# Relevance of Curriculum Content for Learning ICT-Mediated Teaching: Perspectives from Tanzanian Computer Science Student Teachers and Tutors

George Chalale[1]*, Wadrine Maro[2], & Albert Tarmo[3]
[123]Department of Educational Psychology and Curriculum Studies, School of Education, University of Dar es Salaam, Tanzania
*Corresponding Author[1]: georgechalale@gmail.com
Email[2]: marowadrine2016@gmail.com
Email[3]: palbert@udsm.ac.tz

**Abstract**

*This study explored the perspectives of computer science student-teachers and tutors on the relevance of curriculum content for learning ICT-mediated teaching in Tanzanian diploma teachers' colleges. Using a qualitative multiple-embedded case study design, data were collected from 30 participants through focus group discussions, interviews, and document analysis. The findings indicate that both student-teachers and tutors consider the ICT curriculum relevant, particularly topics such as computer applications, networking, and programming languages, which support lesson planning, teaching, and assessment using ICT. The study concludes that effectively integrating these technological topics enhances ICT-mediated teaching skills among future educators. It recommends that teacher education institutions, including the Tanzania Institute of Education (TIE), embed these topics more comprehensively into syllabi for science and mathematics student-teachers, emphasising digital literacy and technical proficiency.*

**Keywords:** *ICT curriculum content, ICT-mediated teaching, computer applications, networking and programming languages, computer science student teachers, future educators*

**DOI:** *https://dx.doi.org/10.56279/ped.v42i2.special.10*

## Introduction

The increasing dominance of ICT-mediated teaching has transformed education worldwide, compelling teacher education institutions to prepare student teachers to integrate ICT effectively into their teaching practices (Sart et al., 2022). ICT facilitates seamless information exchange between instructors and learners anytime and anywhere (UNESCO, 2020), making it a crucial component of modern education. Recognised as a catalyst for education reform, ICT encompasses

various technologies such as computers, digital media, online learning platforms, and artificial intelligence (Mbah, 2010; UNESCO, 2020). Studies highlight that ICT enhances real-life learning experiences, fosters student independence, and improves higher-order thinking skills (Afolabi, 2013; Pu et al., 2020). Moreover, social constructivist theory supports ICT-mediated teaching as it emphasises learner-centred approaches and knowledge construction through interactive tools (Bai et al., 2016; Carlos & Gadio, 2012).

Global organisations such as UNESCO and the World Bank advocate for ICT-mediated teaching to expand access to quality education, particularly for disadvantaged populations, including persons with disabilities, migrants, and refugees (Kumar & Tammelin, 2018; UNESCO, 2023). The Sustainable Development Goals (SDG-4) and the Education 2030 Agenda underscore the role of ICT in fostering equitable and inclusive education (Muasa, 2019; Harindranath & Liebenan, 2020). However, despite strong policy support, studies indicate that many student teachers remain reluctant to engage in ICT-mediated teaching due to inadequate training and a lack of confidence in using digital tools (UNESCO, 2023). This reluctance raises concerns about the preparedness of future teachers to integrate ICT into their pedagogical practices.

ICT-mediated teaching encompasses various modalities, including e-learning, blended learning, open and distance learning, and massive open online courses (MOOCs) (UNESCO, 2022). These approaches have become integral to global education systems in response to the evolving needs of 21st-century learners (Bai et al., 2016; Meredyth, 2021). The COVID-19 pandemic further accelerated the adoption of ICT in education, prompting governments to reinforce digital learning policies and infrastructure (UNESCO, 2021). Countries such as Sweden, the USA, Denmark, Japan, and Finland have implemented comprehensive national strategies to promote ICT in education, demonstrating its potential to enhance teacher-student interactions, innovative teaching methodologies, and student engagement (Assan, 2013; Pu et al., 2020).

In Tanzania, efforts to integrate ICT-mediated teaching into teacher education have gained momentum in alignment with the SDGs and national education policies. The country's engagement with ICT in education dates back to 1965, with significant expansion occurring in the 1980s following economic liberalisation ((Ministry of Education and Culture [MoEC], 1995; Ministry of Work, Transport, and Communication [MoWTC], 2016). The ICT Policy for Basic Education (2007) and the Education Sector Development Plan (2016/17–2020/21) underscore ICT's role in enhancing teaching and learning (MoEVT, 2007; ESDC, 2018). Since the 2000s, various ICT initiatives, supported by the Tanzanian government and

international agencies such as the Swedish International Development Cooperation Agency (SIDA), have strengthened ICT-mediated teaching in teacher education (Anderson et al., 2014; TESP, 2020). Key projects, including the ICT in Teachers' Colleges and the ICT for Sciences and English Language projects, contributed to building ICT infrastructure and capacity in teacher training institutions.

Despite these initiatives, challenges persist. Many Tanzanian teachers' colleges struggle with inadequate ICT infrastructure, unreliable internet connectivity, limited access to digital resources, and insufficient training for both tutors and student teachers (Malima, 2010). Studies indicate that tutors often lack the requisite digital skills to model effective ICT use in pedagogy, which affects student teachers' ability to integrate ICT into their teaching practice (TESP, 2020; UNESCO, 2023). Additionally, the digital divide between urban and rural areas exacerbates disparities in ICT access, hindering equitable teacher preparation for ICT-mediated teaching. As such, a successful integration of ICT into teacher education requires a multifaceted approach that addresses policy implementation, institutional capacity-building, and professional development for educators (Harindranath & Liebenan, 2020). Research suggests that effective ICT-mediated teaching relies on comprehensive teacher training, access to high-quality digital content, and a supportive institutional culture that encourages innovation in pedagogy (Pu et al., 2020). Moreover, fostering a positive attitude towards ICT among student teachers is crucial to ensuring their readiness to use digital tools in their future classrooms (Winnans & Brown, 1992).

This study examines the effectiveness of ICT-mediated teaching in preparing student teachers for contemporary classrooms, with a particular focus on Tanzania's teacher education colleges. It explores the extent to which ICT is integrated into teacher training curricula, the challenges encountered in its implementation, and the strategies required to enhance its impact. The study is expected to provide insights for policymakers, educators, and researchers seeking to improve digital teaching practices in teacher education colleges in the Tanzanian context and beyond.

## Problem statement and research questions

Despite progress in integrating ICT into Tanzanian teachers' colleges, several challenges persist. Limited access to ICT infrastructure and resources, particularly in rural and remote colleges, remains a significant obstacle (Masalu, 2018; Kihoza et al., 2016). Many institutions lack adequate computers, reliable internet connectivity, and well-equipped computer laboratories, significantly hindering both tutors' and student teachers' ability to engage with ICT-mediated teaching practices. This infrastructural gap widens the digital divide between urban and rural colleges,

undermining efforts to ensure equitable access to ICT-enhanced education (Chirwa, 2018). In addition to infrastructural challenges, human resource constraints further complicate the effective implementation of ICT-mediated teaching. Most student teachers in diploma teachers' colleges have only received basic ICT training, leaving them underprepared to effectively implement ICT-mediated instruction in their future teaching roles (TIE, 2019). Although initiatives such as the ICT in Teacher Education Programme (ITEP) have addressed some of these shortcomings, comprehensive nationwide programs to train tutors in advanced ICT pedagogies remain insufficient (PO-RALG, 2020). This skills gap limits tutors' capacity to effectively support student teachers in mastering the use of ICT tools for teaching and learning (Ghavifekr et al., 2016). To address these gaps, the current study aimed to explore how student teachers can effectively learn ICT-mediated teaching during initial teacher education. In line with this overarching research objective, the study sought to answer two research questions:

i. What are the relevant topics of ICT curriculum content that could support student teachers' learning of ICT-mediated teaching during initial teacher education?

ii. How does the ICT curriculum content from each topic support student teachers' learning of ICT-mediated teaching during initial teacher education?

## Literature Review and Theoretical Framework

### Review of related work

#### *Relevant topics in ICT curriculum content for learning ICT-mediated teaching*

The integration of ICT into teacher education programs has gained prominence in computer science education. Key ICT curriculum topics include computer applications, networking, and programming languages. These topics are central to ICT-mediated teaching, aligning with curriculum demands and research on ICT integration (Anderson et al., 2014; Chirwa, 2018; Masalu, 2019; Barakabitze et al., 2020). Computer applications, including word processing, spreadsheets, and presentation software, are fundamental for developing digital teaching resources, lesson plans, and interactive content (UNESCO, 2022; Barakabitze et al., 2020). Networking topics, such as internet usage, wireless communication, and local area networks, are essential for teaching student teachers how to access and share online educational resources effectively (Masalu, 2019; Chirwa, 2018). Additionally, teaching basic programming fosters problem-solving skills and the ability to create custom educational software or apps, directly supporting ICT-mediated teaching (Anderson et al., 2014; Barakabitze et al., 2020).

### *How ICT curriculum content supports learning ICT-mediated teaching*

ICT curriculum content supports learning by enabling the development of critical teaching competencies. Vygotsky's (1978) pedagogical stages—planning, presentation, generalization, assessment, and application—provide a theoretical lens for analyzing how curriculum content supports practicum activities and ICT integration. For instance, topics such as computer applications and networking facilitate the design of ICT-rich lesson plans, enabling teachers to integrate multimedia resources and interactive teaching aids (Rutto, 2017; UNESCO, 2022). Programming skills enhance teachers' abilities to demonstrate interactive educational tools, improving student engagement (Chirwa, 2018; Mazzuki, 2017). Networking skills support the use of internet-based platforms for collaborative learning and real-time feedback during teaching practicums (Masalu, 2019; Muasa, 2020). ICT tools also aid in formative and summative assessments, offering diverse methods to evaluate student learning outcomes (Douglas, 2014).

Teaching practicum activities, such as microteaching, peer group teaching, demonstration, and block teaching, play a vital role in enabling student teachers to apply ICT skills in real classroom settings. Microteaching allows student teachers to practice ICT-mediated teaching strategies in a controlled environment, focusing on feedback and improvement (Douglas, 2014). Peer group teaching encourages collaborative learning and peer feedback, enhancing the use of ICT tools for lesson delivery and classroom management (Muasa, 2020). The demonstration allows student teachers to showcase ICT applications, fostering confidence and proficiency in using digital tools (Mazzuki, 2017). Block teaching offers extended teaching practice, enabling student teachers to apply ICT skills in diverse classroom scenarios (Rutto, 2017).

### *Research gap and policy implications*

Despite the growing emphasis on ICT integration, significant gaps remain in understanding how curriculum content supports ICT-mediated teaching during initial teacher education, particularly in Tanzania. Previous studies have predominantly focused on broader ICT integration strategies in the Global South, including Nigeria and Kenya, with limited exploration of Tanzanian contexts (Masalu, 2019; UNESCO, 2023). Existing research often overlooks the role of specific practicum activities, focusing instead on non-practicum methods for learning ICT-mediated teaching (Chirwa, 2018; Mazzuki, 2017). Additionally, there is insufficient evidence on the systematic evaluation of ICT curriculum content and its uniform delivery across teacher education programs (Barakabitze et al., 2020). Aligned with Tanzanian education policies (NECTA, 2021), this study emphasizes strengthening ICT curriculum content and integrating practical teaching components. It underscores

the need for investment in teacher training programs focused on ICT integration, enhancements to curriculum content to better support ICT-mediated teaching, and emphasis on experiential learning through practicum activities. By addressing these aspects, this study contributes to curriculum reforms, preparing future educators to meet the challenges of ICT-mediated teaching during and after initial teacher education.

## Theoretical framework

The study is guided by social constructivist theory. According to Vygotsky (1978), the social constructivist theory is a learning philosophy founded on the premise that, by reflecting on our prior experiences, we construct our understanding of the world we live in. People generate their own "rules" and "mental models" to make sense of our experiences. Learning, therefore, is simply the process of adjusting our mental models to accommodate new experiences. The use of pre-instructional concepts is part of social constructivism. Vygotsky (1978) explained the mental models of social constructivism. According to Vygotsky, there are two guiding principles of social constructivism. First, learning is a search for meaning. Therefore, learning must start with the issues around which student teachers actively try to construct meaning. Second, meaning requires an understanding of wholes and parts (Vygotsky, 1978). The parts must be understood in the context of the whole. The learning process focuses on primary concepts, not isolated facts. To teach well, we must understand the mental models that student teachers use to perceive the world and the assumptions they make to support those models (Vygotsky, 1978). Therefore, the purpose of learning is for an individual to construct their meaning, not just to memorise the "right" answers and regurgitate someone else's meaning.

Since education is inherently interdisciplinary, the only best way to measure learning is to assess parts of the learning process, ensuring it provides student teachers with information on the quality of their learning. For the constructivist, learning is not knowledge written on or transplanted to a person's mind as if the mind were a blank slate waiting to be written on or an empty gallery waiting to be filled. Theorists have argued that the construction of new knowledge in ICT is strongly influenced by prior knowledge, that is, conception gained before the point of new knowledge (Vygotsky, 1978). Specifically, this theory was used in guiding data collection on research questions one, and two, which aimed to explore and examine the prior experiences of computer science student teachers' learning ICT-mediated teaching through examining the relevance of ICT curriculum content for student teachers learning ICT-mediated teaching. To enhance both computer science and non-computer science student-teachers learning ICT-mediated teaching during initial teacher education in TCs. Also, the social constructivist theory is used

to examine how ICT curriculum content be used by student teachers for learning ICT-mediated teaching during initial teacher education in Tanzania and elsewhere.

## Methodology

### Participants and study area

This study involved 30 participants, including computer science student teachers and tutors from four Diploma Teachers' Colleges (TCs) in Tanzania. These colleges were purposively selected from the Eastern, Central, Southern, and Northern zones of Tanzania. Participants were identified through a typical case sampling technique, which focused on individuals' excellence in ICT-mediated teaching practices. This excellence was evidenced by their ability to plan, implement, and evaluate lessons using ICT. Snowball sampling was employed to refine the participant selection, leveraging recommendations from peers and instructors to identify key contributors. Informed consent was obtained from all participants after explaining the study's objectives, procedures, and potential risks. Participation was entirely voluntary, and anonymity was ensured through the use of coded identifiers during data presentation.

### Research approach and design

The study adopted a qualitative research approach within an interpretivist paradigm. This approach was deemed suitable as it enables a deep exploration of participants' experiences and perceptions of ICT-mediated teaching practices. The research utilised a multiple-embedded case study design, as recommended by Yin (2014), to facilitate an in-depth examination of the phenomenon across diverse contexts. Previous studies (see, for example, Pesambili, 2013; Pesambili & Mkumbo, 2018, 2024) have employed a qualitative case study design within an interpretivist paradigm to conduct in-depth investigations of socio-cultural practices, such as FGM in Tarime. These studies demonstrate the effectiveness of this design in capturing participants' lived experiences, making it well-suited for exploring ICT-mediated teaching in Tanzanian Diploma Teachers' Colleges. The interpretivist paradigm supported the exploration of subjective meanings, aligning with the study's aim to understand participants' lived experiences.

### Data collection methods

Data were collected using three primary methods: focus group discussions (FGDs), interviews, and documentary reviews. FGDs provided a platform for collective insights from participants, enabling the exploration of shared experiences and diverse perspectives. Focus groups are valuable for providing a forum to discuss

the diverse experiences and conflicting views held by participants (Pesambili & Novelli, 2021). Interviews were conducted to delve deeper into individual experiences and perceptions, ensuring a comprehensive understanding of the phenomenon. Specifically, one-to-one semi-structured interviews were used because they allow for in-depth exploration of individual perspectives, providing flexibility to probe deeper into participants' responses while maintaining consistency in the topics covered (See also Pesambili, and Novelli, 2021; Pesambili, 2024). Documentary reviews such as academic and pedagogy computer science syllabi for three-year diplomas for science and business studies complemented these methods by providing contextual and historical data on ICT-mediated teaching practices in the selected colleges. The combination of these methods ensured data triangulation, enhancing the reliability and validity of the findings. Each method was chosen for its relevance in capturing the multifaceted nature of ICT-mediated teaching practices.

## Data analysis

Thematic analysis, guided by Braun and Clarke's (2006) six-step framework, was employed to analyse the data. This involved familiarization with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the final report. Data were analysed manually to ensure a nuanced understanding of participants' narratives. Two researchers independently coded the data to enhance reliability. Discrepancies in coding were resolved through collaborative discussions, ensuring consensus. Issues of validity, reliability, and transferability were addressed by maintaining a detailed audit trail, member checking, and triangulating data sources. Ethical considerations were upheld throughout the analysis process, ensuring the confidentiality and integrity of the data.

## Findings and Discussion

The purpose of the study is to explore the views of computer science student teachers and tutors on the relevance of curriculum content for learning ICT-mediated teaching in diploma teachers' colleges in Tanzania. The findings and discussions are organized into two key themes based on the research questions: identifying relevant curriculum content for student teachers learning ICT-mediated teaching, and understanding how these topics contribute to the development of ICT-mediated teaching skills among student teachers. The following sections provide detailed findings and discussions on these topics, highlighting their significance in enhancing the development of ICT-mediated teaching capabilities among student teachers.

## Relevant topics in ICT curriculum content for learning ICT-mediated teaching

### *The computer applications*

The findings demonstrated that computer science student teachers perceived that the computer application topic is relevant for them in learning ICT-mediated teaching. This topic helps them prepare lesson notes, exam result reports, and lesson presentations during classroom teaching, as revealed by the following quote:

> We used computer application topics during my initial teacher education to learn ICT-mediated teaching. The topics we used included Microsoft Word and Microsoft Excel for learning ICT-mediated teaching, like the preparation of lesson plans, schemes of work, and lesson notes. We use Microsoft Excel topic for preparation for the secondary school examination result reports. While writing the project report, we drew histograms and pie charts graphs for presentation and analysis of the project findings (Focus Group Discussion, Student Teachers from Teacher's College One: 27/08/2021).

A similar view on perceived computer applications as a topic relevant for student teachers learning ICT-mediated teaching was commented on by one tutor from Teacher's College Two. The tutor said computer applications are a suitable topic for student teachers learning ICT-mediated teaching because, in that topic, student teachers learn how to prepare lesson notes and present lesson slides through a PowerPoint program. A quote below verifies what the tutor said:

> The topics in the diploma syllabi that support me when teaching student teachers ICT-mediated teaching include Microsoft Presentation, Multimedia, file management, and Information technology. I use Microsoft presentation for preparing my lesson notes and teaching student teachers to practise preparation lesson slides. Also, I use file management and information technology content to teach student teachers how to properly store information on the computer and get awareness and scope of information technology knowledge for diploma student teachers (Interviews, Teacher Educator One from Teacher's College Two: 13/09/2021).

Similarly, findings from the computer science pedagogy syllabus, analysis show that computer application is a relevant topic for student teachers' learning ICT-mediated teaching. The syllabus states as follows:

> The teaching of the selected topics in the Information and Computer Studies syllabus is as follows: teaching of computer file management, the teaching of office application programs and multimedia, which includes explaining the importance of teaching and learning multimedia in Information and Computer Studies and describing different strategies in preparation of multimedia lessons and teaching database as an information system (Tanzania Institute of Education, 2020).

The findings indicate that student teachers' engagement with computer application topics—such as Microsoft Word, PowerPoint, multimedia tools, Excel, and database management—enhanced their ability to learn ICT-mediated teaching. These topics provided practical skills for creating and delivering multimedia-enriched lesson materials, improving the teaching experience. Document analysis reinforced these findings, identifying office applications, multimedia tools, and file management as core to ICT-mediated instruction. Conversely, their absence hindered ICT integration, highlighting their critical role in fostering technical proficiency and pedagogical effectiveness. These findings align with social constructivist theory, which emphasizes interactive, contextually relevant learning (Afolabi, 2013; Rutto, 2017). By enabling student teachers to incorporate ICT tools, computer applications foster engaging, collaborative learning consistent with Vygotsky's principles. Empirical studies support this. Kafyulilo (2015) highlighted their role in ICT-mediated teaching, while Chirwa (2018) found that proficiency in office applications helps teachers develop materials and analyze performance. Barakabitze et al. (2019) noted that multimedia tools enhance engagement and teacher confidence, and UNESCO (2023) underscored their importance in delivering interactive lessons.

However, Kihoza et al. (2016) cautioned that technical skills alone are insufficient, advocating for integration into broader pedagogical frameworks, such as TPACK. Baran et al. (2017) warned against over-reliance on technical skills, as an exclusive focus on applications may neglect learner-centred approaches and problem-solving. Thus, while computer applications are vital to ICT-mediated teaching, their effectiveness depends on integration within pedagogical frameworks. This aligns with social constructivist theory and addresses literature-identified limitations, ensuring student teachers develop both technical proficiency and pedagogical expertise for ICT-integrated classrooms.

### *The networking*

The findings revealed that computer science student teachers perceived that the networking topic is relevant for student teachers learning ICT-mediated teaching. The computer science student teachers from Teacher's College Three supported this view during Focus Group Discussion (FGD) and noted that:

> We learn ICT-mediated teaching through networking topics in diploma TC. Networking topics like website design, web management, and web development are relevant to us while learning ICT-mediated teaching in colleges and schools. Both web design and development topics are relevant to our learning by doing ICT-mediated teaching and being able to practise teaching computer science subjects. (Focus Group Discussion, Student Teachers from Teacher's College Three: 16/10/2021).

A similar view on perceiving networking as a relevant topic for student teachers learning ICT-mediated teaching was remarked on by tutors from Teacher's College Two who said:

> The network, including internet access, is a key topic for teaching student teachers about ICT-mediated instruction. This topic is relevant because it enables student teachers to communicate with their peers and access Learning Management Systems (LMS). Furthermore, it involves practical activities, such as connecting computers to the internet, which are essential for student teachers to effectively learn ICT-mediated teaching (Interviews, Teacher Educator Two from Teacher's College Two: 30/09/2021).

Similarly, the analysis of the diploma computer science pedagogy syllabus shows the following:

> The teaching of the selected topics in the ICS syllabus is as follows: teaching of computer networking and the internet, which includes explaining the importance of teaching and learning computer networks, and the internet and analysing different teaching and learning strategies for teaching computer networks and the internet, and teaching web development (Tanzania Institute of Education, 2020).

The findings highlight the critical role of computer networking topics—such as internet systems, web design, development, and management—in enhancing student teachers' ability to learn ICT-mediated teaching. These topics provided essential skills for hosting and managing Learning Management Systems (LMS) and integrating

ICT tools effectively. Networking knowledge also supports collaborative, interactive teaching strategies vital for engagement in technology-rich classrooms. Conversely, its absence hindered student teachers' grasp of the technical and pedagogical aspects of ICT-mediated teaching, underscoring the need for comprehensive networking content in teacher education curricula. These findings align with Chirwa (2018), who emphasized the practical applications of networking in real-world teaching, demonstrating its role in preparing student teachers for modern educational environments. However, while technological knowledge is essential, Kihoza et al. (2016) argued that it must be integrated within broader pedagogical frameworks. They advocated for the Technological Pedagogical Content Knowledge (TPACK) framework, which combines technological, pedagogical, and content knowledge to holistically prepare student teachers for ICT-mediated teaching. Overall, the findings underscore the importance of networking topics in teacher education curricula. Beyond enhancing technical skills, these topics foster collaborative, interactive teaching strategies essential for ICT-integrated classrooms. Integrating them with broader pedagogical frameworks, such as TPACK, can further optimize ICT-mediated teaching and learning.

### *The computer programming languages*

The findings showed that computer science student teachers perceived that the computer programming languages topic is relevant to student teachers learning ICT-mediated teaching. This is because, in the programming languages, they learn how to create calculators and different mathematical formulae. The student teachers from Teacher's College One noted:

> The topic of programming languages helped us to learn ICT-mediated teaching, including data presentation, system development, operating systems, visual basics, and algorithms. This topic teaches us how to design and create calculator program formulae for manipulating different Mathematics and to account calculations. These topics are part of computer programming language lessons in diploma teachers' colleges (Focus Group Discussion, Student Teachers from Teacher College One: 09/08/2021).

A close view of computer programming languages as a relevant topic for student teachers learning ICT-mediated teaching was stated by a tutor from Teacher College Three. This view is because it further explains the relevance of computer programming languages for student teachers learning ICT-mediated teaching. This view was verified during interviews with a tutor from Teacher College Three who stated as follows:

> Computer programming languages such as Java, Pascal, C, and C++ in the diploma computer science syllabus influenced my approach to teaching ICT-mediated instruction for school teaching. These topics require student teachers to engage in hands-on learning, applying ICT-mediated teaching in diploma-teacher colleges. I found this particularly enjoyable, as I guided student teachers through learning by doing (Interview, Teacher Educator Two from Teacher's College Three: 25/10/2021).

The findings above were similar to those revealed during the analysis of the diploma computer science academic syllabus, which reads as follows:

> The topic of C++ programming languages includes programming languages, introduction to C++ programs, data types, variables and constants, input/output, expressions and assignments, decisions, iteration, functions, arrays and strings (Tanzania Institute of Education, 2010).

The quotes highlight the role of curriculum content in enhancing student teachers' ICT-mediated teaching, particularly through programming languages like Visual Basic, C, C++, and Java. These topics equip student teachers with essential skills, such as troubleshooting technical issues and developing Learning Management Systems (LMS), strengthening their ICT competencies. Their inclusion correlates with improved ICT integration in instruction, while their absence hinders skill development, underscoring programming knowledge as crucial for addressing technical challenges and creating digital teaching tools. These findings align with Vygotsky's Social Constructivist Theory, which emphasizes interactive and relevant content for meaningful learning. The study further revealed that the ICT curriculum primarily emphasized technological knowledge—computer applications, networking, and programming. While these topics are vital for ICT-mediated teaching, their impact is enhanced when integrated with broader pedagogical frameworks, as argued by Kihoza et al. (2016) and reflected in the TPACK framework.

However, the curriculum's limited focus on pedagogy and content knowledge may hinder comprehensive teacher preparation. This aligns with Kafyulilo (2015), who stressed the importance of technological topics, and Barakabitze et al. (2020), who warned against prioritizing technology over pedagogy. UNESCO (2023) also advocated for balanced content to maximize ICT-mediated teaching effectiveness. As such, while programming, computer applications, and networking are essential for technical expertise, their integration with pedagogical frameworks is crucial for preparing educators for technology-driven classrooms. These findings reinforce

the need for a balanced curriculum that incorporates technological, pedagogical, and content knowledge to equip student teachers for ICT-mediated instruction.

### *How ICT curriculum content supports learning ICT-mediated teaching*

Participants perceived technological knowledge topics as instrumental in facilitating their learning of ICT-mediated teaching. During focus group discussions and interviews, student teachers shared examples of how topics such as computer maintenance and networking directly supported their learning. For instance, networking topics enabled them to understand information transfer processes, such as sending assignments and receiving feedback via ICT platforms. These practical applications underscored the importance of technological topics in fostering hands-on learning experiences. This finding aligns with the social constructivist theory, which emphasizes experiential and collaborative learning opportunities.

Programming topics also emerged as particularly relevant, with participants noting the practical skills gained through activities such as programming language exercises. These findings echo those of Njiku et al. (2021) and Masalu (2018), who identified programming as a crucial component of ICT-mediated teaching. The frequent use of programming activities, such as Moodle platform development, further demonstrated the relevance of these topics in preparing student teachers to integrate ICT into their teaching practices. Participants expressed a desire to apply these skills in secondary school classrooms, highlighting the transformative potential of programming topics in their professional development.

Despite these positive findings, the study also revealed gaps in the ICT curriculum, particularly the lack of integration of pedagogical knowledge. For example, while technological topics like programming and networking are relevant, they need to be paired with pedagogical strategies, such as classroom management in ICT-rich environments and designing ICT-mediated assessments. As Kihoza et al. (2016) and Barakabitze et al. (2020) emphasize, integrating TPACK into teacher education can ensure that student teachers are not only technologically competent but also effective future educators in ICT-mediated teaching contexts.

## Policy and practical implications

These findings have important implications for curriculum developers and policymakers. First, the ICT curriculum should be expanded to incorporate broader pedagogical knowledge, including ICT-based classroom management, strategies for student engagement, and ICT-mediated assessments. Second, integrating the TPACK framework into Tanzanian teacher education programs could bridge existing gaps, offering a more holistic approach to ICT-mediated teaching. Lastly,

teacher training institutions should emphasize experiential learning, such as microteaching and peer teaching, to help student teachers apply and refine their ICT competencies in real-world settings. To this end, while the study reaffirms the relevance of technological knowledge in ICT-mediated teaching, it also underscores the need for a more balanced curriculum that integrates pedagogical and content knowledge. Addressing these gaps would enhance teacher preparation for ICT-integrated classrooms across diverse contexts.

## Conclusions and Recommendations

This study concludes that the ICT curriculum in Tanzanian Diploma Teachers' Colleges is highly relevant for preparing computer science student teachers for ICT-mediated teaching. Both tutors and student teachers value key topics—computer applications, networking, and programming languages—which collectively develop essential ICT competencies. Computer applications support lesson planning and assessment, networking enhances communication and collaboration, and programming enables troubleshooting and e-learning platform development. These complementary roles highlight the need for a balanced ICT curriculum to equip future teachers with diverse ICT integration skills.

To enhance ICT-mediated teaching, this study recommends integrating these topics comprehensively into initial teacher education, particularly for science and mathematics student teachers. Curriculum revisions should emphasise pedagogical strategies and practical ICT applications, such as simulations and data analysis, to strengthen digital literacy. Capacity-building initiatives through tailored training and workshops should improve ICT proficiency for tutors and student teachers. Policymakers must prioritise funding for ICT infrastructure to ensure equitable access to quality education, aligning with Sustainable Development Goals (SDGs). The Ministry of Education should extend ICT curriculum content to other disciplines, broadening its impact. Future research should examine the long-term effects of ICT training on classroom practices and explore integrating emerging technologies, such as artificial intelligence and cloud computing, into teacher education curricula to align with evolving digital demands.

## References

Afolabi, S. O. (2013). How teaching practice is an integral part of the training programme at Nigeria certificate in education. *Journal of Kwara State College of Education, 5*, 58-63.

Akar, H. (2018). *Challenges face implementation of teacher training colleges in Poland.* Middle East Technical University Press.

Alharbi, E. (2014). *A study on the use of ICT in teaching in secondary schools in Kuwait [Unpublished master's thesis]*. Cardiff Metropolitan University.

Ali, G., Haolader, F. A., & Muhammad, K. (2013). The role of ICT to make teaching-learning effective in higher institutions of learning in Uganda. *International Journal of Innovative Research in Science, Engineering and Technology, 2*(8), 5-12.

Anderson, G., Nfuka, K., Sumra, V., Uimonen, H., & Pain, M. (2014). *Evaluation of ICT implementation in teacher education colleges in Tanzania*. Sweden International Development Agency (SIDA).

Assan, T. E. B. (2013). Teaching practice for the 21st century: Challenges and prospects for teacher education North-West, South Africa. *Journal of Social Science, 37*(3), 279-91.

Bai, Y., Mo, D., Zhang, L., Boswell, M., & Rozelle, S. (2016). The impact of integrating ICT with teaching: Evidence from a randomized controlled trial in rural schools in China. *Computers & Education*, *96*, 1–14. https://doi.org/10.1016/j.compedu.2016.02.005.

Baran, E., & Correia, A. P. (2017). Exploring the impact of teaching with technology on student learning in the classroom. *Computers & Education, 107*, 1-15. https://doi.org/10.1016/j.compedu.2017.01.003.

Barr, R. B. & Tagg, J. (1995). From teaching to learning – A new paradigm for undergraduate education. *Journal of Change, 27*(6), 13–26. https://doi.org/10.1080/00091383.1995.10544672.

Bhargava, A. (2009). Teaching practice for student teachers of education programme. *Turkish Online Journal of Distance Education, 10*(2), 30-45.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77-101. https://doi.org/10.1191/1478088706qp063oa.

Carlos, S & Gadio. C. T. (2012). *Teachers' professional development in the use of technology*. Taylor and Francis.

Chirwa, G. (2018). *Assessment of Internet uses for teaching and learning in teacher training colleges [Unpublished master thesis]*. Mzumbe University.

Douglas, S. A. (2014). *Student teachers in school practice: An analysis of learning opportunities*. Macmillan. https://doi.org/10.1057/9781137268686

Douglas, S. A. (2019). Learning to teach: a focus on the personal rather than the technical aspects of teacher education. *Teacher Education Advancement Network, 11*(1)*,* 71-83.

Ekundayo, H. T., Alonge, H.O., Kolawole, A. O. & Ekundayo, S. A. (2014). Teaching practice exercise for education students in Nigerian Universities: Challenges and the way forward. *Mediterranean Journal of Social Science, 5*(9), 486-492.

Ghavifekr, S., Kunjappan, T., Ramasamy, L., & Anthony, A. (2016). Teaching and learning with ICT tools: issues and challenges from teachers' perceptions. *Malaysian Online Journal of Educational Technology*, 4(2), 38-57.

Harindranath, G., & Liebenan, H. (eds.) (2020). *Information technology policies and application in the commonwealth developing countries*. Commonwealth Secretariat Publication.

Hennessy, S., Harrison, D., & Wamakote, L. (2010). Teacher factors influencing classroom use of ICT in Sub-Saharan Africa. *Itupale Online Journal of African Studies*, *2*, 39 – 54.

Kihongoa, H. M. (2011). *Assessment of tutors' ICT knowledge and skill levels for effective ICT subject teaching in Mpwapwa and Morogoro diploma teachers' colleges [Unpublished master's dissertation]*. University of Dar es Salaam.

Kihoza, P., Irina Zlotnikova, I., Bada, J. & Kalegele, K. (2016). Classroom ICT integration in Tanzania: Opportunities and challenges from the perspectives of TPACK and SAMR models. *International Journal of Education and Development using Information and Communication Technology (IJEDICT), 12*(1), 107-128

Kira, E., & Sawe, E. (2021). Digital skills and learning in Tanzania secondary schools: Students and teachers' influence. *Qeios*. https://doi.org/10.32388/0hcsqs.

Kumar, S., & Tammelin, M. (2018). *Integrating ICT into language learning and teaching.* Linz, Austria: Goenitzer Ges.m.b.H.

Luande, J. S. J. (2006). *Incorporating Indigenous science and technology (IST) into school science teaching [Unpublished master's dissertation]*. University of Dar es Salaam.

Makata, E. (2010). *Student teachers' perceptions of the importance of block teaching practice in Tanzania [Unpublished master thesis]*. University of Dar es Salaam.

Malima, E. (2010). *Classroom assessment of the ICT syllabus implementation for diploma in secondary education [Unpublished Master's dissertation]*. University of Dar es Salaam.

Maphosa, C., Shumba, J., & Shumba, A. (2017). Mentorship for students on teaching practice in Zimbabwe: are student teachers getting a raw deal? *South African Journal of Higher Education, 21*, 296-307.

Masalu, K. (2018). *Challenges preventing student teachers and tutors from exploiting ICT in their learning and teaching in teacher education colleges [Unpublished master's dissertation]*. Open University of Tanzania.

Mazzuki, D. B. (2017). Effectiveness of teacher education in developing teaching commitment among student teachers in Tanzania [Unpublished Doctoral Thesis]. University of Dar es Salaam.

Mbah, T. B. (2010). The impact of ICT on students' study habits. Case study: University of Buea, Cameroon. *Journal of Science and Technology Education Research, 1*(5), 107 – 110.

Meena, W. E. (2009). *Curriculum innovation in teacher education: Exploring conceptions on Tanzania teacher educators.* Abo Akademi University Press.

Meredyth, H. (2021). *Real-time: computers, change and schooling.* Sage.

Ministry of Education and Vocational Training [MoEVT]. (2014). *Education and Training Policy*. Author.

Ministry of Education, Science, and Technology [MoEST]. (2020). *Computer science pedagogy syllabus for diploma course in secondary teacher education*. Tanzania Institute of Education.

Ministry of Education and Vocational Training [MoEVT]. (2009). *Computer science syllabus for advanced secondary schools*. Author.

Ministry of Education and Vocational Training [MoEVT]. (2009). *Information and computer studies pedagogy syllabus for diploma in education*. Author.

Ministry of Education and Vocational Training [MoEVT]. (2009). *Information and communication technology syllabus for diploma in education*: Author.

Ministry of Work, Transport, and Communication. (2016). *National information and communication policy*. Author.

MoEVT & SIDA. (2005). *Implementation of ICT in teachers' colleges in Tanzania*. Authors.

Ministry of Education and Vocational Training. (2007). *Information and communication technology policy for basic education*. Author.

Ministry of Education and Vocational Training. (2008). *ICT in teacher education programme*. Author.

Ministry of Education and Vocational Training. (2009). *Information and computer studies pedagogy syllabus for diploma in secondary education*. Dar es Salaam: Author.

Msanga, W. D. (2015*). Factors affecting the deteriorating of diploma student teachers' academic performance in teachers' colleges in Tanzania [Unpublished master's dissertation]*. Jordan University College.

Msangya, B. W., Mkoma, S. L., Yihuan, W. (2016). Teaching practice experience for undergraduate student teachers: A case study of the department of education at SUA, Tanzania. *Journal of Education and Practice 7*(14), 113-118.

Msonde, C. E. (2006*). Innovation in teacher education: formative evaluation on implementing the learner-centred approach in Tanzania's new diploma teacher education curriculum [Unpublished master's dissertation]*. University of Dar es Salaam.

Muasa, B. M. (2019). *Factors influencing ICT in training teachers in public teachers training colleges in Kenya: A case of Kilimambogo, Machakos, and Kitui TTCs [Unpublished master thesis]*. University of Nairobi.

Mukerrem, A. J., & Karabay, A. (2016). Developing teaching skills through the school practicum in Turkey: a meta-synthesis study. *Journal of Education and Training Studies, 4*(11), 1-13. https://doi.org/10.11114/jets.v4i11.1906.

Mumtaz, S. (2000). Factors affecting teachers' use of information and communications technology: a review of the literature. *Journal of Information Technology for Teacher Education, 9*(3), 319-342. https://doi.org/10.1080/14759390000200096.

Mushi, B. (2015). *The role of teaching practicum in preparation of secondary school teachers in Tanzania [Unpublished Master thesis]*. University of Dar es Salaam.

Mwalongo, A. (2011). Teachers' perceptions about ICT for teaching, professional development, administration and personal use. *International Journal of Education and Development using Information and Communication Technology (IJEDICT), 7*(3), 36-49.

National Examination Council of Tanzania [NECTA]. (2021). *Diploma teachers' examinations national results reports, 2015-2020*. NECTA.

Ndibalema, P. (2014). Teachers' attitudes towards the use of information communication technology (ICT) as a pedagogical tool in secondary schools in Tanzania: the case of Kondoa District. *International Journal of Education and Research*, *2*(2), 1-16.

Nevenglosky, E., Cale, C., Aguilar, S. (2020). Barriers to effective curriculum implementation in teacher education. *Research in Higher Education Journal, 36,* 1-31.

Nihuka, K. A. (2014). *ICT in teacher education: an analysis of educational media and technology instructional material of the Open University of Tanzania*. Open University of Tanzania.

Njiku, J. Mutarutinya, V., & Maniraho, J. F. (2021). Building mathematics teachers' TPACK through collaborative lesson design activities in Dar es Salaam. *Contemporary Educational Technology, 13*(2)*,* 27-39. https://doi.org/10.30935/cedtech/9571.

Nuru, K. C. D. (2012). *Implementation of the school inspection report on education management and curriculum in teacher training colleges in Iringa* [*Unpublished master thesis], University of Dar es Salaam.*

Nzumbi, T. (2015**).** *The role of IT in improving teaching and learning in secondary schools in Tanzania* [*Unpublished master's dissertation].* Sokoine University of Agriculture.

Pesambili, J. C. (2013). Consequences of female genital mutilation on girls' schooling in Tarime, Tanzania: Voices of the uncircumcised girls on the experiences, problems and coping strategies. *Journal of Education and Practice*, *4*(16), 109–119.

Pesambili, J. C. (2024). Reimagining quality education for pastoralists through Maasai elders' eyes in Monduli, Tanzania. *Quality Education for All*, *1*(1), 417–434. https://doi.org/10.1108/QEA-03-2024-0022.

Pesambili, J. C., & Mkumbo, K. A. K. (2018). Implications of female genital mutilation on girls' education and psychological well-being in Tarime, Tanzania. *Journal of Youth Studies*, *21*(8), 1111–1126. https://doi.org/10.1080/13676261.2018.1450969

Pesambili, J. C., & Mkumbo, K. A. K. (2024). Beyond the surface: unpacking the methodological and ethical challenges of researching into a sensitive female genital mutilation practice. *SN Social Sciences*, *4*(22), 1–20. https://doi.org/10.1007/s43545-023-00822-4

Pesambili, J. C., & Novelli, M. (2021). Maasai students' encounter with formal education: Their experiences with and perceptions of schooling processes in Monduli, Tanzania. *International Journal of Educational Research Open*, *2*, 1–9. https://doi.org/10.1016/j.ijedro.2021.100044.

Pu, S., Ahmad, A. & Yap, N. K. (2020). Factors affecting practical knowledge acquisition of pre-service computer teachers during the practicum: a multiple regression analysis. *International Journal of Learning, Teaching, and Educational Research, 19*(2), 214-230. https://doi.org/10.26803/ijlter.19.2.13.

Punch, K. (2012). *Introduction to research methods in education*. SAGE.

Ropp, M. M. (2019). Exploring individual characteristics associated with learning to use computers in preservice teacher preparation. *Journal of Research on Computing in Education, 31* (4), 402-424.

Rosen, L. D. & Weil, M. M. (2015). Computer availability, computer experience, and technophobia among public school teachers. *Computers in Human Behavior, 11*(1), 9-31. https://doi.org/10.1016/0747-5632(94)90019-1.

Rutto, D. K. (2017). Pedagogical theories. *International Journal of Scientific & Engineering Research, 8*(6), 2025-2030.

Sart, G., Bayar, Y., Corpădean, A.-G., & Gavriletea, M. D. (2022). Impact of ICT and globalization on educational attainment: evidence from the new EU member states. *Sustainability, 14*(5), 30-39. https://doi.org/10.3390/su14053039

Selwyn, N. (2021). *Schools and schooling in the digital age: a critical analysis*. Oxford University Press.

Shayo, S. G. (2014). *Effectiveness of demonstration secondary schools in education and training of science: teachers in Tanzania: a study of three colleges of teacher education in Tanzania [Unpublished master's dissertation]*. University of Dar es Salaam.

Tanzania Institute of Education [TIE]. (2010). *Computer science syllabus for advanced secondary schools, V-VI*. Author.

Tanzania Institute of Education [TIE]. (2019). *Framework for the implementation of a year's diploma in teacher education for ICT, Science, and Business Studies.* TIE.

Tanzania Institute of Education [TIE]. (2020). *Computer science pedagogy syllabus for diploma course in secondary teacher education*. Author.

Teacher Education Support Project [TESP]. (2020). *Training for tutors report*. Author.

Tilya, F.N. (2007). *ICT in Education in Tanzania: Lesson and experiences from IICD-supported projects*. IICDE.

Timostsuk, T., Sikka. H. (2008). The role of reflection in understanding teaching practice. *Problem of Education in the 21st Century*, *7,*147-152.

UNESCO. (2020). *ICT Competency Framework for Teachers.* UNESCO.

UNESCO. (2022). *Guidelines for teachers on how to integrate ICT in teaching and learning Physics*. UNESCO-China Fund in Trust.

UNESCO. (2023). *Global education monitoring report, 2023: technology in education*. Author.

Vygotsky, L. (1978). *Mind in society*. London, England: Harvard University Press.

Wakuru, M. (2014). *Assessing the effectiveness of demonstration secondary schools in achieving the mission of colleges of teacher education in Tanzania [Unpublished master dissertation].* University of Dar es Salaam.

Watson, H., & Osibodu, B. M. (1987). *Learning to teach: practical activities for teachers in training*. Evans Brothers Limited.

Winnans, C. & Brown, D. S. (1992). Some factors affecting elementary teachers' use of the computer. *Journal of Computers in Education, 18,* 301-309.

Yin, R. K. (2014). *Case study research: design and methods.* SAGE.