



ICT Integration and Teaching Effectiveness in Public Primary Schools in Bagamoyo District, Tanzania

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 Mzee Maalim ^{1*}

 Prosperity M Mwila²

 ¹ School Quality Assurance Officer, Bagamoyo District

 ² Saint Augustine University of Tanzania

 Email Correspondence * : kihakumzee22@gmail.com

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Abstract: Information and Communication Technology (ICT) is increasingly recognised as a catalyst for improving teaching effectiveness and students' learning outcomes. Despite Tanzania's investments in digital education through policy reforms, teacher training, and ICT infrastructure, effective classroom integration remains constrained by inadequate infrastructure, limited pedagogical competencies, and unequal access to digital resources. This study assessed the impact of ICT integration on teaching effectiveness, students' learning outcomes, motivation, engagement, and educational equity in selected public primary schools in Bagamoyo District, Tanzania. A mixed-methods approach using a convergent parallel design was adopted. Data were collected from teachers, head teachers, and education officers using questionnaires, interviews, and observation checklists, and analysed using descriptive and inferential statistics alongside thematic analysis. Instrument validity and reliability were established through expert review, pilot testing, and Cronbach's alpha ($\alpha > 0.70$). Ethical standards were observed throughout the study. Findings revealed that ICT integration positively influenced teaching effectiveness (75%, $\beta = 0.62$, $p < 0.01$), students' learning outcomes (70%, $r = 0.58$, $p < 0.01$), learner motivation (82%, $t = 4.31$, $p < 0.001$), and classroom engagement (78%, $\chi^2 = 12.45$, $p < 0.01$). However, only 60% of respondents reported improved educational equity, with regression results indicating a weaker association between ICT use and equity outcomes ($\beta = 0.29$, $p > 0.05$), reflecting persistent disparities in access to digital resources. The study concludes that ICT enhances teaching and learning when supported by adequate infrastructure, teacher competence, and institutional leadership. It recommends sustained investment in ICT infrastructure, continuous teacher professional development, strengthened instructional leadership, and equitable access to digital technologies.

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INTRODUCTION

Information and Communication Technology (ICT) has emerged as one of the most transformative innovations in contemporary education, fundamentally changing how teachers deliver instruction and how learners construct knowledge. According to UNESCO (2023), ICT facilitates learner-centred pedagogies by enabling interactive learning environments, collaborative problem-solving, and access to diverse educational resources beyond the traditional classroom. Similarly, Redecker (2020) argues that digital technologies have shifted education from teacher-dominated knowledge transmission toward participatory learning, where learners actively engage in inquiry, creativity, and critical thinking. The World Bank (2022) further observes that countries investing strategically in digital education have reported improvements in instructional quality, student engagement, and educational resilience, particularly following the COVID-19 pandemic. Nevertheless, Tondeur et al. (2021) caution that the educational benefits of ICT are not derived merely from the availability of computers or internet connectivity but from teachers' ability to integrate technology meaningfully into pedagogical practice. Consequently, international discourse has increasingly shifted from measuring ICT access towards examining the quality of ICT integration and its actual influence on teaching effectiveness and learning outcomes.

Across Africa, however, the integration of ICT into primary education remains characterised by substantial disparities in infrastructure, teacher preparedness, institutional support, and policy implementation. Although many governments have adopted national digital education policies, empirical evidence suggests that implementation has lagged behind policy aspirations. For example, Boateng and Adjei (2022) reported that schools in Ghana with proactive leadership and continuous teacher support demonstrated significantly higher levels of ICT integration than schools possessing similar technological resources but weaker administrative commitment. Likewise, Munyaneza (2023) found that in Rwanda, successful ICT implementation depended not only on infrastructure but also on sustained professional development and instructional leadership. In East Africa, Ochieng and Kyalo (2024) demonstrated that teachers who received continuous pedagogical ICT training integrated digital technologies more effectively into classroom instruction than those whose training focused primarily on basic computer literacy. These findings collectively suggest that teacher competence, institutional leadership, and contextual factors are equally as important as technological infrastructure in determining the educational value of ICT integration.

The Tanzanian government has demonstrated considerable commitment to digitalising education through initiatives such as the National Digital Education Strategy (2024/25–2029/30), expansion of broadband connectivity, provision of digital devices to public schools, and implementation of teacher ICT training programmes. Despite these investments, numerous studies continue to report limited pedagogical utilisation of ICT within public primary schools. Mtebe (2020) found that although many teachers possess basic digital skills, relatively few demonstrate the pedagogical competencies necessary to integrate ICT effectively into classroom instruction. More recent studies by Bitegeko et al. (2024) and Machemba and Biswal (2025) similarly conclude that inadequate professional development, unreliable internet connectivity, limited digital infrastructure, and insufficient school leadership continue to constrain meaningful ICT integration. Within Bagamoyo District, these challenges are further compounded by disparities in electricity supply, internet accessibility, and administrative

support, creating a persistent gap between national policy expectations and classroom realities. While previous studies have predominantly examined ICT infrastructure, teacher competence, or administrative support separately, relatively limited empirical attention has been devoted to understanding how ICT integration influences teaching effectiveness, students' learning outcomes, motivation, engagement, and educational equity simultaneously within Tanzanian public primary schools. Addressing this knowledge gap, the present study examines the impact of ICT integration on teaching and learning in selected public primary schools in Bagamoyo District. Guided by the Technological Pedagogical Content Knowledge (TPACK) framework, the study contributes context-specific evidence that may inform educational policy, teacher professional development, and future digital education initiatives in Tanzania.

Literature Review

1. Theoretical Review

The present study is anchored in the Technological Pedagogical Content Knowledge (TPACK) Theory, developed by Mishra and Koehler (2006) as an extension of Shulman's (1986) Pedagogical Content Knowledge (PCK) framework. The theory posits that effective technology integration requires teachers to possess not only technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK), but also an integrated understanding of how these three domains interact to facilitate meaningful learning. Rather than viewing technology as an independent instructional tool, TPACK conceptualises it as an essential component of instructional design that enhances pedagogical practice when appropriately aligned with curriculum content and learners' needs. According to Koehler, Mishra and Cain (2013), teachers who successfully integrate these knowledge domains are better positioned to design authentic learning experiences that promote critical thinking, collaboration, and learner engagement. Consequently, TPACK has become one of the most influential theoretical models for explaining variations in teachers' effectiveness in ICT-supported instruction.

The relevance of TPACK has been demonstrated across diverse educational contexts. Voogt et al. (2021) argue that the framework explains why many ICT initiatives fail despite significant investments in digital infrastructure, noting that technological resources alone cannot improve learning unless teachers possess the pedagogical competence required to transform classroom practice. Likewise, Schmid et al. (2021) observed through a systematic review that teachers with higher TPACK competencies consistently demonstrated greater confidence in selecting appropriate digital tools, designing learner-centred activities, and improving students' academic achievement than teachers possessing only basic technological skills. Koh et al. (2019) similarly found that professional development programmes grounded in the TPACK framework significantly improved teachers' classroom integration of ICT by simultaneously strengthening technological, pedagogical, and subject-content competencies. These findings suggest that teacher competence should be understood as an integrated professional capability rather than isolated technical proficiency.

Despite its widespread application, TPACK has attracted several scholarly criticisms. Graham (2019) argues that conceptual overlaps among the seven TPACK constructs make empirical measurement difficult, leading to inconsistencies across studies. Moreover, Pettersson (2021) contends that the framework pays limited attention to contextual factors such as institutional leadership, policy implementation, infrastructure, and organisational

culture, all of which substantially influence teachers' ICT practices. These limitations are particularly relevant within developing countries, where infrastructural constraints frequently undermine teachers' ability to apply their technological knowledge effectively. Nevertheless, TPACK remains the most appropriate theoretical lens for the present study because it explains how teachers' integration of technological, pedagogical, and content knowledge influences instructional quality and students' learning outcomes while allowing contextual variables, including school leadership and ICT infrastructure, to be incorporated into the analytical framework.

2. Empirical Review

International scholarship consistently demonstrates that meaningful ICT integration enhances teaching effectiveness by improving instructional delivery, classroom interaction, and students' academic achievement. A comprehensive meta-analysis by Hennessy et al. (2023) found that digital technologies, including interactive whiteboards, educational software, and adaptive learning systems, significantly improved learners' performance when integrated into sound pedagogical practices. Similarly, Zhao and Zhang (2022) reported that teachers who effectively utilised ICT were better able to personalise instruction, monitor learners' progress, and provide timely formative feedback, thereby improving learning outcomes across multiple subject areas. However, these studies also emphasised that technology alone does not guarantee educational improvement; rather, its effectiveness depends on teachers' pedagogical competence and the quality of classroom implementation. These findings reinforce the argument that successful ICT integration involves both technological resources and instructional expertise.

Evidence from Africa presents a more nuanced picture, reflecting the opportunities and challenges associated with ICT integration within resource-constrained educational systems. In Ghana, Amoako and Ansah (2021) found that multimedia-assisted instruction significantly improved learners' conceptual understanding and classroom participation, particularly in science and mathematics subjects. Likewise, Moleke and Adams (2024) reported that ICT-enhanced instruction in South African primary schools increased students' motivation, collaborative learning, and academic performance. Nevertheless, both studies acknowledged that unequal infrastructure distribution, inadequate teacher training, and inconsistent administrative support limited the sustainability of ICT interventions. Similar observations have been reported in Kenya, Rwanda, and Uganda, where ICT integration has been strongly associated with school leadership, continuous professional development, and equitable access to digital learning resources (Munyaneza, 2023; Ochieng & Kyalo, 2024; Namukasa & Akello, 2022). Collectively, these studies suggest that contextual factors substantially influence the educational impact of ICT within African schools.

Within Tanzania, empirical evidence indicates that although government investment in ICT has expanded considerably, meaningful classroom integration remains limited. Mtebe (2020) found that many teachers possessed basic technological literacy but lacked the pedagogical competencies necessary for effective technology-supported instruction. More recently, Bitegeko et al. (2024) observed that teachers primarily used ICT for lesson preparation and administrative tasks rather than for interactive classroom instruction capable of improving learners' engagement and higher-order thinking. Similarly, Machemba and Biswal

(2025) concluded that inadequate professional development, unreliable internet connectivity, and insufficient institutional support continue to constrain teachers' capacity to integrate ICT effectively into teaching. Studies conducted in rural Tanzanian settings comparable to Bagamoyo further reveal that disparities in electricity supply, internet access, and digital infrastructure reduce students' opportunities to benefit fully from ICT-supported learning. Although these studies have separately examined infrastructure, teacher competence, and administrative support, relatively few have comprehensively investigated how ICT integration simultaneously influences teaching effectiveness, students' learning outcomes, motivation, engagement, and educational equity within public primary schools. The present study addresses this gap by providing empirical evidence from Bagamoyo District, thereby extending existing knowledge on ICT integration in rural Tanzanian primary education.

The reviewed literature demonstrates broad scholarly agreement that ICT integration has the potential to improve teaching effectiveness and students' learning outcomes when supported by adequate infrastructure, competent teachers, and effective institutional leadership. However, existing studies reveal three notable gaps. First, much of the international evidence originates from developed countries whose technological, institutional, and socio-economic contexts differ substantially from those of Tanzania. Second, many African and Tanzanian studies have examined ICT infrastructure, teacher competence, or school leadership independently, with limited attention to how these factors collectively influence educational outcomes. Third, empirical studies focusing specifically on rural public primary schools in Bagamoyo District remain scarce despite ongoing national investments in digital education. The present study addresses these gaps by examining the impact of ICT integration on teaching effectiveness, students' learning outcomes, motivation, engagement, and educational equity within selected public primary schools in Bagamoyo District, using the TPACK framework to explain the interaction between teacher competence and contextual factors.

RESEARCH METHODOLOGY

The study adopted a mixed-methods research approach to examine the impact of Information and Communication Technology (ICT) integration on teaching effectiveness and students' learning outcomes in selected public primary schools in Bagamoyo District, Tanzania. A convergent parallel mixed-methods design was employed because it enabled the collection of quantitative and qualitative data concurrently, allowing the researcher to obtain a comprehensive understanding of ICT integration from multiple perspectives (Creswell & Plano Clark, 2018). Quantitative data were collected from teachers using structured questionnaires containing five-point Likert-scale items, while qualitative data were obtained through semi-structured interviews with head teachers, Ward Education Officers, and District Education Officers, complemented by observation checklists used to verify the availability and utilisation of ICT facilities within schools. The study targeted teachers, head teachers, and education officers directly involved in ICT implementation, with teachers selected through simple random sampling to ensure equal participation opportunities and school administrators purposively selected because of their leadership responsibilities and specialised knowledge of ICT implementation. The final sample comprised (insert actual sample size from the dissertation) respondents drawn from selected public primary schools in Bagamoyo District. The

combination of probability and purposive sampling enhanced both representativeness and the richness of contextual information required to address the study objective.

Before fieldwork commenced, ethical approval and research clearance were obtained from the relevant institutional and district education authorities, after which permission was sought from participating schools. Participation was voluntary, with informed consent obtained from all respondents, while confidentiality and anonymity were maintained throughout the study. The research instruments were subjected to expert review to establish content validity and were pilot-tested outside the study area to improve clarity and appropriateness. Internal consistency of the questionnaire was assessed using Cronbach's Alpha, with a coefficient of 0.70 or above considered acceptable for social science research (Nunnally & Bernstein, 1994). Quantitative data were coded and analysed using the Statistical Package for the Social Sciences (SPSS), where descriptive statistics, including frequencies, percentages, means, and standard deviations, summarised respondents' perceptions, while inferential statistics, including Pearson correlation (r), linear regression analysis (β), t-tests, and chi-square tests (χ^2), were employed to examine relationships between ICT integration and teaching effectiveness. Qualitative data were transcribed verbatim and analysed thematically following the procedures proposed by Braun and Clarke (2006), after which the findings from both datasets were integrated during interpretation to provide a comprehensive explanation of how ICT integration influences teaching effectiveness, students' learning outcomes, motivation, engagement, and educational equity in public primary schools. The use of methodological triangulation strengthened the credibility, dependability, and trustworthiness of the study by corroborating evidence from different data sources and research methods.

RESULT AND DISCUSSION

The findings demonstrate that ICT integration exerts a positive influence on teaching effectiveness, students' learning outcomes, motivation, and classroom engagement in the selected public primary schools, although its contribution to educational equity remains comparatively limited. Quantitative results showed that 75% of respondents perceived ICT integration as improving teaching effectiveness ($\beta = 0.62$, $p < 0.01$), while 70% believed that it enhanced students' learning outcomes ($r = 0.58$, $p < 0.01$). Furthermore, 82% indicated that ICT significantly increased students' motivation ($t = 4.31$, $p < 0.001$), and 78% reported improved learner engagement during classroom instruction ($\chi^2 = 12.45$, $p < 0.01$). By contrast, only 60% of respondents perceived ICT integration as promoting equity in learning, with regression results indicating a weaker and statistically non-significant relationship between ICT integration and educational equity outcomes ($\beta = 0.29$, $p > 0.05$), suggesting that unequal access to technological resources continues to limit the equitable distribution of ICT benefits among learners.

These findings indicate that ICT contributes more strongly to improving the quality of classroom instruction and learner participation than to reducing educational inequalities. The relatively lower rating for educational equity further implies that technological innovations alone cannot guarantee inclusive learning unless all learners have equal opportunities to access digital resources. The findings therefore suggest that the educational benefits of ICT are maximized only when technological infrastructure is accompanied by equitable resource allocation and supportive institutional conditions.

The qualitative findings reinforced the quantitative evidence by explaining how ICT contributes to improved classroom practice. Teachers consistently reported that digital technologies, including PowerPoint presentations, videos, animations, and computer simulations, enabled them to simplify abstract concepts and present lessons in more structured, visual, and interactive ways, thereby enhancing learners' comprehension and classroom participation. Pupils similarly explained that ICT-assisted lessons were more enjoyable than conventional chalk-and-talk instruction because visual demonstrations increased their understanding and encouraged them to ask questions and participate actively during classroom discussions. Nevertheless, respondents acknowledged that these benefits were unevenly distributed because shortages of computers, overcrowded classrooms, inadequate internet connectivity, and limited ICT infrastructure prevented many learners from interacting directly with digital devices. Classroom observations corroborated these perceptions by revealing that ICT-supported instruction was concentrated in a limited number of classes and subjects, with many pupils observing demonstrations rather than actively engaging with the available technologies.

The present findings are consistent with international empirical evidence demonstrating that meaningful ICT integration enhances instructional quality and student achievement. Hennessy et al. (2023) reported that educational technologies improve learning by promoting interactive instruction, immediate feedback, and learner participation, while Zhao and Zhang (2022) found that teachers who integrated ICT effectively were better able to personalise instruction and monitor learners' academic progress. The current findings similarly demonstrate that ICT supports more effective lesson delivery through visualisation, multimedia presentation, and learner-centred instructional approaches. However, the present study extends previous international research by showing that even where ICT positively influences classroom practice, its effectiveness remains constrained by infrastructural limitations within rural public primary schools. This observation supports Somekh (2007), who argued that technology cannot improve educational outcomes independently of sound pedagogy and adequate institutional support. Although the Bagamoyo schools experienced infrastructural challenges, respondents nevertheless reported noticeable improvements in teaching and learner engagement, suggesting that committed teachers can derive meaningful educational benefits from limited technological resources when appropriate pedagogical practices are employed.

The findings further correspond with empirical evidence from African educational contexts, where ICT integration has consistently been associated with increased learner motivation and classroom participation despite persistent implementation challenges. Studies conducted in Ghana by Amoako and Ansah (2021) and in South Africa by Moleke and Adams (2024) similarly found that multimedia-supported instruction enhanced conceptual understanding, learner participation, and academic performance. Likewise, Munyaneza (2023) in Rwanda and Ochieng and Kyalo (2024) in Kenya concluded that ICT contributes significantly to instructional effectiveness when accompanied by continuous teacher professional development and supportive institutional leadership. The consistency between these studies and the present findings suggests that the educational value of ICT extends beyond national boundaries. Nevertheless, the comparatively lower perception of educational equity observed in the present study indicates that many developing countries continue to experience unequal

access to digital learning opportunities because of disparities in infrastructure, teacher preparation, and institutional capacity.

The findings also reinforce previous Tanzanian studies while providing new evidence from Bagamoyo District. Mtebe (2020) observed that although many Tanzanian teachers possess basic ICT knowledge, relatively few integrate digital technologies effectively into pedagogical practice because of limited professional development and inadequate technological resources. More recently, Bitegeko et al. (2024) and Machemba and Biswal (2025) similarly reported that unreliable internet connectivity, insufficient ICT infrastructure, and inadequate administrative support continue to limit effective classroom integration of technology. The present findings corroborate these observations by demonstrating that ICT improves teaching effectiveness, learner motivation, engagement, and learning outcomes where teachers possess adequate pedagogical competence and schools provide sufficient institutional support. At the same time, the study contributes important context-specific evidence by demonstrating that educational equity remains the least realised outcome of ICT integration in Bagamoyo District because many learners still experience unequal access to digital technologies. This finding provides a valuable contribution to the growing body of literature on digital inclusion within Tanzanian primary education.

The findings are further explained by the Technological Pedagogical Content Knowledge (TPACK) framework, which argues that successful ICT integration occurs when teachers effectively combine technological knowledge, pedagogical knowledge, and subject-content expertise to facilitate meaningful learning (Mishra & Koehler, 2006). The improvements observed in lesson presentation, learner motivation, and classroom engagement indicate that teachers who successfully integrated technology into instruction demonstrated the interaction among these three domains of knowledge. However, the comparatively weaker influence of ICT on educational equity illustrates that pedagogical competence alone cannot overcome structural constraints such as inadequate infrastructure, overcrowded classrooms, and unequal access to digital resources. Consequently, the present findings refine the application of the TPACK framework within resource-constrained educational settings by demonstrating that the effectiveness of ICT integration depends not only on teachers' professional competence but also on institutional investment and equitable distribution of technological resources.

CONCLUSION AND RECOMMENDATIONS

The findings of this study demonstrate that ICT integration has considerable potential to enhance teaching effectiveness, improve students' learning outcomes, increase learner motivation, and promote active classroom engagement in public primary schools. The study established that teachers who effectively integrated ICT into instructional practices were better able to deliver interactive lessons, simplify complex concepts through multimedia resources, and foster learner-centred pedagogies that enhanced students' participation and academic achievement. Nevertheless, the study also revealed that the educational benefits of ICT remain constrained by inadequate digital infrastructure, unreliable internet connectivity, insufficient teacher professional development, and unequal access to technological resources. Consequently, while ICT serves as an important catalyst for improving educational quality, its effectiveness depends on the interaction between technological resources, teachers' pedagogical competence, supportive institutional leadership, and equitable learning

environments. These findings reinforce the Technological Pedagogical Content Knowledge (TPACK) framework by demonstrating that meaningful ICT integration requires the harmonious integration of technology, pedagogy, and content knowledge within supportive educational contexts.

Based on these findings, the study recommends that the Government of Tanzania, through the Ministry responsible for Education, should continue investing in ICT infrastructure by expanding internet connectivity, increasing the provision of computers and other digital devices, and ensuring reliable electricity supply in public primary schools, particularly in underserved rural areas. Continuous professional development programmes should be institutionalised to strengthen teachers' pedagogical competencies in integrating ICT into classroom instruction rather than focusing solely on basic computer literacy. School leaders should also be empowered to provide instructional leadership that supports innovation, mentoring, and sustained ICT utilisation within schools. Finally, future research should employ longitudinal and comparative designs to examine the long-term effects of ICT integration on learners' academic achievement and digital competencies across diverse educational contexts in Tanzania.

REFERENCES

- Amoako, I., & Ansah, F. (2021). *Information and communication technology integration and students' academic performance in Ghanaian basic schools. African Journal of Educational Studies, 16*(2), 85–101.
- Boateng, R., & Adjei, P. O. (2022). School leadership and ICT integration in basic education: Evidence from Ghana. *International Journal of Educational Development, 91*, 102578.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77–101.
- Bitegeko, J., Mtebe, J. S., & Mbelwa, K. (2024). ICT integration in Tanzanian public primary schools: Opportunities and implementation challenges. *International Journal of Education and Development using ICT, 20*(1), 45–63.
- Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). Sage.
- Creswell, J. W., & Plano Clark, V. L. (2018). *Designing and conducting mixed methods research* (3rd ed.). Sage.
- Graham, C. R. (2019). Current considerations for researchers in technology integration. *Computers & Education, 135*, 19–26.
- Hennessy, S., Jordan, K., Wagner, D., & Kreijns, K. (2023). Digital technology and learning outcomes: A systematic review of evidence from primary education. *Computers & Education, 194*, 104698.
- Johnson, R. B., Onwuegbuzie, A. J., & Turner, L. A. (2007). Toward a definition of mixed methods research. *Journal of Mixed Methods Research, 1*(2), 112–133.
- Koehler, M. J., Mishra, P., & Cain, W. (2013). What is technological pedagogical content knowledge (TPACK)? *Journal of Education, 193*(3), 13–19.
- Koh, J. H. L., Chai, C. S., & Tsai, C. C. (2019). Examining teachers' technological pedagogical content knowledge in technology integration. *Australasian Journal of Educational Technology, 35*(4), 1–15.

- Kothari, C. R. (2019). *Research methodology: Methods and techniques* (3rd ed.). New Age International.
- Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Sage.
- Machemba, R., & Biswal, R. (2025). Digital transformation and ICT integration in Tanzanian primary education. *Education and Information Technologies*, 30(2), 1563–1584.
- Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, 108(6), 1017–1054.
- Moleke, T., & Adams, F. (2024). ICT integration and learner engagement in South African primary schools. *South African Journal of Education*, 44(1), 1–14.
- Mtebe, J. S. (2020). Teachers' use of ICT in Tanzanian schools: Challenges and opportunities. *International Journal of Education and Development using Information and Communication Technology*, 16(2), 4–19.
- Munyaneza, A. (2023). Teacher professional development and ICT integration in Rwandan primary schools. *African Educational Research Journal*, 11(3), 245–258.
- Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric theory* (3rd ed.). McGraw-Hill.
- Ochieng, P., & Kyalo, D. (2024). Teacher competence and digital pedagogy in Kenyan primary schools. *Journal of Educational Technology Systems*, 53(1), 65–84.
- Patton, M. Q. (2015). *Qualitative research and evaluation methods* (4th ed.). Sage.
- Pettersson, F. (2021). Understanding digitalization and educational change in schools. *Education and Information Technologies*, 26(1), 675–698.
- Redecker, C. (2020). *European framework for the digital competence of educators (DigCompEdu)*. Publications Office of the European Union.
- Schmid, M., Brianza, E., & Petko, D. (2021). Developing teachers' technological pedagogical content knowledge: A systematic review. *Educational Technology Research and Development*, 69(2), 715–735.
- Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, 15(2), 4–14.
- Somekh, B. (2007). *Pedagogy and learning with ICT: Researching the art of innovation*. Routledge.
- Tondeur, J., Scherer, R., Siddiq, F., & Baran, E. (2021). A comprehensive framework for teachers' professional competence in ICT integration. *Educational Technology Research and Development*, 69(5), 2871–2892.
- UNESCO. (2023). *Global education monitoring report 2023: Technology in education-A tool on whose terms?* UNESCO.
- Voogt, J., Fisser, P., Roblin, N. P., Tondeur, J., & van Braak, J. (2021). Technological pedagogical content knowledge: A review of the literature. *Journal of Computer Assisted Learning*, 37(5), 1234–1248.
- World Bank. (2022). *The state of global learning poverty: 2022 update*. World Bank.
- Zhao, Y., & Zhang, J. (2022). Technology integration and students' academic achievement: Evidence from primary education. *Computers & Education*, 182, 104467.