that needed more training. The results were presented in Table 5

Table 5: Responses of Headteachers and Teachers on the Key Areas for Further Training

Area of Training needed	Head teachers (n=290)		Teachers (n=305)	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Basic Computer Skills & Packages	81	27.9	44	14.4%
Use of Specific Tools (PowerPoint, Excel, Projectors)	54	18.6	28	9.2%
ICT Integration in Teaching & Learning	48	16.6	50	16.4%
Content Creation & Searching Information	37	12.8	-	-
Use of Digital Devices (Tablets, Laptops, Smartphones)	32	11.0	-	-
AI Tools & Advanced Applications	20	6.9	34	11.1%
Virtual Labs, Simulations & Programming	19	6.6	75	24.6%
Online Assessment & Monitoring Learner Progress	15	5.2	19	6.2%
Coding / Programming & Visual Programming	-	-	23	7.5%

The results showed that headteachers needed basic computer skills and packages at 27.9 %, use of specific tools at 18.6 %, ICT integration in teaching and learning at 16.6 %, Content creation and searching information at 12.8 %, Use of digital devices (Tablets, Laptops, Smartphones) at 11.0%, AI tools and advanced applications at 6.9 %, Virtual labs, simulations and programming at 6.6 % and online assessment and monitoring learner progress at 5.2 %. From the results of teachers, it was clear that the need for Virtual labs, simulations and programming at 24.6 % was the highest, followed by ICT integration in teaching and learning at 16.4 %, basic computer skills and packages at 14.4 %, AI Tools and advanced Applications at 11.1%, use of specific tools such as PowerPoints at 9.2 %, Coding / Programming and Visual Programming at 7.5 % and online assessment and monitoring learner progress at 6.2 %.

The headteachers and teachers were also asked to indicate how digital resources made teaching of STEM subjects enjoyable as opposed to contemporary methods. The findings were presented in Table 6.

Table 6: Responses of Headteachers and Teachers on the Ways Digital Resources Make STEM Teaching Enjoyable

Ways that digital resources made teaching STEM subjects enjoyable	Head teachers (n=290)		Teachers (n=305)	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Increased Interactivity & Learner Engagement	88	30.3	106	34.8
Visualization of Abstract Concepts	81	27.9	81	26.6
Easier Understanding	30	10.3	48	15.7
Promotes Hands-on & Practical Learning	48	16.6	44	14.4
Stimulates Curiosity & Critical Thinking	59	20.3	106	34.8

From the results above, it is evident that 30.3% of headteachers supported those digital resources when used in teaching, increased interactivity and learner engagement, 27.9 % were in support of helping in the visualization of abstract concepts, 10.3% said it enhanced easier understanding, 16.6% were in agreement that it promotes hands-on and practical learning, while 20.3% said it stimulated curiosity and critical thinking. The results from teachers showed that digital resources increased interactivity and learner engagement when used in teaching, at 34.8%, helped in visualization of abstract concepts 26.6%, enhanced easier understanding at 15.7%, promoted hands-on and practical learning at 14.4%, while stimulating curiosity and critical thinking at 34.8%.

The headteachers and teachers were asked to indicate the measures to enhance teacher training on digital resources. The findings were presented in Table 7

Table 7: Responses of Headteachers and Teachers on the Measures to enhance teacher training on digital resources

Measures to enhance teacher training on digital resources	Head teachers (n=290)		Teachers (n=305)	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Frequent Training & Workshops	115	39.7	106	34.8
Government Intervention & Funding	106	36.5	129	42.3
School-Based / Zonal / Cluster-Level Training	54	18.6	34	11.1
Provision of Digital Devices & Infrastructure	48	16.6	59	19.3
Mandatory & Continuous Professional Development	30	10.3	-	-
CEMASTEA / TSC-Led Retooling	20	6.9	28	9.2

The results showed that most headteachers agreed that frequent workshops and trainings was the best measure to enhance teacher training on digital resources integration at 39.7 %, government intervention and funding at 36.5 %, School-based or zonal or cluster level trainings at 18.6%, provision of digital devices and infrastructure at 16.6 %, mandatory and continuous professional development at 10.3 % while 6.9 % suggested on CEMASTEA / TSC-led Retooling. The results from teachers also agreed that frequent workshops and trainings were a good measure to enhance teacher training on digital resources integration at 34.8 %, government intervention and funding at 42.3 %, School-based or zonal or cluster level trainings at 11.1%, Provision of digital devices and infrastructure at 19.3 %, mandatory, while 9.2% suggested on CEMASTEA / TSC-led Re-tooling.

In order to improve the quantitative findings on teachers' digital competency, interviews were conducted with SCQASOs in Kitui County. The responses were organized thematically as presented in Table 8

Table 8: Responses of Qualitative Findings from SCQASOs on Teachers' Digital Competency and the Implementation of STEM subjects.

Theme	**Sub Theme**	**Quotes**
Teacher Digital	Moderate digital competency among	Average as most were not properly trained."

Competency	teachers	
	Reliance on mobile phones for instruction	"Fairly as most rely on their mobile phones."
Technology Integration Skills	Capacity building initiatives	"Through capacity building workshops and training."
	Use of virtual simulations and laboratories	"I assess whether teachers use tools like simulations and virtual labs to replace missing physical apparatus.
	Use of projectors and smart boards	"I look for the effective use of projectors and interactive whiteboards to move away from purely theoretical instruction."
Digital Content Management	Digital content curation	"I assess how teachers navigate the content void by finding or sharing e-books and ICT supplementary materials through peer networks like WhatsApp."
	Connectivity problem-solving	"Competency is demonstrated by teachers who manage to maintain instruction despite poor signal strength and high data costs."
Digital Literacy Training	STEM-specific digital training	"There have been targeted efforts to train teachers on using digital resources for STEM subjects."
	Basic digital literacy skills	"Initial training focused on fundamental computer operations and using government-provided tablets and laptops."
	Training on digital content access	"Teachers have been trained on how to access e-books, digital textbooks, and government-curated digital content portals.
Informal Teacher Learning	Peer-to-peer training	"Many teachers engage in informal peer-to-peer training."
	WhatsApp collaboration and troubleshooting	"Teachers often use platforms like WhatsApp to share retooling tips and troubleshoot technical issues."
	Self-training and innovation	A significant portion of teachers have effectively self-trained to integrate their personal smartphones and laptops into classroom instruction."
Institutional Support Strategies	Sensitization workshops	"We organize one or two-day sensitization workshops." "Workshops provide training on accessing and managing e-books, virtual simulations, and digital portals.
	Zonal collaboration between schools	"Schools that neighbor better-equipped institutions are encouraged to share digital resources and technical know-how."
Peer Support Mechanisms	Communities of practice	"We encourage teachers to use platforms like WhatsApp to share retooling tips and troubleshoot digital STEM content issues."

The quantitative results of teachers and head teachers corroborated the qualitative responses from SCQASOs which confirmed that the teachers' digital competency had a significant impact on the implementation of STEM subjects in public junior schools in Kitui County. The quantitative results indicated that overall, teachers' digital competency was moderate, but weak in the areas of internet use, guiding the learner, and using digital instruction tools. This was corroborated by the qualitative responses where it was found that the majority of teachers have an average level of digital competency, due to the lack of adequate professional training in ICT amongst a number of teachers. The respondents highlighted the support that teachers sometimes provided to teaching using personal devices and mobile phones, indicating that digital competency is to a large extent a matter of necessity and not of formal institutional capacity.

The study further conducted cross-tabulations to establish whether there was a significant difference between training attendance and implementation of STEM subjects. The results are presented in Table 9

Table 9: Cross-tabulations on Training Attendance vs Implementation of STEM subjects

Implementation of STEM subjects	Maybe	No	Yes	Total
Low	0(0.0%)	2(1.0%)	28(14.3%)	30(15.3%)
Moderate	1(0.5%)	13(6.6%)	51(26.0%)	67(34.2%)
High	8(4.1%)	20(10.2%)	71(36.2%)	99(50.5%)
Total	**9(4.6%)**	**35(17.9%)**	**150(76.5%)**	**196(100.0%)**

The cross-tabulation analysis shows a strong positive correlation between the successful implementation of STEM subjects in public junior schools in Kitui County and Teacher Digital competency. The higher the training level, the more often teachers effectively implement STEM subjects. The data also revealed a very important "implementation gap," which needs to be explored. Notably, 10.2% of teachers who had a high level of teacher training indicated that the implementation of STEM was not taking place, while 6.6% of teachers with moderate teacher training indicated that the implementation of STEM was not taking place.

Regression analysis was conducted to understand how a unit change in teachers' digital competency may cause a change in the implementation of STEM subjects in public junior schools in Kitui County, Kenya. The coefficient of determination showed how a statistical model is expected to predict future results. The results were shown in Table 10

Table 10: Regression Results on Teachers' Digital Competency and Implementation of STEM Subjects

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.264[a]	.070	.065	1.397

ANOVA[b]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	28.358	1	28.358	14.520	.000[a]
	Residual	378.882	194	1.953		
	Total	407.240	195			

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.621	.182		19.930	.000
	Teachers' Digital Competency	.281	.074	.264	3.811	.000
a. **Dependent Variable**: Implementation of STEM Subjects						

The model summary of the results in Table 4.29 indicated that teachers' digital competency explains 7% of the variance in implementation of STEM subjects (R-square = 0.070). Further, the F-test statistic ($F = 14.520$, $p = .000$) shows the fitness of the regression model, which means that teachers' digital competency was a significant predictor of implementation of STEM subjects.

DISCUSSIONS AND INTERPRETATIONS

The findings Table 2 showed that a majority of the head teachers and teachers had undergone training on digital literacy skills. This implies that the government, educational agencies and other stakeholders had made considerable efforts to ensure that teachers in public junior schools are digitally competent and that this had been achieved for a significant number of junior school teachers. The results suggested that many teachers had, at least basic digital knowledge and skills to support technology in both the teaching and learning process of STEM at 76.4 percent. The study additionally confirmed that teachers indicated a slightly higher level of digital literacy training than the head teachers. A significant number of both headteachers and teachers, however, noted that they had no training on digital literacy at 31.2 percent and 18 percent, respectively. This indicated that there is still a need for professional development and acquiring digital skills for teachers. The lack of training could negatively affect teachers' capacity to effectively incorporate digital technologies, use online educational resources, and facilitate student-centered STEM learning. This is in agreement with Michael et al. (2016), who found that teachers' ICT competency significantly influences the successful integration of ICT in teaching and learning.

The findings also revealed that a small percentage of teachers (5.8%) were not sure if they got enough training in digital literacy, with the "maybe" responses. This also meant that some teachers had received only minimal or informal training, which did not adequately provide them with digital teaching skills. It also highlighted the differences in the quality, depth, and/or relevance of digital literacy instruction provided to educators. These results are in agreement with Abdullahi (2020) that the majority of teachers in public schools in Garissa County had not attended any training on how to implement the new curriculum.

On the types of training undertaken on digital content for STEM teaching from the results, Table 3 indicated that most of the headteachers and teachers had undertaken common trainings on digital content and ICT integration in STEM teaching. Only a few head teachers had been trained in AI tools or in advanced digital pedagogies (7 %) which may be attributed to low utilization of digital resources. A high number of teachers had received no formal training necessary to use digital content and tools for the STEM classes. These findings are in agreement with Johnson and Smith (2023) who discovered that teacher preparedness for ICT usage in classrooms was restricted, especially in places with lower socio-economic status, where access to training resources is less numerous. A majority of the trained teachers (39 %) had attended CEMASTEA workshops, especially in virtual laboratories, and the general retooling programme. Only a few (4.1 %) had been trained in AI tools or advanced digital pedagogy, which may be the main reason for the underutilization of the existing digital resources and poor implementation of the CBE in junior schools. The findings are in agreement with Barker and James (2022) that even though a lot of teachers were proficient with the fundamentals of computers, those without the necessary resources and training still found it difficult to prepare lessons using technology.

On the perceptions of teachers on digital competency, the findings from Table 4 showed that digital competency of the teachers in the junior schools of Kitui County was at a moderate level with a mean of 2.97 for the head teachers and 3.15 for the teachers respectively. The results showed that the respondents perceived teachers trained in ICT were more confident in utilization of digital devices than untrained teacher. This indicated the importance of digital literacy training to enhance teachers' self-efficacy and interest for the use of technology in education. The results suggested that teachers with the competencies in ICT were more inclined to use digital teaching methods and effectively implement STEM subjects. The study also showed moderate agreement on the use of computers to present procedures and presentations developed by teachers with a mean of 3.04. This indicated that in some schools, some teachers used digital presentation tools (PowerPoint) in STEM lessons, but not all teachers did so. The findings suggested that limited digital competency, lack of devices or lack of training in the use of digital instructional materials may have limited teachers' capacity to create and use the digital instructional materials for the teaching of STEM subjects. The results also indicated a moderate agreement with other pre-made presentations created by others using digital devices. This implies that teachers' ability in using ready-made digital materials was greater than their ability in creating their own digital materials. The dependence on pre-prepared materials due to lack of technical skills, time for preparation or confidence in their ability to make personalized digital learning resources. These findings were in agreement with Muchiris (2021) also established that majority of teachers had not received training on the implementation of the Competency-Based Curriculum.

Moderate consensus was also found on the use of digital devices for the purposes of teaching new subject knowledge or content in STEM subjects. This indicated that digital technologies were increasingly being integrated into teaching and learning delivery, but not to a great degree. The moderate scores, however, suggested that the effective use of online learning platforms and internet-based instructional support is still not fully developed across public junior schools in Kitui County. The results suggested that although good digital practices are progressively being integrated into the school context, many of the teachers could continue to experience difficulties in integrating technology into their regular classroom instruction. The findings also showed that teachers and head teachers, in general, indicated that the teachers' digital competency and using digital resources directly affected students' performance in STEM subjects through improving the effectiveness of teaching and learning outcomes.

The study also demonstrated comparatively high consensus among teachers in relation to their competencies in supporting the search for relevant information through information technology resources on the internet. The findings further indicated that many teachers had basic digital facilitation skills, which were required for the facilitation of online learning and information literacy of learners, and many teachers are increasingly adopting the role of facilitators in learning environments supported by technology, instead of just a teacher-centered approach. The results also showed agreement on the teachers' competencies in completing activities or following up on classwork via the internet and Learning Management Systems (LMS), which were in support of Kalinga and Ndibalema (2023) who found that majority of teachers were at the first level of technological competence which was knowledge acquisition which entailed basic ICT skills such as using digital devices for general purpose.

The study also revealed moderate agreement among teachers in their ability to track learners' progress when using online STEM simulations during lessons at mean of 3.20. This indicated a low level of engagement in online monitoring of learners, while some teachers did have skills in digital assessment and monitoring. Results from Table 4 further indicated the potential risk that schools and educators have not fully adopted higher-level digital teaching/learning methods with STEM education. Additionally, these findings demonstrated that respondents were not in agreement as to whether schools provided ICT training opportunities to teachers/staff, which was in agreement with Mugabo et al. (2021), who also found that there exists a difference in CBE teacher training and insufficient training.

On the key areas that needed further training, the results from Table 5 showed that there was a great difference between head teachers and classroom teachers in terms of their perceptions of training needs. These findings indicated that school heads understood that to successfully integrate technology fully, they must start with a strong foundation of technology basics for teachers which was at 14.4 %. On the contrary, teachers emphasized more on practical and vocational skills. The teachers were in dire need on trainings on Virtual Labs (24.5%), Simulations and Programming (16.3%), and ICT Integration in Teaching & Learning (11.2%). This meant that teachers were more interested in gaining skills directly applicable to their classroom delivery and practical STEM teaching.

The relatively low demand for training (5.3% head teachers, 6.1% teachers) in online assessment and monitoring learner Progress suggested that this area is not yet perceived as a need or priority, perhaps as a result of less exposure to Learning Management Systems (LMS). The data also pointed out a two-level capacity gap on one hand, the school leaders are looking for basic capacity building in digital skills, while on the other hand, the teachers should be provided with more in-depth training in pedagogical and digital skills, particularly in engaging with virtual labs and AI tools. These findings are in agreement with Ndambukia et al. (2024) who noted that the professional development courses are not adequate and needed to be improved, especially on technical and practical subjects like sciences, home science, ICT, and agriculture.

The headteachers and teachers also indicated the ways digital resources can make STEM lesson enjoyable. The results from Table 6 showed that, when digital resources are used effectively, they can have a transformative impact on STEM lessons, making them more active and fun. A majority of head teachers and teachers (32.5%) identified the benefit of increased interaction and learner engagement as their key benefit. This indicated that digital tools helped improve the rate of students' participation in learning which may not be the case in the chalk-and-talk approach. The second most cited benefit (27.3%) was visualization of abstract concepts. This was especially significant in STEM disciplines, where concepts like chemical structures, circuits and models required visualization to aid understanding. This was echoed by Shuro (2020) who added that when ICT is introduced into teaching and learning, it will play a positive role in grasping concepts and this makes STEM subjects visual, practical and learner-centred, thus enhancing motivation and learning. Teachers also strongly believed that digital resources stimulate curiosity and critical thinking (34.7%). Although the use of digital resources was still low as a result of the shortage of infrastructure and teachers' skills, teachers understood the potential for change when digital resources are accessible and effective. This was a good indicator that there was need to meet some of the challenges of infrastructure, content, and teacher training to make learning STEM more hands-on and engaging in Kitui County. These findings are in agreement with Gesar et al. (2023) that teacher competency plays a key role in the efficiency of teaching using ICT as it boosts teacher confidence while integrating ICT.

On the measures to enhance teachers' training on digital resources, the findings in Table 7 showed high agreement of both head teachers and teachers on the need for more regular and formal training. Frequent training and workshops (37.2%) are the most recommended measure by the headteachers. This was due to general dissatisfaction with the existing one-off or inadequate retooling programs and a need for ongoing professional development. Government intervention or funding was recommended (38.5%). The respondents opine that making digital competency sustainable requires deliberate policy support, increased funding, and systematic coordination by the Ministry of Education and TSC. Interestingly, teachers were slightly more likely to consider the provision of digital devices and infrastructure (19.4%) as a priority as opposed to head teachers (16.4%). This implies that classroom teachers acknowledge that training is not enough if they don't have the tools to practice and apply those skills in the classroom. These findings also agree with Okeyo and Mokua (2023) that all public junior schools were unprepared to execute CBE curriculum.

The preference for school-based / zonal / cluster-level training also suggests a need for more context-specific, accessible and less disruptive forms of capacity building. The data showed that headteachers and teachers didn't disagree with the integration of digital tools into the education system, but rather they are requesting a more structured, well-supported and ongoing professional development process for teachers. The fact that a lot of workshops are emphasized, government support is needed and infrastructure provision has been given from the point of view of frequency and practicality, it is understood that the current training program is not adequate in terms of frequency and practicality which concurred with Waweru (2018) who claimed that teachers need more than two years to acquire the necessary knowledge to effectively instruct learners although. Most of the JS instructors did not receive training in the new curriculum. Moreover, the training frequency was minimal, as just 18.9% of educators underwent training more than three times, while 81.1% attended training one, two, or three times.

The Qualitative data from the interview with the SCQASOs on the teacher's digital competency, showed that teachers had a moderate competence in using technology in STEM learning by using simulation, virtual laboratory, projector, and interactive whiteboard as indicated in Table 8. This was corroborated by the qualitative results, where the teachers who were rated as competent by their SCQASOs did consider that they used simulations and virtual laboratories to make up for the lack of physical laboratories. The SCQASOs further noted that projectors and smartboards that were used effectively enabled teachers to shift their teaching methods from the theoretical to more practical and visual STEM instruction. This triangulation implies that the preparation of teachers to be digitally competent was slowly but surely improving, especially in the presence of infrastructure challenges.

Findings also showed that teachers moderately used digital devices that could be used for demonstration during lessons, for internet-based learning and to support learners in accessing information on the internet. The results matched the qualitative data, indicating adaptive responses of teachers to manage digital content and instruction. Teachers often used peer sharing software like WhatsApp to share e-books, additional ICT materials and teaching materials such as schemes of work. Furthermore, teachers were also identified as being resilient and innovative when teaching STEM in the context of weak internet connection and high cost of data, highlighting their ability to carry on with teaching even in such conditions.

The research also revealed that although most teachers had received some digital literacy training, there were still some areas where they lacked competence with digital skills. This was confirmed by the qualitative results which showed that teachers had made use of digital training in many different ways: CBC digital integration programs, STEM specific ICT training, basic computer literacy courses. The SCQASOs further noted that teachers had been trained on accessing digital textbooks, e-books, and government-curated digital content

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portals. However, the results also indicated that most of the training had mainly focused on basic digital operations and not on pedagogical and technical maintenance skills. This has led to moderate competency being reported by teachers and head teachers in the quantitative findings.

The results also demonstrated that informal learning processes were an important part of developing teachers' digital competency. Qualitative responses in general showed that the teachers were involved in peer learning, collaborative problem solving and self-training because they had no formal technical support systems. Teachers often shared their "retooling" tips and addressed digital teaching problems through communities of practice and platforms, such as WhatsApp. The respondents also noted that some teachers had self-trained themselves to the use of their own personal smartphones and laptops in the classroom. Such findings are consistent with the quantitative findings of moderate level of digital competency, even with the low level of institutional support for ICTs. Another finding of the study was that the digital competency of teachers was not realized due to the lack of institutional support. Results of the quantitative analysis revealed low agreement in relation to the school-organized ICT training program for teachers.

Likewise, the qualitative results showed that very few schools carried out the short introductory workshops that were one or two days in total, and did not have enough time to develop the competencies of digital teaching. The need for ongoing and localized retooling programme, as opposed to isolated workshops was highlighted. The results also indicated that the current educational programme tended to focus more on theoretical teaching than on technical maintenance, which resulted in teachers lacking the ability to deal with technical failures and hardware breakdowns without the support of their teachers. Lastly, the results found that there were collaborative institutional approaches in place for enhancing teachers' digital competence. The qualitative results showed that schools established collaboration with the neighbouring institutions on the sharing of digital materials, technological knowledge, and ICT infrastructure. The development of communities of practice and peer mentorship were also encouraged to enhance teachers' digital skills. The quantitative results indicated a moderate level of teachers' competency despite the lack of infrastructure and institutional support, which is supported by these findings.

The study further looked at the training attendance versus implementation of STEM subjects to understand how they correlate; the trend in Table 9 indicated that digital competency is one of the key factors of the educational reform in the region. This indicated that a strong understanding of digital tools among teachers is strongly associated with the likelihood of such knowledge being translated into practice. Moreover, the overall implementation rate is quite high (76.5%) and suggests a widespread institutional shift toward the use of STEM. This implies that digital competency is a necessity, but not an end in itself. These "No" responses suggest that external factors such as inadequate infrastructure, access to digital devices, and lack of content alignment may be limiting the successful implementation of the STEM curriculum by even the most skilled teachers. The results are in agreement with Shuro (2020), who revealed that ICT increases learners' motivation and concentration span, helps learners to participate effectively, assists in the grasping of concepts and minimises barriers to learning.

The study went further to test the hypothesis **$H_0$3**: There is no statistically significant influence between teachers' digital competency and the implementation of STEM subjects in public junior schools in Kitui County, Kenya. The regression results from Table 10 showed that the F-test statistic ($F = 14.520$, $p = .000$) shows the fitness of the regression model, which means that teachers' digital competency was a significant predictor of the implementation of STEM subjects. On individual significance, teachers' digital competency was significant since p-values was less than 0.05 giving the predictive model as: implementation of STEM subjects = 3.621 + 0.281 teachers' digital competency. This means that if teachers' digital competency was increased by one-unit, implementation of STEM subjects would on average increase by 0.281 units. Therefore, the hypothesis $H_0$3 was rejected and an alternative accepted that states that there is statistically significant influence between teacher's digital competency and the implementation of STEM subjects in public junior schools in Kitui County which are in support of a study by Montilla et al (2023) that there is a significant relationship between teachers' pedagogical digital competence and students' academic motivation. The statistical results further showed that teacher digital competency even though statistically significant, has the weakest influence amongst the four predictors ($\beta = 0.194$). This implies that whereas teachers' skills in using digital tools are essential, their influence on STEM implementation is more effective when supported by adequate infrastructure, digital content, and proper technical systems. Based on these inferential results, the researcher concluded that poor implementation of STEM curriculum in public junior schools in Kitui County was caused by inadequate teacher digital competency, as shown by the descriptive results.

CONCLUSIONS

The study found that digitally competent teachers were more confident in incorporating digital tools in the classroom, navigating learners through a digital platform and Learning Management Systems (LMS) and creating interactive STEM learning experiences. It also found that most teachers had not been adequately trained or capacity build on the use of digital platforms for teaching. Inferential analysis showed that there was a positive and significant influence between teacher digital competency and the implementation of STEM subjects. Descriptive data showed that there is a moderate level of digital competencies among teachers, and they still need additional training on virtual laboratories, simulations, programming, AI tools and online assessment of students. The study, therefore, concluded that low levels of digital competency among teachers was the cause for poor implementation of STEM in junior public schools in Kitui County.

RECOMMENDATIONS

Based on the study findings and conclusions, the study recommends as follows;

1. The MOE should develop a policy framework and manuals that will enhance teacher training on digital resources and ICT for junior schools.
2. The CEMASTEA should carry out a needs assessment on the digital infrastructures available in junior schools and identify the urgent training needs.
3. The government, through the MOE, should retool teachers on Virtual laboratories, simulations, programming, AI tools, and online assessment of students to enhance teaching of STEM.
4. The need for a comprehensive approach that combines enhancement of teachers' digital competencies with improved infrastructural and administrative support to strengthen STEM implementation in public junior schools.

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