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Technology Integration in Project-Based Learning and the Development of 21st Century Learning Skills in Public Secondary Schools in Tanzania

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Abstract: This study examined the contribution of technology-integrated project-based learning (PBL) to the development of 21st century learning skills in public secondary schools in Mkuranga District, Tanzania. This study was guided by Jean Piaget's constructivist learning theory, complemented by Lev Vygotsky's social constructivist perspective, which emphasizes active learning through experience and social interaction. A qualitative research approach with a case study design was employed. The study involved 63 participants, including one district secondary education officer (DSEO), two ward education officers (WEOs), four heads of schools, sixteen teachers, and forty Form Three and Form Four students. Purposive, quota, and snowball sampling techniques were used to obtain participants. Data were collected through interviews and focus group discussions and analysed thematically using narration and direct quotations. The findings revealed that technology-integrated project-based learning significantly contributes to the development of key 21st century learning skills. Students enhanced their communication skills through digital presentations and online discussions, whereas their collaboration skills were strengthened through teamwork and the shared use of technological resources. Furthermore, students developed creativity and critical thinking skills through the use of digital tools to investigate real-life problems, analyse information, and generate innovative solutions. The study concludes that integrating technology into project-based learning enhances learner engagement and promotes the acquisition of the essential skills required in contemporary society. Strengthening the implementation of technology-supported participatory teaching approaches in public secondary schools is recommended to improve educational effectiveness and prepare learners for the demands of the 21st century

Keyword : Technology integration, Project-based learning, 21st century learning skills, Public secondary schools

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INTRODUCTION

In the 21st century, education was significantly reshaped by rapid technological progress, globalization, and changing social dynamics. Conventional approaches centered on memorization and passive learning are no longer adequate for equipping learners with the skills needed to navigate the challenges of contemporary life and the

workplace (Santhosh, 2023). Consequently, educational paradigms have shifted toward developing a set of abilities known as 21st century learning skills, such as communication, creativity, collaboration and critical thinking skills (Cheng, 2024; Şahin, 2024). One effective method for developing these important skills is project-based learning (PBL) (Gampala, 2023). Project-based learning emphasizes hands-on, active knowledge that encourages students to solve real-life problems, work with classmates, think deeply, and develop important modern-day skills. (Nadia et al., 2024).

In the project-based learning method, students work on a project for a prolonged time, and their learning is shown through a final product or presentation that reflects their knowledge and understanding (Sedubun & Nurhayati, 2024). In the 21st century, where strong thinking and reasoning are needed to keep up with both social and job-related demands, project-based learning helps students gain real-life skills such as problem-solving, creativity, teamwork, and communication. These are key to deeper learning, better thinking skills, and greater chances of success in their future careers (Gabuardi, 2021; Baird, 2019; Quinapallo-Quintana & Baldeon-Zambrano, 2024).

Historically, project-based learning (PBL) began in the early 20th century as part of educational reforms. In 1918, William Heard Kilpatrick introduced this approach, which is based on the idea that students learn best through real-life experiences. Project-based learning was first used in medical education in the 1950s and later spread to different subjects and countries (Xiong, 2021). According to Guerrero et al. (2021), project-based learning focuses on active learning, where students are responsible for their own learning.

Over the years, technology has become an important part of project-based learning. It allows students to research information online, collaborate with others from a distance, and use digital tools to complete their projects. The use of online platforms and cross-curricular learning has made PBL more flexible. This helps students deal with real-world problems while becoming more engaged and accountable for their learning (García et al., 2020). Project-based learning continues to develop, supporting a deeper understanding and preparing students for a constantly changing world (Almulla, 2020).

Globally, project-based learning (PBL) is a teaching method used in many countries, such as the United States, Malaysia, Indonesia and China, to help students gain real-world skills by working on hands-on tasks and solving real problems. In the United States, project-based learning involves real-world tasks in which students investigate and create final products or presentations. Project-based learning has become more popular in the 21st century and is used in many fields (Grossman et al., 2019). In many teacher-centered classrooms, technology is used mainly by teachers. However, in student-centered classrooms, students use technology more often.

Because of this shift in technology use, technology directly improves the effectiveness of project-based learning (PBL) (Pitura and Monika 2018). Utilizing technology during PBL is among the best ways to help students address real-world problems and prepare for life after college (Pitura & Monika, 2018). In Indonesia, using technology is very important for making project-based learning effective in the 21st century. Digital tools such as online collaboration platforms, multimedia tools, and virtual simulations allow project work to go beyond traditional classrooms. Technology helps make projects more realistic and prepares students to meet the digital needs of modern life (Moubareck, 2022; Syahril, 2022). In Malaysia, Yin and Huat (2021) explain that project-based learning has been implemented to promote student-centered learning, where students take an active role, make decisions, and collaborate with others. Pham (2018) notes that this approach helps students develop knowledge and skills through hands-on activities and real-world problem solving, often supported by digital tools and online resources. In this learning environment, teachers act as facilitators who guide the process, while students use technology to explore ideas, collaborate, and develop their own understanding (Duke et al., 2020). In China, many studies support learning through projects as a creative teaching method. It is used for teaching and testing students' learning progress (Ma, 2022). Teachers guide students while allowing them more freedom and control over their learning, helping them prepare for today's world (Zheng, 2022). This method focuses on student independence, working together, and evaluating students on the basis of real tasks, helping them better understand and master content (Yazdanpanah, 2019).

In African countries such as many developing countries, the quality of education is improving (Sari, & Angreni, 2022). This effort focuses mainly on improving teaching, learning, and assessment practices in education institutions (Mncube & Maphalala, 2023). As technology and workplace demands continue to change in the 21st century, schools need to update their teaching methods to better prepare students for a fast-changing and technology-driven global economy (Sari & Angreni, 2023). Project-based learning (PBL) has become a widely used teaching approach in South Africa and other countries (Guo et al., 2023). PBL uses real-world problems and often integrates digital tools and technologies to support learning (Indrawati et al., 2022). Project-based learning methods help students develop important skills such as creativity, critical thinking, collaboration, problem-solving, and the effective use of technology (Ratnasari et al., 2022). Through technology-supported projects, students actively apply knowledge and skills, making learning more relevant, practical, and aligned with modern workforce expectations (Indrawati et al., 2022). Additionally, in Ghana, project-based learning helps students improve their thinking and creativity by asking them to examine information, solve difficult problems, and connect what they learn to real life. It also supports independent learning (Kimani, 2024). The government has added project-based learning to its

STEM education programs to provide students with the problem-solving skills needed for technology and economic growth (Boakye-Yiadom et al., 2025). In addition, project-based learning in Uganda inspires student participation, creativity, and teamwork in addressing real-world issues (Tukakira et al., 2024). Unlike traditional, teacher-centred methods, this approach gives students more control, allowing them to make choices and create meaningful projects. It focuses on teamwork, independent learning, and real experiences (Wakumire, 2022).

In Tanzania, through the syllabus for ordinary secondary education, MoEST (2023) gives teachers the knowledge they need to plan their lesson plans efficiently. Additionally, it offers educational opportunities that help teachers implement various methods and approaches to promote students' textile literacy and garment construction skills. Tanzania Education and Training Policy 2014, 2023 edition emphasized that curricula at all levels should focus on developing 21st century learning skills such as communication, collaboration, creativity, critical thinking, and problem-solving skills (URT,2023). Teachers are encouraged to plan and use teaching and learning methods that are based on the environment or context and integrated with the everyday lives of students, including discussions, ground visits, practical work, research, technical experiments, and project work. Different teaching methods have been emphasized in schools to improve the education system, focusing on skills such as critical thinking, creativity, communication, and teamwork, which are important in the 21st century (TIE, 2019). Project-based learning is an effective teaching method that helps students learn well and provides opportunities to develop research, problem-solving, creativity, communication, collaboration and critical thinking skills. When integrated with technology, project-based learning provides students with opportunities to use digital tools to conduct research, analyse information, solve problems, and generate creative solutions. It is also used for the continuous student assessment of grades for form four students (Mathias 2023). It involves students working on a topic or issue over an extended period by collaborating with other classmates in groups, conducting investigations, drawing conclusions and communicating their findings by presenting what they come up with to show their understanding and application of knowledge gained (Mkimbili et al 2024). In Mkuranga District, teachers emphasize the use of participatory teaching methods that engage learners directly in their studies and develop important 21st century learning skills: communication, collaboration, critical thinking and creativity (4Cs). The Tanzania Education and Training Policy (2014; 2023 edition) guides teachers in designing and delivering lessons aligned with the secondary school curriculum. It emphasizes integrating technology to improve teaching efficiency and learning outcomes. The use of digital tools, modern equipment, and online resources enhances instructional approaches. These technologies strengthen students' textile literacy and clothing fabrication skills. Overall, the policy supports the development

of 21st century learning skills (MoEST, 2023). However, in many public secondary schools in the Mkuranga district, many students who graduate from secondary schools are claimed to lack those essential aids in the country's growth. These circumstances prompted the researcher to investigate how technology integration in project-based learning contributes to the development of 21st century learning skills in Mkuranga District public secondary schools.

Theoretical Review

The study was based on Jean Piaget's constructivist learning theory (1970), supported by Lev Vygotsky's social constructivist view (1978). The theory suggests that learners build knowledge by interacting with their environment and linking new ideas to what they already know rather than just receiving facts. It stresses the importance of personal experience and reflection in learning. Piaget suggested that learning is most effective when learners connect new knowledge with real-life experience. Later, Vygotsky reported that learning also occurs through social interaction, especially with more knowledgeable people such as teachers or peers (Wibowo et al., 2025). This theory helps explain how project-based learning (PBL) supports the development of essential 21st-century skills in public secondary schools. PBL fits well with constructivist ideas because it encourages students to work on real-life projects, solve problems, think critically, and collaborate in teams. Instead of rote learning, students gain knowledge through active, hands-on tasks. Additionally, technology integration further strengthens the effectiveness of project-based learning within this constructivist framework. The use of digital tools such as online research resources, collaborative platforms, and multimedia applications enables students to explore real-world problems, work collaboratively, and construct knowledge actively. Through technology-supported PBL, learners also develop digital literacy and communication skills that are essential for meeting future academic and workplace demands. Since PBL focuses on solving real-world problems, constructivist theory is a useful method for preparing students for future challenges.

Contribution of Technology Integration in Project-Based Learning in Developing 21st Century Learning Skills

Maspul (2024) examined the benefits of combining technology and computer coding in project-based learning to improve STEM education in the United States. The findings showed that using technology helped students develop problem-solving, creativity, and logical thinking skills. Students worked together on coding projects that covered multiple subjects and supported a deeper understanding. Online tools and flexible learning options allowed students to practice coding outside the classroom. Teachers were encouraged to use learning theories such as constructivism, technological pedagogical content knowledge (TPACK), and social constructivism to

design learning activities that encourage teamwork and meet learning goals. Approaches such as project-based, inquiry-based, and self-guided study increase student involvement and understanding. Schools need to provide resources, training, and technical support to make this approach work. This study shows how combining coding and technology can help students succeed. Nevertheless, it does not directly explain how this approach supports the development of all 21st-century learning skills within project-based learning. Hence, the current research revealed how integrating technology into project-based learning helps students develop these essential skills.

In Indonesia, Hoesny et al. (2024) investigated how using digital tools in project-based learning affects students' speaking ability. They used a quasiexperimental design and chose participants randomly. Data were analysed to test whether using digital technology improved speaking performance. The study revealed that tools such as voice recorders, speaking apps, and online materials improved students' grammar, vocabulary, and understanding. These tools made students interact more during their projects and added value to the learning process. With the internet, teachers could access a wide range of resources, such as audio, video, and written content, which helped them become more creative in their teaching. The researchers advised that digital tools should be included in project-based learning lessons to help students practice and improve speaking, especially in terms of grammar, vocabulary, and comprehension. However, this study focused only on improving speaking and did not show how these digital tools support students in developing 21st-century learning skills. Therefore, this research explored how adding technology to project-based learning helped students in public secondary schools develop the skills needed in today's world.

In South Africa, Ramaila and Molwele (2022) studied how using technology in life science lessons helped students gain 21st-century skills. They used both surveys and interviews to collect information. The results revealed that teachers believed that technology helped students learn communication, collaboration, problem-solving, critical thinking, and logical reasoning skills. Technology was seen as making the learning environment more engaging, which helped increase student performance and interest. While the study clearly showed that technology helps build important skills, it did not focus on how these skills are developed specifically through project-based learning. This leaves room for further study on how combining project-based learning and technology can help students develop all-approximately 21st-century learning skills, and this study filled that gap.

In Nigeria, Laleye (2022) investigated how different groups, such as parents, teachers, and the government, help promote the use of technology in schools. This study focused on senior secondary school students, parents, and teachers in Akoko South West, Ondo State. Using a questionnaire, the study revealed that parents are expected to provide digital tools for their children and supervise their use. It also

revealed that stakeholders such as alums, the government, and local associations should support schools by equipping ICT units and training teachers. Organizing workshops to help teachers use digital tools more effectively are recommended. However, the focus was only on the support roles of different groups and not on how technology use within project-based learning helps students develop 21st-century learning skills. Therefore, this study explored how the digital tools used in project-based learning help students in public secondary schools gain important skills.

In Uganda, Kaahwa et al. (2023) studied how technology-supported learning affects student interactions in secondary schools in Kampala. The researchers used a qualitative case study and collected data through classroom observations, teacher interviews, and student focus group discussions. They reported that digital tools helped students work together better and improved their research and learning skills. It also made classroom discussions more interesting, as students could access information easily and participate actively. The study recommended allowing students to bring their own devices to school and encouraged schools to use tools such as digital boards to make lessons more engaging. Although this study showed how technology helped students work and learn together, it did not focus on supporting the full range of 21st-century skills through project-based learning. This created a gap that the current research filled by studying how technology is used in project-based learning to support such skills.

In Tanzania, Manyengo (2021) studied how technology is used in the country's education system. The research used different methods, including reviewing documents and conducting interviews in person and by phone. Although technology is growing in many areas of Tanzanian life, more needs to be done in the education sector. While some policies promote technology use in schools, some are outdated or not fully carried out. Problems include a shortage of trained teachers, limited access to digital tools at school and home, and poor internet and electricity in some areas. Although the study highlights the need to improve technology use in schools, it does not focus on any particular level of education or link technology use to specific teaching methods. It also did not show how these tools are used within PBL to develop students' 21st-century skills. Therefore, this study filled that gap by determining how using technology in project-based learning helps secondary school students develop skills such as creativity, collaboration, communication, and critical thinking.

METHODOLOGY

This study employed a qualitative research approach and a case study design, where the researcher obtained detailed information from participants on the basis of their ideas and experience on the topic.

The research targeted a population of 10,600 individuals in Mkuranga District, categorized as 1 district secondary education officer (DSEO), 25 ward education

officers (WEOs), 37 heads of public secondary schools, 637 teachers from public secondary schools, and 9,900 form three and four public secondary students. The sample size of this study was 63, including 1 DSEO, 2 WEOs, 4 heads of schools, 16 teachers and 40 students, and snowball sampling, quota sampling and purposive sampling techniques were applied to choose the respondents.

Additionally, the instruments for data collection were focus group discussions and interviews. The trustworthiness of the qualitative research data was addressed through credibility, transferability, dependability and confirmability criteria.

The data were analysed thematically and presented with interpretation by using narration and direct quotations, which described the obtained ideas. Ethical considerations involved obtaining permission from relevant authorities, ensuring voluntary participation, maintaining confidentiality, and adhering to APA 7th edition standards.

RESULT AND DISCUSSION

Contribution of Technological Integration in Project-based Learning to Developing 21st Century Learning Skills in Public Secondary Schools

The objective of this study was to determine the contribution of technological integration in project-based learning to the development of 21st century learning skills in public secondary school. The researcher collects information from the district secondary education officer, the ward education officer, the head of schools, teachers and public secondary students of forms III and IV. Through interviews and focus group discussions with selected participants, it was revealed that technological integration in project-based learning significantly contributes to the development of essential 21st-century learning skills among students. Communication, collaboration, creativity and critical thinking. The respondents shared their experiences illustrating how technology enhances student learning and engagement as follows:

Enhancing Communication Skills

The study revealed that technology integration in project-based learning contributes to the development of 21st century learning skills. The findings show that using technology in project-based learning enhances communication skills. Learners use digital platforms such as PowerPoint, Google search, and YouTube to improve their verbal and written communication skills. Technology enabled them to prepare better presentations, share ideas, and receive feedback. Interviewee Y3 said that

> *"In our school, we have computers that teachers guide students on how to find materials by using them, which helps them accomplish their projects well and develop learning skills such as communication skills".*

These data imply that the integration of computers in the learning process, when facilitated by teacher guidance, supports a constructivist approach to education. According to constructivist theory, learning is most effective when learners are actively involved in constructing their own understanding rather than passively receiving information. By encouraging students to search for information themselves, with support from teachers, learners become more independent and engaged in the learning process. Furthermore, the process of finding materials and working on projects can promote collaborative learning and communication skills, which are also key aspects of constructivist pedagogy. In this context, technology is used as a tool to enhance active learning, critical thinking, and meaningful interaction between students and teachers. Additionally, in a focus group discussion conducted by participants, one participant from school A responded that

> *"In our school, we try to help students use technology. For example, last year in the geography area, I guided my students to conduct a project, and then at the time of presentation, I helped them prepare slides and then presented their work using PowerPoint. They gain more confidence in expressing their ideas. They also learn to organize information logically".* (T from school A, FGD July 2025).

This means that using technology in project-based learning helps students develop important skills. By guiding students to create PowerPoint slides for their presentations, the teacher helped them learn how to organize their ideas clearly and present them in a structured way. This improved their ability to express themselves and increased their confidence when speaking in front of others. The use of technology made the learning process more engaging and practical. The implication is that when teachers integrate technology into projects, students develop both digital and communication skills, which are essential for their future education and careers in the modern world. This is connected with the findings of Hoesny et al. (2024). The study revealed that tools such as voice recorders, speaking apps, and online materials improved students' grammar, vocabulary, and understanding. These tools made students interact more during their projects and added value to the learning process. With the internet, teachers had access to a wide variety of resources, such as audio, video, and written content, which helped them become more creative in their teaching. A respondent from school C responded that:

> *"Before, we used to write notes only, but now we use PowerPoint even though we have only one computer in our school. Nevertheless, teachers give us chances to use it during our presentations and even speak English. That helped us improve our speaking skills". (S from school C, FGD July 2025).*

These insights from teachers and students clearly show that even minimal access to technology can have a meaningful effect when it is used effectively. Project-

based learning, supported by digital tools, creates opportunities for students to participate actively in their education. It fosters important skills beyond academics, preparing them to communicate effectively, think critically, collaborate, and be creative. These findings are strengthened by Moustafa & Al-Rashaida (2024); through hands-on activities, students work on real challenges, collaborate in teams, and learn by asking questions and exploring solutions, which helps prepare them for school and future careers. This approach also fits well with recent education reforms such as the GIGA School Program, which brings digital tools into classrooms to improve learning experiences.

Promoting Critical Thinking Skills

Technological integration in project-based learning contributes to the development of 21st-century learning skills in public secondary schools. The field's findings revealed that technology gives students access to a wide range of information, allowing them to compare sources, analyse data and present them. Using technology such as searching materials from the internet helped students search for real-life issues related to their projects, which helped them develop deeper thinking. Technology allows learners to engage in inquiry-based learning, strengthening their critical thinking. Students use internet searches such as Google and watch different videos related to their project. A participant from school C responded to the discussion as follows:

> *"Instead of depending only on the textbook, students now search for more information online by using computers in our school, and sometimes we help them search from our tablets. Additionally, the same respondent added that I gave my students a project on soil erosion. The researcher researched real data, identified causes and suggested solutions for it. The depth of their thinking surprised me". (T from school C, FGD July 2025).*

Project-based learning inspires learners to go beyond textbooks and actively search for more information using digital tools such as computers and tablets. This helps them develop research skills and become more independent learners. Project-based learning allows them to think deeply and critically about the topic. Giving students access to technology and real-world projects helps them become more engaged, think more deeply, and develop important skills, including problem-solving and key skills for achievement in today's world. This finding was supported by that of Ramaila and Molwele (2022), who reported that technology made the learning environment more engaging, which helped increase student performance and interest. Additionally, the respondent commented that:

> *"We have been given a project in Kiswahili that we need to prepare play and present it in our class. We go through the internet and find different plays to know we can create ours we think critically and successfully prepare it and present it well in our class". (S from school A, FGD July 2025).*

This study shows that using technology in project-based learning is much more common than having students use devices. It's about giving them the power and responsibility to lead their learning journeys. Technology helps students become independent learners who can think critically, work well with others, be creative, and communicate their ideas. These skills are important for school and life beyond the classroom. By blending technology with hands-on projects, students are better prepared to face real-world challenges and opportunities. Kaahwa et al. (2023) support this by finding that using digital tools helps students work together better and improves their research and learning skills. It also made classroom discussions more interesting, as students could access information easily and participate actively.

Improving Collaboration Skills

Technological integration in project-based learning improves collaboration among learners because of the sharing of resources such as computers. Students work together to ensure that they obtain the materials needed for their work. Teachers highlighted that integrating technology such as smartphones, computers, and internet access helps students work more effectively in teams. Additionally, the students reported that technology increased their ability to coordinate and support each other in group work. From the interviews conducted with the interviewee, interviewee Y4 A responded.

> *"Here in our school, we have computers; although there are not enough for every student to use their own, they share them when they find materials concerning their work. Therefore, through the sharing of computers and other sources of materials, students work as a team, which improves their collaboration skills". (Interviewee Y4 July 2025).*

The comment shows that even if there are not enough resources, such as computers, for each student, sharing these resources helps students learn how to work together. As they search for information and complete tasks in groups, learners advance essential collaboration skills, communication, and problem-solving. This reflects Jean Piaget's constructivist theory, which explains that students learn better through active involvement and interaction with their environment. According to Piaget, learning occurs when students are involved in meaningful activities that challenge their thinking and allow them to build knowledge through experience. In this case, the need to share materials creates real-life situations where students must cooperate and support each other, which helps them grow both socially and

intellectually. This experience not only advances their academic skills but also prepares them to work with others in the future. Additionally, during the interview, an interviewee X1 said the following:

> *"Now, teachers put more effort into using participatory teaching methods, as we emphasize them to use them. In many schools, they integrate technology into the learning process because it stimulates active learning among students. Therefore, teachers use computers, smartphones and tablets to facilitate learning, and through that, students share their ideas and collaborate well in the learning process, which improves their ability to collaborate because they learn and enjoy them at the same time". (Interviewee X1, July 2025).*

The quotation indicates that, with encouragement and support, many schools have also started using technology such as computers, smartphones, and tablets to make learning more interactive and enjoyable. This use of technology helps students become more engaged, share their ideas, and work together better in class. As a result, students enjoy learning more and develop important skills such as collaboration and communication. This means that when teachers combine active teaching methods with technology, it creates a more effective and enjoyable learning situation that helps learners develop the skills they need for school and future life. This relates to the findings of Ramaila and Molwele (2022). The results revealed that teachers believed that technology helped students learn skills such as communication, collaboration, problem-solving, critical thinking, and logical reasoning. Technology was seen as making the learning environment more engaging, which helped increase student performance and interest. At the time of the teachers' focus group discussion in school B, one participant said the following:

> *"We use project-based technological tools to influence students to cooperate and share their ideas by relating information from internet sources to their real situation, improving their collaboration skills". (T from school B, FGD July 2025).*

The results of this study reveal that technology can catalyze the transformation of traditional classroom dynamics. It shifts learning from an individual task to a collective, interactive process where students learn with and from each other. This collaborative learning environment nurtures important 21st-century skills, preparing learners for future academic and professional achievement. This aligns with Maspul (2024), who showed that technology helped students develop skills such as problem-solving, creativity, and logical thinking. Students worked together on coding projects that covered multiple subjects and supported a deeper understanding.

Stimulating Creativity

The study revealed that integrating technology in project-based learning stimulates creativity among students by enabling them to express ideas in various

formats, solve problems innovatively, and adopt available tools to create unique work outcomes. Learners in public secondary schools show a high level of creativity when supported with even minimal technological resources and teacher guidance. The participant from school C stated the following:

> *"Giving students access to technology during project-based learning allowed them to approach real-world problems more innovatively. For example, in my subject, I have given learners a project to work on environmental pollution. I used my phone to show them examples from the real situation, which helped them to come up with their findings, so technology stimulated creativity in their work". (T from school C, FGD July 2025).*

The results of this study revealed that integrating technology in project-based learning enhances creativity and helps students develop other significant skills, such as problem-solving, critical thinking, and adaptability. These skills are crucial for achievement in the 21st century and prepare students to meet future academic and life challenges with confidence and originality. Boakye-Yiadom et al. (2025) reported that project-based learning provides students with strong problem-solving skills and that creativity is needed for both technology and economic growth. Additionally, a participant from school D contributed to the focus group discussion by saying that

> *"the incorporation of technology encourages students to explore various means of expression and presentation". (T from school D, FGD July 2025).*

The findings show that using technology in the classroom allows students to explore different ways of expressing and presenting their ideas. This means that technology is not just a tool for learning facts; it helps students become more creative and take control of how they communicate their understanding. This finding supports Jean Piaget's constructivist theory, which emphasizes that learners actively construct knowledge by interacting with their environment and making sense of experiences in their own way. By using digital tools such as videos, slides, or online research, students can choose how they want to learn and show what they have learned. This encourages them to think critically, solve problems, and express ideas uniquely rather than following a set method. The implication is that incorporating technology supports deeper, more personalized learning, where students are not passive receivers of information but active creators of meaning, as Piaget's theory suggests.

CONCLUSION

Project-based learning is a participatory teaching method that involves engaging learners directly in learning by focusing on hands-on, active learning, solving different problems, working with classmates, thinking deeply, analysing and then showing their findings through presentations. The results of this study revealed

that the integration of technology in project-based learning contributes to the development of 21st century learning skills for students because through technology platforms, such as the internet, it helps students obtain different sources of materials that help them discuss and share ideas to develop collaboration skills. The use of PowerPoint in their presentations promotes confidence and easy communication skills, and other platforms, such as YouTube, help them develop creativity and critical thinking. The government should improve the school's infrastructure and facilities, such as electricity, and provide resources such as computers to simplify the integration of technology in teaching and learning.

Recommendations

The study recommends that public secondary schools in Tanzania should deliberately strengthen the integration of technology within project-based learning because it has been shown to effectively develop key 21st-century skills, namely, communication, collaboration, critical thinking and creativity. When students use digital tools to work on real-life projects, they communicate their ideas more clearly, collaborate more actively with peers, think more deeply when they are solving problems, and express creativity through innovative solutions. However, these benefits can be fully realized only if teachers are well trained to use technology in learner-centred ways rather than for basic content delivery. Therefore, continuous professional development is essential to equip teachers with the skills needed to design meaningful technology-supported projects. Additionally, schools need reliable infrastructure, such as internet access, digital devices and technical support, to ensure equal learning opportunities for all students. The curriculum should also be reviewed to clearly promote project-based learning and technology use, while assessment methods should focus on students' ability to apply knowledge, work in teams and generate original ideas. Overall, coordinated efforts from policymakers, school leaders and educators are necessary to ensure that technology-integrated project-based learning genuinely supports the development of 21st century skills in Tanzanian public secondary schools.

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