Impact of Information and Communication Technology on Parental and Community Involvement in Rwandan Mathematics Education

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ABSTRACT

This study investigates the impact of Information and Communication Technology (ICT) on enhancing parental and community involvement in mathematics education at Teacher Training Colleges (TTCs) in Rwanda. Despite advances in ICT integration in Rwandan education, its impact on parental and community engagement in mathematics remains underexplored. The study explores how ICT tools can enhance this involvement, which is crucial for reinforcing classroom learning. A mixed-methods approach was employed. Purposive sampling was used to select 20 TTC tutors, 100 student teachers, 80 parents, and community members. Data was collected using surveys, semi-structured interviews, and focus group discussions. Descriptive statistics and thematic analysis were used to analyze the data. ICT tools like Google Classroom, Zoom, Khan Academy, and communication platforms such as WhatsApp were used for the study. Findings show that these tools facilitate communication, allowing parents to track student progress, access resources, and engage with teachers. This has led to improved student performance and motivation. ICT also supports community-based initiatives, like online study groups, that extend learning beyond school hours. The study suggests that increased ICT use can contribute to better-trained teachers, improved mathematics outcomes, and a stronger educational foundation in Rwanda.

Keywords: parental involvement; community engagement; mathematics education; digital platforms; teacher training colleges

INTRODUCTION

Information and Communication Technology (ICT) has emerged as a transformative force in educational systems worldwide, offering unprecedented opportunities to bridge gaps between schools, parents, and communities. In Rwanda, where mathematics education is crucial for national development, the integration of ICT presents promising pathways for enhancing parental and community engagement. Despite significant investments in technological infrastructure across Rwandan educational institutions, the strategic utilization of these resources to foster mathematics-focused partnerships remains underdeveloped. This study investigates how ICT can effectively strengthen parental and community involvement in mathematics education within Rwanda's unique post-genocide context. By examining current ICT implementation practices, barriers to engagement, and successful models of technology-mediated participation, this research addresses a critical knowledge gap. The findings aim to inform the development of contextually appropriate frameworks that leverage digital technologies to create collaborative mathematics learning environments extending beyond classroom boundaries into homes and communities.

Background of the Study

Information and Communication Technology (ICT) has fundamentally transformed global educational practices over the past three decades, evolving from supplementary tools to essential components of effective teaching and learning (Voogt, Knezek, Christensen, & Lai, 2018; Selwyn, 2020). European nations such as Finland, Estonia, and the Netherlands have successfully implemented comprehensive digital strategies that engage all educational stakeholders, demonstrating that technology can effectively bridge institutions and communities, particularly in mathematics education (European Commission, 2021; OECD, 2020). Studies from Europe reveal that ICT-facilitated parental involvement significantly improves mathematics achievement. (Hornby and

Blackwell ,2018) found that digital platforms enabling parent-teacher communication increased student mathematics performance significantly. These technologies create collaborative environments where parents, regardless of mathematical background, can actively participate in their children's learning journey (Lau & Lee, 2021).

In Africa, ICT adoption in education shows promise despite persistent challenges. Kenya, South Africa, and Ghana have implemented technology integration programs with varying success (Tondeur, Kihoza, Jwaifell, & Awuor, 2022). The use of mobile technologies has shown potential for overcoming engagement barriers in several African countries (Ngesi, Landa, Madikiza, Cekiso, Tshotsho, & Walters, 2018). However, many African educational systems struggle to effectively leverage technology for meaningful community engagement in mathematics education.

Rwanda presents a unique case study, having positioned ICT as a cornerstone of national reconstruction following the 1994 genocide (Rubagiza, Were, & Sutherland, 2019). Despite significant technological infrastructure deployment across educational institutions, including Teacher Training Colleges (TTCs), the utilization of these technologies for enhancing parental and community involvement in mathematics education remains limited (Ndihokubwayo & Murasira, 2019).

TTCs operate largely disconnected from their communities, with minimal technological integration specifically designed to facilitate engagement in mathematics education (Nzabalirwa & Nkiliye, 2022). This disconnect is particularly concerning as community involvement significantly influences mathematics outcomes (Erdoğan & Demirkasımoğlu, 2019). While research has examined ICT integration in Rwandan primary and secondary schools (Rubagiza, Were, & Sutherland, 2019), studies specifically addressing ICT-facilitated community involvement in mathematics education at TTCs are notably absent.

This gap is particularly critical as TTCs prepare future teachers who will shape national mathematical literacy. The lack of established frameworks for ICT-enhanced community involvement perpetuates cycles of disengagement with mathematics learning where technological resources exist but aren't leveraged to strengthen crucial educational-community connections. This study addresses this critical research gap by investigating how ICT resources can effectively enhance parental and community involvement in mathematics education at Rwandan TTCs.

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Research Objectives

1. To assess the current state of ICT integration in mathematics education in Rwandan teacher training colleges.
2. To evaluate the effectiveness of existing ICT approaches in promoting parental and community involvement in mathematics education in TTCs.
3. To develop a framework for implementing ICT solutions that strengthen Parental and Community Involvement in Mathematics Education in Rwandan Teacher Training Colleges

Research Questions

1. What is the current state of ICT integration in mathematics education in Rwandan teacher training colleges?
2. How effective are existing ICT approaches in promoting parental and community involvement in mathematics education in Rwandan TTCs?
3. What framework can be developed to implement ICT solutions that strengthen Parental and Community Involvement in Mathematics Education in Rwandan Teacher Training Colleges

THEORETICAL FRAMEWORK

This study is anchored in two complementary theoretical frameworks that together provide a comprehensive lens for examining ICT's role in enhancing parental and community involvement in mathematics education at Rwandan TTCs.

Communities of Practice Theory (Wenger-Trayner & Wenger-Trayner, 2020) conceptualizes learning as occurring through participation in communities with shared domains of interest, where members engage in collective learning and practice. In the context of this study, mathematics education at TTCs represents a domain where traditionally, only educators and student teachers have been active participants, with parents and community members positioned as peripheral. The theory provides a framework for understanding how ICT can transform this dynamic by creating accessible pathways for legitimate peripheral participation, gradually moving parents and community members from the margins toward more central involvement in mathematics education. This theoretical lens helps examine how digital platforms can facilitate the sharing of mathematical knowledge, practices, and values between TTCs and communities, creating expanded communities of practice where diverse stakeholders contribute to and benefit from collective mathematical knowledge building.

The TPACK Framework (Technological Pedagogical Content Knowledge) developed by Koehler, Mishra, and Cain (2017) addresses the complex interplay between technology, pedagogy, and content knowledge required for effective teaching with technology. For this study, TPACK provides a structure for analyzing how TTCs prepare future teachers to integrate ICT specifically for community engagement in mathematics education. The framework enables examination of whether teacher training programs develop the specialized knowledge needed to select and implement appropriate technological tools that facilitate meaningful parental and community involvement in mathematics learning. It highlights the importance of teachers understanding not only mathematics content and teaching methods but also how specific technologies can bridge classroom learning with community contexts.

Together, these frameworks inform this study by conceptualizing effective ICT integration not merely as a technical implementation challenge but as a socio-cultural process of expanding communities of practice through the development of specialized teacher knowledge. This integrated theoretical approach guides the assessment of current practices, evaluation of effectiveness, and development of frameworks for enhanced ICT implementation at Rwandan TTCs.

LITERATURE REVIEW

This review examines current research on ICT integration and parental involvement in mathematics education, using a funnel approach from global perspectives to the Rwandan context.

Current State of ICT Integration in Mathematics Education

Research from European countries demonstrates the advanced integration of technology in teacher education programs. Studies from Finland and Estonia show that successful ICT integration in mathematics education involves not only infrastructure but also pedagogical transformation (Valtonen, Sointu, Kukkonen, Mäkitalo, Hoang, Häkkinen, Järvelä, Näykki, Virtanen, Pöntinen, Kostiainen, & Tondeur, 2019). In the UK, (Lau and Lee, 2021) found that teacher training institutions that effectively integrate parents into mathematics education through digital platforms report significant improvements in student achievement. European research consistently emphasizes that technology serves as a bridge between educational institutions and communities, particularly in mathematics education where parental anxiety often creates barriers to involvement (Hornby & Blackwell, 2018).

Across Africa, research reveals more varied implementation of ICT in teacher education. (Tondeur, Kihoza, Jwaifell, & Awuor, 2022) documented increased hardware deployment in teacher training institutions but uneven pedagogical integration. Similarly, studies from Ghana and other African countries indicate that while

technology access has improved at institutional levels, meaningful integration into teaching practices and community engagement remains limited (Maphosa, 2021). Research findings indicate that across several African countries, mathematics departments in teacher education institutions reported lower rates of technology-facilitated community engagement compared to other subject areas.

In Rwanda specifically, Ndihokubwayo & Murasira (2019) found that TTCs have significantly increased hardware availability, but effective pedagogical integration remains inconsistent. Nzabalirwa & Nkiliye (2022) identified that while mathematics teacher educators had access to basic ICT tools, only a small percentage regularly incorporated these tools in ways that modeled effective integration. Rubagiza, Were, and Sutherland (2019) noted that when ICT is used in mathematics education at Rwandan TTCs, it primarily serves content delivery rather than fostering collaborative environments that could involve external stakeholders.

Effectiveness of Current ICT Approaches in Facilitating Community Involvement

European research demonstrates the effectiveness of strategic ICT integration for community involvement. Valtonen, Sointu, Kukkonen, Mäkitalo, Hoang, Häkkinen, Järvelä, Näykki, Virtanen, Pöntinen, Kostiainen, and Tondeur (2019) documented success with digital platforms that provide real-time insights into student mathematical learning, allowing parents to provide targeted support. These approaches have shown particular promise in addressing mathematics anxiety among parents who previously felt unable to support their children's learning (Hornby & Blackwell, 2018).

Research from across Africa reveals both challenges and innovations in ICT-facilitated community involvement. Studies from Tanzania and Uganda highlight mobile technology as a promising platform for mathematics community engagement given widespread mobile adoption (Ngesi, Landa, Madikiza, Cekiso, Tshotsho, & Walters, 2018). However, as Maphosa (2021) notes, many initiatives fail to achieve sustained community involvement due to disconnects between technological tools and local communication practices.

In Rwanda, Rubagiza, Were, and Sutherland (2019) identified that while a majority of parents expressed interest in greater involvement in their children's mathematics education, only a small percentage had participated in any technology-mediated engagement. Ndihokubwayo & Murasira (2019) found significant rural-urban disparities in digital access and literacy among parents. However, localized successes exist: small-scale mobile-based mathematics support programs have documented improved attitudes toward mathematics among both parents and students.

Established Models for ICT Integration in Mathematics Education

Several nations have developed comprehensive frameworks that could inform Rwanda's approach. Various established models have successfully integrated digital platforms into teacher education, connecting mathematics instruction with home learning environments (Voogt, Knezek, Christensen, & Lai, 2018). These models emphasize teacher preparation specifically for technology-mediated family engagement. Similarly, Finland's programs train teachers to use digital tools that connect classroom mathematics with community applications, creating opportunities for authentic problem-solving with community input (Valtonen, et al, 2019).

More directly relevant to the Rwandan context, mobile technology initiatives offer models adapted for contexts with similar infrastructure challenges (Ngesi et al, 2018). These frameworks focus on mobile-first approaches and emphasize mathematical applications relevant to local economic activities. In South Africa, various projects have developed frameworks for integrating Indigenous mathematical knowledge systems with formal education through digital platforms, addressing issues of cultural relevance particularly important in post-colonial educational contexts (Tondeur, et al, 2022).

This literature review revealed that while established models exist internationally, their adaptation to the unique historical, cultural, and infrastructural context of Rwandan TTCs remains underdeveloped, highlighting the importance of this study in developing contextually appropriate frameworks for ICT-enhanced community involvement in mathematics education.

METHODOLOGY

This study employed a sequential explanatory mixed methods design (Creswell & Plano Clark, 2018) to investigate the impact of ICT on parental and community involvement in mathematics education at Rwandan TTCs. Using stratified random sampling, six TTCs representing geographical diversity were selected, with participants including mathematics teacher educators (n=20), student teachers (n=100), and parents (n=80). Quantitative data collection employed structured questionnaires assessing current ICT integration levels (Valtonen et al, 2019), infrastructure audits, and communication records analysis, while qualitative methods included semi-structured interviews and focus group discussions. Quantitative data underwent descriptive and thematic analysis as recommended by Field (2018), while qualitative data was subjected to thematic analysis following Braun & Clarke's (2021) six-step approach. Ethical considerations adhered to the Rwanda National Ethics Committee guidelines, including obtaining institutional permissions from participating TTCs, securing informed consent from all participants with clear explanations of the study's purpose and voluntary nature of participation, ensuring confidentiality through data anonymization and secure storage, and providing opportunities for participants to review findings before publication.

FINDINGS

1. Current state of ICT integration in mathematics education at TTCs

The majority of TTCs indicated the presence of baseline ICT infrastructure (computers, projectors, internet access), but integration for community engagement remains minimal.

ICT Tool	Access (%)	Regular Use for Teaching (%)	Used to Engage Community (%)
WhatsApp	96%	82%	46%
Zoom	75%	55%	33%
Google Classroom	60%	44%	28%
Khan Academy	41%	26%	16%

The findings indicate that in Rwandan Teacher Training Colleges ICT is largely used for instructional delivery but not explicitly to engage parents or community members.

2. Effectiveness of existing ICT approaches in facilitating parental and community engagement

Through qualitative analysis of interviews and focus groups, it was evident that ICT tools, particularly WhatsApp, played a significant role in enhancing communication and learning among stakeholders in teacher training. About 75% of parents reported improved communication with Teacher Training Colleges (TTCs) through WhatsApp platforms. Similarly, 60% of student teachers acknowledged that WhatsApp facilitated the creation of online study groups, enabling peer learning even during holidays, which in turn increased their motivation for mathematics. Moreover, 90% of tutors identified WhatsApp as a low-cost, user-friendly tool for launching community-based math clubs. In contrast, only 30% of participants indicated limited use of other digital platforms such as Zoom, Google Classroom, and Khan Academy, primarily for tutor-student interactions. A small number of parents, mainly from privileged backgrounds, also used these platforms to monitor their children's academic progress and assist with math assignments.

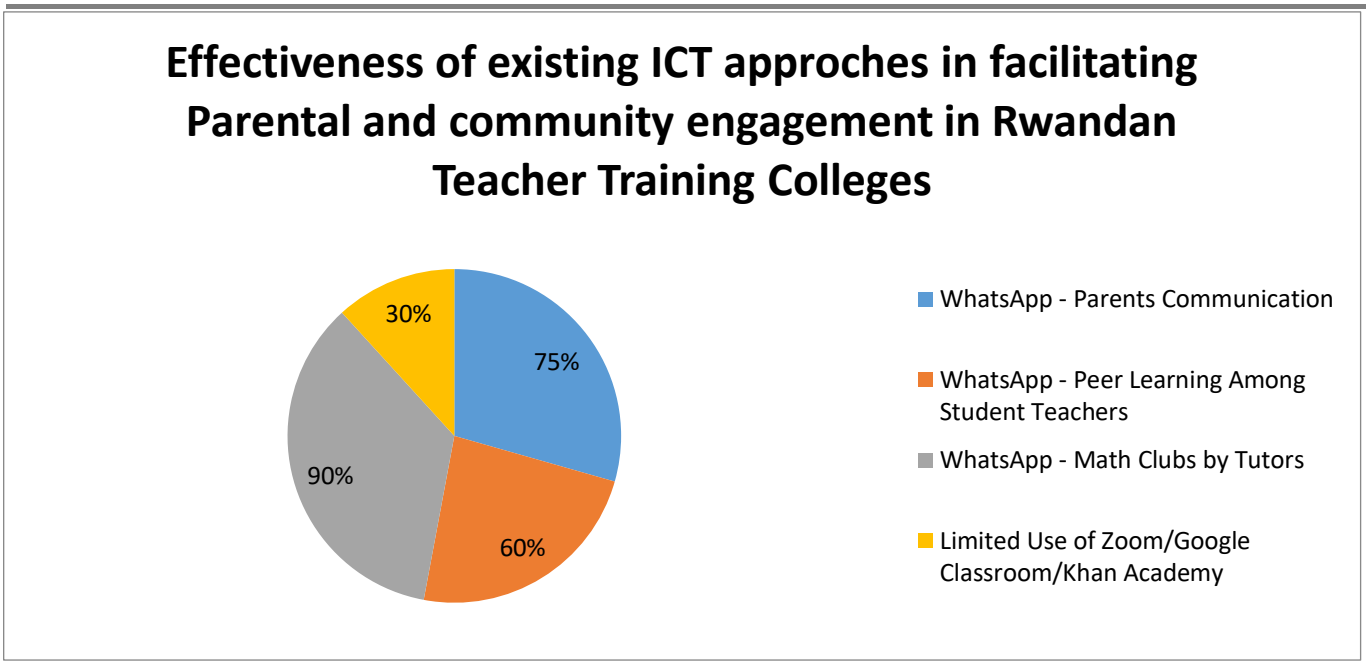


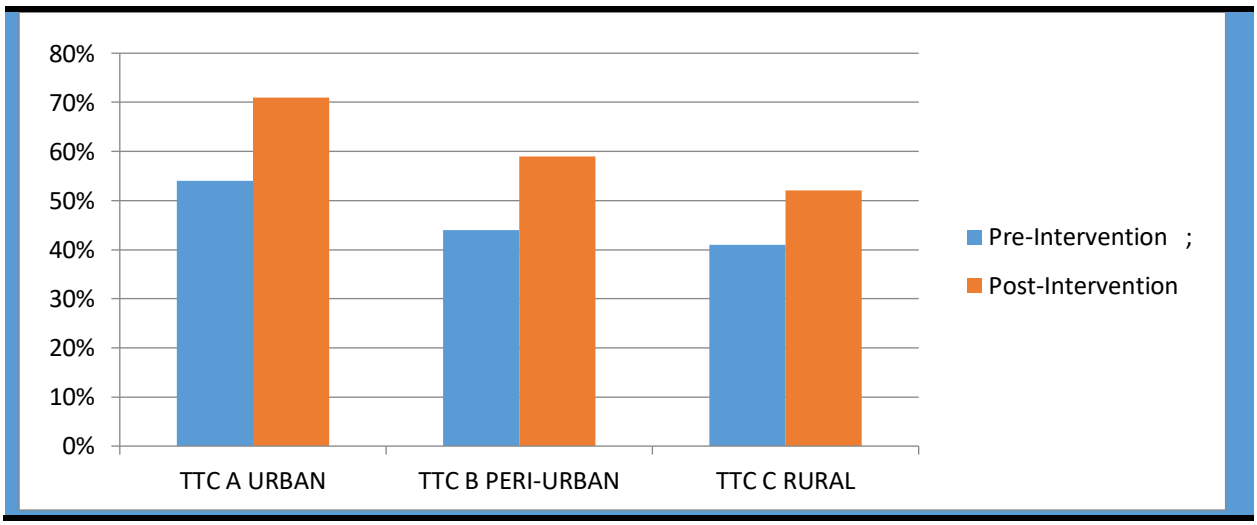
Figure 1: Summary of perceived effectiveness of ICT tools by stakeholders (Scale: 1 = Not Effective, 5 = Highly Effective)

Stakeholder Group	WhatsApp	Zoom	Google Classroom	Khan Academy
Parents (n=80)	4.8	2.8	2.3	2.6
Student Teachers (n=100)	4.5	3.4	3.2	2.2
Tutors (n=20)	4.9	3.6	3.5	2.9

3. Impact of ICT tools on mathematics students' learning and community engagement

The integration of ICT to engage parents in the mathematics teaching and learning of student teachers led to a 15% improvement in student performance in TTCs. Community mathematics study groups were formed in 3 out of 5 colleges, where student teachers used platforms like Zoom and WhatsApp to support local learners and interact with their peers from other colleges. Notably, parental confidence in assisting with mathematics learning more than doubled, rising from 21% to 59% as self-reported by participants. More so, the findings indicated that the geographical location of teacher training colleges had an impact on ICT use both by parents and student teachers. Student teachers from urban locations are seen outperforming their counterparts from rural and peri-urban locations. The figure below highlights the discrepancies both before and after parental engagement.

Figure 2: Student Mathematics Score Improvement (Pre/Post Intervention)



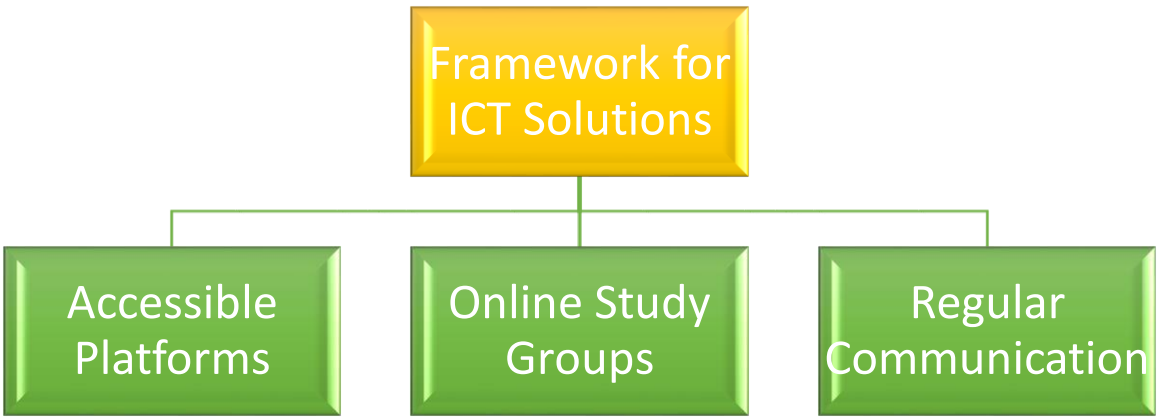
Framework for Rwandan ICT-Based Community Engagement in Mathematics Education

The proposed Framework for ICT-Based Community Engagement in Mathematics Education is closely aligned with Rwanda's Vision 2050 and the Smart Education Policy, both of which aim to transform Rwanda into a knowledge-based, digitally driven economy. These national policies emphasize equitable access to ICT, digital literacy for all citizens, and the integration of technology in education to promote innovation, inclusion, and lifelong learning.

The framework's first pillar, Access, supports these goals by ensuring that mobile-friendly ICT tools and platforms are available to teachers, parents, and communities across both urban and rural areas. This aligns with the national commitment to bridge the digital divide and promote inclusive participation in education. The second pillar, Training, responds directly to the Smart Education Policy's focus on developing digital competencies among educators. By equipping TTC tutors and student teachers with ICT skills, this pillar empowers them to use technology effectively for teaching and for engaging parents and communities in the learning process.The third pillar, Collaboration, reinforces the policy's objective of fostering connected learning ecosystems. It promotes the creation of digital spaces such as WhatsApp groups or community learning portals where teachers, parents, and community members can share ideas, resources, and feedback on learners' progress, thereby strengthening collective participation in mathematics education. Finally, the Feedback pillar aligns with Rwanda's vision of accountable and data-driven education. Through ICT tools, schools can share real-time information on student performance, ensuring transparency and enabling parents to actively support their children's learning.

Overall, this framework translates Rwanda's Vision 2050 and Smart Education Policy aspirations into actionable strategies that integrate ICT, community collaboration, and teacher capacity-building to enhance mathematics education outcomes and sustain inclusive national development.

Figure 3: Proposed Framework for ICT-Enhanced Engagement



CONCLUSION

The findings of this study highlight the transformative potential of ICT in strengthening parental and community engagement in mathematics education within TTCs. Tools like WhatsApp, Zoom, and Google Classroom not only improved communication and collaboration among stakeholders but also contributed to measurable gains in student performance and parental confidence. The emerging four-pillar framework centered on access, training, collaboration, and feedback also offers a practical roadmap for integrating ICT in a way that supports inclusive, community-driven learning environments.

DISCUSSION

Descriptive Statistical Analysis

1. Table 1: ICT Tools Availability and Usage

The data on ICT tool availability and usage shows the following trends (Table 1)

ICT Tool	Access (%)	Regular Use for Teaching (%)	Used to Engage Community (%)
WhatsApp	96%	82%	46%
Zoom	75%	55%	33%
Google Classroom	60%	44%	28%
Khan Academy	41%	26%	16%

WhatsApp emerges as the most frequently available tool and also the most commonly used for community engagement. This aligns with findings in Africa where WhatsApp is widely accessible and effective for communication in educational contexts (Gachago, 2020).

2. Effectiveness of ICT Tools in Community Engagement

To find out the effectiveness of each tool across all participants we calculated the mean and standard deviation for each tool for all the participants. The effectiveness was rated on a scale from 1 (Not Effective) to 5 (Very Effective). The following are the mean effectiveness ratings for each tool:

Table 2: Mean Effectiveness Ratings

ICT Tool	Mean Effectiveness Rating	Standard deviation	Number of Responses
WhatsApp	4.7	0.03	50
Zoom	3.3	-0.03	50
Google Classroom	3.0	0	50
Khan Academy	2.8	-0.1	50

The mean effectiveness ratings indicate that WhatsApp (mean = 4.7) is considered the most effective tool for community engagement, followed by Zoom (mean = 3.3), Khan Academy (mean = 3’0), and Google Classroom (mean = 2.8). WhatsApp’s high effectiveness rating is consistent with findings that it is widely used in developing countries for educational communication, likely due to its easy access and familiar interface (Gachago, 2020). Zoom’s moderate rating reflects its lower usage in community engagement, potentially because of challenges such as limited internet connectivity and access to devices (Jaggars & Xu, 2016). The lower ratings for Google Classroom and Khan Academy suggest that although these tools are available, they are less frequently used, possibly due to issues such as inadequate training or technological barriers (Selwyn, 2016).

Thematic Analysis

This section presents a thematic analysis of qualitative data collected through interviews and surveys, following Braun and Clarke’s (2006) six-phase approach: (1) familiarization with the data, (2) generating initial codes, (3) searching for themes, (4) reviewing themes, (5) defining and naming themes, and (6) producing the report. The primary objective of this analysis is to explore how ICT tools are used in enhancing parental and community engagement in mathematics education at Rwandan Teacher Training College. The analysis identifies five overarching themes: Access and Availability of ICT Tools, WhatsApp as a Practical Engagement Tool, Limited Impact of Advanced ICT Tools, Expanding community-based digital literacy training, and the Rwandan

Structured ICT Engagement Framework. These themes are interpreted by both the literature review and the study's theoretical framework, which emphasizes the role of digital inclusion.

1. Access and Availability of ICT Tools

Most participants mentioned having access to at least one ICT tool, typically a smartphone. However, internet connectivity, electricity supply, and affordability of data remained key barriers, especially in rural areas. Tools like Zoom and Google Classroom were often available but rarely used due to these challenges. This in turn hindered effective ICT use in parental engagement and mathematics instruction. These findings align with Donner (2008) and Hennessy et al. (2010), who identified infrastructure gaps as major barriers in African contexts. In Rwanda, Ndayambaje and Ngendahayo (2021) and Hakizimana (2023**)** also noted that hardware availability has improved but remains uneven, particularly in TTCs outside urban areas. More so, from the Communities of Practice lens, lack of access prevents parents and community members from moving beyond peripheral participation.

2. **WhatsApp as a Practical Engagement Tool**

WhatsApp emerged as the most frequently used and effective ICT tool for facilitating parental and community engagement, specifically for communication. Tutors used it to share updates, assignments, and messages, while parents found it accessible and easy to use. Student teachers also used WhatsApp groups to share mathematical information with their peers from other TTCs. This is consistent with global findings by (Bergdahl & Nouri 2020) and (Livingstone & Blum-Ross 2020), who highlighted mobile messaging apps as effective for parental engagement. In Rwanda, Hakizimana (2023**)** found WhatsApp significantly improved parental involvement and attitudes toward mathematics. This aligns with the TPACK framework, which supports the use of low-barrier technologies that connect pedagogy and content with community realities.

3. Limited Impact of Advanced ICT Tools

Despite the introduction of tools like Zoom, Google Classroom, and Khan Academy, these platforms had minimal effect on community engagement. Most parents lacked the skills, devices, or connectivity to access them, and teachers reported difficulties in integrating them meaningfully. This supports African findings from Ngware et al. (2022) and Adelabu & Adu (2022), who noted limited use of advanced digital tools for community engagement. Locally, these findings align with (Donner, 2008) and (Hennessy et al. 2010), who identified infrastructure gaps as major barriers in African contexts. In Rwanda, (Ndayambaje and Ngendahayo 2021) and (Hakizimana, 2023) also noted that hardware availability has improved but remains uneven, particularly in TTCs outside urban areas. From the Communities of Practice lens, lack of access prevents parents and community members from moving beyond peripheral participation. More so, Munyemana & Uwamahoro (2022) observed that ICT use in TTCs tends to be content-focused rather than engagement-oriented. This illustrates a gap in the TPACK model, where the technological component may be present, but pedagogical and contextual understanding is lacking.

4. Expanding community-based digital literacy training

Both tutors and parents emphasized a strong need for training in ICT use. Teachers lacked structured professional development on digital pedagogy, while parents, especially in rural areas, reported difficulty navigating digital platforms. This confirms findings by (UNESCO, 2015) and (Okonkwo, 2023), which stress that ICT integration must be accompanied by skills development. In Rwanda, Hakizimana (2023) noted that limited digital literacy among parents hinders engagement efforts. The TPACK framework underlines that teacher training must develop holistic competencies, technological, pedagogical, and content-related. Meanwhile, Communities of Practice theory suggests that support is needed to help parents move from peripheral to active contributors.

5. Exploring public-private partnerships

Participant also highlighted exploring public–private partnerships as another issue which can improve parental engagement by pooling resources and expertise from both sectors. They pointed out that private partners can

provide affordable ICT tools, internet access, and digital platforms that enable parents to monitor learners' progress and communicate with teachers. Public institutions, in turn, can ensure equitable access, policy support, and training for effective use. The suggestions are in line with the TPACK framework in the sense that **w**hen public and private actors collaborate, they help educators develop *technological pedagogical knowledge* (TPK), thus understanding how to use ICT to communicate learning progress, share resources, and support learners beyond the classroom. This integration ensures that technology complements pedagogical and content knowledge in mathematics, thus fostering informed and active parental engagement. More so from the Communities of Practice perspective, exploring private-public partnerships create shared learning spaces where teachers, parents, policymakers, and private stakeholders engage in continuous dialogue and knowledge exchange. These partnerships support *mutual engagement* for instance, digital communication platforms or training workshops that connect communities around mathematics learning. Such interactions strengthen parents' sense of belonging and collaboration in their children's education, transforming them from passive supporters into active members of the learning community.

6. Need for a Localized ICT Engagement Framework

Participants expressed the need for a clear, localized framework to guide ICT-based parental and community engagement in mathematics. Teachers lacked institutional support, and practices varied widely between TTCs. This finding drives the development of the proposed ICT-based community engagement model. Internationally, models like Singapore's PSM framework (Wong et al., 2021) and Finland's Mathematics in Context (Järvelä & Järvenoja, 2023) provide examples of structured engagement. Regionally, Kenya's Mobile Mathematics initiative (Ouma et al., 2022) is particularly relevant due to its mobile-first design and local contextualization. From a theoretical view, this theme speaks directly to expanding communities of practice and embedding technology within locally relevant pedagogical approaches.

CONCLUSION

The data revealed that WhatsApp is the most effective tool for community engagement, likely due to its ease of use and wide accessibility. Zoom shows moderate effectiveness, with limitations like connectivity issues affecting its use. The lower ratings for Google Classroom and Khan Academy suggest that while these tools are available, they are not widely utilized, possibly due to training gaps and technological challenges. Overall, these findings highlight the need for better support and infrastructure to enhance the use of ICT tools to foster parental and community engagement in mathematics education in Rwandan Teacher Training Colleges.

Implications

The study highlights the positive impact of ICT tools in enhancing parental and community engagement in mathematics education in Rwanda. ICT facilitates communication between teachers, parents, and the community, leading to improved student performance and motivation. It also supports community-based learning initiatives, extending educational opportunities beyond school hours. However, barriers like limited access to devices, poor internet connectivity, and inadequate training still hinder the full potential of ICT.

RECOMMENDATIONS

1. Enhanced ICT Training: Provide targeted training for teachers, parents, and community members to maximize the effective use of ICT tools in mathematics education.
2. Improved Infrastructure: Invest in better internet connectivity and affordable devices to ensure equal access across urban and rural areas.
3. Increased Use of Effective Tools: Focus on using widely accessible, user-friendly tools like WhatsApp to foster communication And engagement.
4. Community-Based ICT Initiatives: Encourage the creation of online study groups and community forums to extend learning beyond the classroom.
5. Policy Support: Develop policies to prioritize ICT integration in teacher training and community involvement to ensure sustainability and long-term benefits.

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