



Teachers' Perceptions about Digitalization of Teaching and its Influence on Students' Engagement at GS Kagugu, Rwanda

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Abstract: The digitalization of teaching has become a global educational priority aimed at enhancing student engagement and promoting learner-centered instruction. In Rwanda, national initiatives such as the ICT in Education Policy and Smart Classroom Project seek to integrate digital technologies into classroom practices. However, limited evidence exists regarding teachers' perceptions of digitalization and its influence on student engagement at the school level. This qualitative case study explored secondary school teachers' perceptions of the digitalization of teaching and its influence on students' behavioral, emotional, and cognitive engagement at GS Kagugu in Gasabo District, Rwanda. Guided by Constructivist Learning Theory and the Technology Acceptance Model (TAM), the study employed an interpretivist paradigm using semi-structured interviews and document analysis. Five purposively selected teachers from different subject areas participated in the study. Thematic analysis revealed that teachers conceptualize digitalization either as the substitution of traditional instructional tools or as a pedagogical transformation that promotes learner-centered and interactive learning. The findings indicated that digital teaching practices positively influence student motivation, participation, attention, and conceptual understanding when effectively integrated. However, challenges including unstable internet connectivity, power interruptions, limited digital competencies, and inadequate professional development constrain meaningful technology integration. The study recommends continuous school-based professional development, peer-led mentoring initiatives, equitable access to digital resources, and the provision of localized offline-capable digital learning materials. Educational digitalization should therefore prioritize teacher capacity building alongside technological investments to maximize student engagement and learning outcomes.

Keywords: Digitalization of Teaching, Teacher Perceptions, Student Engagement, ICT Integration, Secondary Education, Rwanda.

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1. Introduction

The rapid evolution of Information and Communication Technology (ICT) over the past several decades has

fundamentally reshaped the landscape of global education, shifting instructional paradigms from traditional teacher-centered models to modern, interactive, and learner-centered approaches. Globally, the digitalization of

education gained major momentum towards the close of the twentieth century as computers and internet connectivity became increasingly integrated into school systems (Zou et al., 2025). International organizations, most notably UNESCO, have continuously advocated for the transformative potential of digital technologies to enhance educational access, equity, and overall instructional quality (Tangwe and Nizeyumukiza, 2025). According to recent global educational assessments, digital technologies play a critical role in fostering interactive learning environments, facilitating peer collaboration, and encouraging self-directed inquiry (Elsa Oskarita and Hadid Nur'afra Arasy, 2024). However, empirical consensus emphasizes that the mere presence of technology does not automatically improve learning outcomes; rather, the success of educational digitalization is heavily mediated by teachers' beliefs, digital competencies, and subjective attitudes toward these tools (Arisanti, 2025).

Historically, educational research in developed nations such as the United States and the United

Kingdom has demonstrated that digitalization can significantly boost student engagement (Arisanti, 2025). When digital platforms including multimedia resources, online discussion boards, and interactive software are blended seamlessly into pedagogy, students display marked increases in motivation, concentration, and active participation (Fitria Nurulaeni et al., 2026). Conversely, in settings where teachers lack adequate pedagogical training or harbor negative perceptions of digital tools, technology adoption remains superficial, often leading to poor student engagement and uneven learning outcomes (Syed Eirfan Athar, 2026). This disparity underscores the reality that teachers' perceptions are the primary gateway through which digital initiatives translate into classroom realities.

In the African context, the push for educational digitalization is driven by continental frameworks designed to bridge the digital divide and foster a skilled 21st-century workforce. The African Union, through its Continental Education Strategy for Africa (CESA 2016–2025), has designated ICT integration as a core strategic priority for improving the quality and relevance of education across the continent. Despite strong policy commitments, the implementation of digital education across Sub-Saharan Africa is hindered by structural bottlenecks, including fragile infrastructure, erratic electricity, limited internet connectivity, and a lack of systematic teacher professional development (Nthambeleni & Motadi, 2025). Consequently, teachers across the region often navigate digital transitions with mixed feelings, experiencing professional anxiety, technical resistance, or low self-efficacy (Nthambeleni & Motadi, 2025). These negative or hesitant perceptions, in turn, directly limit the active and cognitive engagement of students in digitalized learning activities.

This transition was abruptly accelerated by the COVID-19 pandemic, which forced a massive, unprecedented shift toward online and blended learning modalities worldwide (Russo, 2025). Over 1.5 billion learners globally were impacted by school closures, necessitating rapid emergency remote teaching. While this period highlighted the invaluable role of digital infrastructure in sustaining academic continuity, it simultaneously exposed deep-rooted structural inequalities and a severe lack of digital readiness among teaching staff, particularly in developing nations (Singun, 2025). Courtney et al. (2022) stated that the pandemic made it clear that infrastructural availability is only one part of the equation; without positive teacher perceptions and robust digital competencies, technology cannot be leveraged effectively to sustain meaningful student engagement.

In Rwanda, the Government has articulated a bold vision to transform the nation into a competitive, knowledge-based economy, as outlined in Vision 2050. Recognizing education as a key driver of this transformation, the Ministry of Education (MINEDUC) and the Rwanda Education Board (REB) have launched several ambitious digital initiatives. These include the One Laptop per Child (OLPC) program, the Smart Classroom Project, and various localized e-learning platforms aimed at modernizing instruction and boosting learner participation. According to MINEDUC's ICT in Education Policy, digitalization is explicitly intended to serve as a catalyst for active, collaborative, and student-centered learning.

However, empirical studies conducted in Rwandan secondary schools paint a complex picture. While digital tools have become physically accessible in many schools, their actual classroom utility remains highly variable (Nshunguyimana et al., 2025). Many teachers struggle with heavy workloads, insufficient technical support, and limited pedagogical training on how to transition from traditional lecturing to digital facilitation (Msekelwa, 2026). As a result, digital tools such as projectors and computers are frequently relegated to basic presentation aids rather than interactive learning instruments. Previous research within Rwanda highlights that teacher-related factors—such as their personal pedagogical beliefs, perceived usefulness of technology, and perceived ease of use ultimately dictate whether classroom digitalization succeeds or fails in engaging students (Mudaheranwa & Ntivuguruzwa, 2024).

At the institutional level, GS Kagugu in Gasabo District represents a micro-reflection of these national dynamics. While the school has benefited from national ICT integration initiatives, including the acquisition of basic digital infrastructure such as computers and projectors, the daily application of these tools is inconsistent. Preliminary

observations indicate a wide divide: some teachers confidently employ digital resources to foster student-centered collaboration, whereas others continue to rely almost exclusively on rote, traditional teaching methods. Educational stakeholders in Gasabo District have frequently pointed out ongoing challenges related to unstable connectivity, hardware maintenance, and a lack of continuous, context-specific professional development.

Consequently, there is a profound need to investigate how teachers at GS Kagugu subjectively perceive the digitalization of teaching and how they interpret its actual influence on their students' behavioral, emotional, and cognitive engagement. Grounded in global, regional, and local literature, this study is built on the premise that educational technology cannot be evaluated in isolation from the educators who utilize it. By exploring the lived experiences and perceptions of teachers within this specific secondary school context, this research aims to address a critical gap in understanding how digital policies translate into daily classroom engagement.

1.1 Problem Statement

Globally, the ideal scenario in contemporary education positions digitalization as a primary catalyst for active, learner-centered instruction that enhances students' cognitive, emotional, and behavioral engagement (Dr. Shiv Prakash, 2026). International frameworks spearheaded by UNESCO assert that the effective integration of digital technologies should fundamentally elevate instructional quality and foster meaningful, self-directed student participation. In this ideal context, when teachers confidently and pedagogically integrate digital tools, learners demonstrate increased motivation, collaboration, and deeper critical thinking (Dr. Shiv Prakash, 2026). This theoretical ideal relies on teachers possessing positive perceptions, strong digital competencies, and consistent institutional support to utilize digital technologies interactively rather than superficially.

In alignment with these global goals, the Government of Rwanda has articulated a comparable vision. Through policies designed and implemented by the Ministry of Education (MINEDUC) and the Rwanda Education Board (REB) including the *ICT in Education Policy* and the *Smart Classroom* initiative digital technologies are expected to modernize instruction and improve student engagement across primary and secondary schools. Rwanda's national development strategies, notably Vision 2050, prioritize digital literacy and the development of a knowledge-based economy, implying that schools must effectively integrate Information and Communication Technology (ICT) to enhance learning outcomes.

However, the real situation in Sub-Saharan Africa, including Rwanda, reflects notable challenges. Evidence from the region indicates that physical access to digital devices does not automatically translate into improved classroom engagement, largely due to limited teacher preparedness and mixed perceptions about technology use (Twagilimana et al., 2026). Despite Rwanda's strong commitment to educational digitalization through e-learning platforms, Smart Classrooms, and teacher professional development programs, significant implementation gaps persist (Mugiraneza, 2021). Studies conducted across Rwandan schools indicate that teachers routinely experience difficulties related to limited digital competence, inadequate pedagogical training, insufficient technical support, unreliable internet connectivity, and uneven access to digital resources.

Specifically, research by Mudaheranwa & Ntivuguruzwa (2024) reveals that while smart classroom technologies have the potential to improve classroom participation, their effectiveness depends heavily on teachers' personal ability and confidence in integrating digital tools into everyday instruction. Similarly, Mushimiyimana et al. (2025) report that deep-seated disparities in ICT infrastructure and teacher readiness continue to affect the quality of digital teaching across the country. Policy reports from MINEDUC and REB further highlight the urgent need to strengthen teachers' digital competencies and pedagogical use of technology to maximize the benefits of ongoing investments in educational technology.

At the local level, the situation in Gasabo District and specifically at GS Kagugu suggests that these challenges remain highly prevalent. Although GS Kagugu has benefited from national ICT integration initiatives with tools such as computers, projectors, and internet-based resources available and occasionally used their classroom integration is highly uneven. Preliminary observations indicate that while some teachers feel confident utilizing digital technologies to facilitate interactive learning, others rely mainly on traditional, teacher-centered lecture approaches despite the availability of ICT facilities. Furthermore, local education stakeholders in Gasabo District have highlighted recurring challenges associated with maintaining ICT equipment, securing reliable connectivity, and strengthening teachers' digital competencies.

This situation reveals a critical empirical, contextual, and methodological gap. While ICT infrastructure has gradually expanded in Rwanda, there is limited empirical evidence regarding how teachers subjectively perceive digitalization and how those perceptions influence student engagement at the school level. Most existing studies have focused on quantitative assessments of technology access, policy frameworks, or national infrastructure availability,

leaving the qualitative, lived experiences of teachers unexplored. In particular, no known qualitative study has explored how teachers at GS Kagugu understand digitalization, the micro-level challenges they encounter when using digital technologies, and how they perceive the effect of these technologies on students' engagement.

The motivation of this study is driven by the need to resolve this discrepancy between policy expectations and classroom realities. Investigating teachers' perceptions is vital because teachers act as the ultimate gatekeepers of technology integration. If teachers perceive digital tools as time-consuming, complex, or unhelpful, they are unlikely to use them in ways that foster student participation. Conversely, positive perceptions can unlock innovative, collaborative pedagogies. By capturing the qualitative "voices" of secondary school teachers at GS Kagugu, this study aims to provide context-specific, qualitative insights that can help school leaders, policymakers, and teacher-training institutions design more effective, supportive, and realistic digital education strategies

1.2 Specific Objectives

The specific objectives of this study were:

1. To explore teachers' conceptual understanding of digitalization within their specific secondary school teaching context at GS Kagugu.
2. To examine teachers' perceptions of how digital teaching practices influence students' behavioral, emotional, and cognitive engagement during lessons at GS Kagugu.
3. To suggest practical strategies and recommendations for improving digital teaching practices and enhancing student engagement at GS Kagugu based on teachers' experiences.

1.3 Specific Research Questions

1. To achieve the above objectives, the study addressed the following specific research questions: How do secondary school teachers at GS Kagugu understand and conceptualize digitalization in the context of their daily teaching practices?
2. How do teachers at GS Kagugu perceive the influence of digital teaching practices on their students' behavioral, emotional, and cognitive engagement in the classroom?
3. What strategies and support systems do teachers suggest to improve the integration of digital tools and enhance student engagement at GS Kagugu?

2. Literature Review

2.1 Theoretical Review

This study is conceptually guided by two complementary theoretical frameworks: the Constructivist Learning Theory and the Technology Acceptance Model (TAM). Together, these theories explain how teachers' cognitive perceptions of digital tools shape their classroom integration, and how these practices subsequently influence student engagement.

2.1.1 Constructivist Learning Theory and Digitalization of Teaching

Constructivist Learning Theory, largely associated with the seminal works of Jean Piaget and Lev Vygotsky, posits that learners do not passively absorb information but actively construct knowledge through interaction with their environment. In modern educational settings, digital technologies act as vital tools that support constructivist pedagogy by facilitating interactive simulations, collaborative platforms, and diverse multimedia resources.

According to Wiranda & Ciptaningrum (2024), the integration of Information and Communication Technology (ICT) enhances learner-centered instruction when teachers actively use technology to facilitate exploration, inquiry, and peer collaboration rather than merely using it for passive content delivery. In this pedagogical model, the educator's role shifts from being the sole transmitter of knowledge to acting as a facilitator who designs active, technology-mediated learning experiences. This theory directly informs the exploration of teachers' understanding of digitalization. It suggests that teachers who conceptualize digitalization as a deep pedagogical transformation rather than a simple substitution of traditional tools with digital screens are far more likely to implement interactive teaching strategies that foster meaningful learning.

2.1.2 Technology Acceptance Model (TAM) and Teachers' Perceptions

The Technology Acceptance Model (TAM), originally developed by Fred Davis (1989), remains one of the most influential frameworks used to explain how users accept, adopt, and integrate new technologies. TAM asserts that an individual's behavioral intention to utilize a technology is primarily determined by two core cognitive beliefs:

Perceived Usefulness (PU): The degree to which a teacher believes that utilizing a specific digital tool will enhance their teaching effectiveness. **Perceived Ease of Use (PEOU):** The degree to which a teacher believes that using

the digital technology will be relatively free of physical or cognitive effort. As highlighted by Wohlfart & Wagner (2025), when teachers believe that digital tools are straightforward to operate (high PEOU) and highly effective in improving classroom dynamics (high PU), they are significantly more likely to integrate them into their daily classroom practices. Conversely, negative perceptions or technical anxieties act as barriers, limiting meaningful technology use. Furthermore, Svensson and Baelo (2015) emphasize that teacher confidence, digital competence, and personal attitudes are critical determinants that ultimately shape student outcomes and participation in digitalized learning environments.

TAM provides a direct analytical lens to examine teachers' perceptions of how digital teaching practices influence students' engagement. If teachers perceive digitalization positively and observe that digital tools enhance classroom motivation (reinforcing perceived usefulness), they are more inclined to adopt innovative instructional strategies that actively encourage student participation (Wigati et al., 2025). By combining these two frameworks, the study establishes a holistic theoretical pathway. TAM explains the initial cognitive and perceptual hurdles (perceived usefulness and ease of use) that teachers must overcome to adopt digital tools (Badda, 2025). Once these tools are accepted, Constructivism dictates the active, student-centered manner in which they should be deployed in the classroom. Ultimately, the interaction between positive technology acceptance (TAM) and student-centered lesson design (Constructivism) is what drives multidimensional student engagement.

2.2 Empirical Related Literature

This section provides a thematic and critical analysis of empirical research directly aligned with the three specific objectives of this study, synthesizing global, African, and Rwandan studies while pointing out areas of consensus, divergence, and methodological choices.

2.2.1 Teachers' Conceptual Understanding of Digitalization

Empirical research demonstrates that teachers' perceptions and ultimate adoption of technology are heavily shaped by how they conceptualize digitalization within their local instructional settings. At the global level, a systematic review of technology integration by (Рвачева et al.(2020) revealed that teachers' definitions of digitalization fall along a spectrum, where educators with limited training view digitalization purely as a substitution tool, using computers or projectors merely to display static lecture notes. On the other end, teachers with advanced training conceptualize digitalization as a transformative, pedagogical process that alters how students access, share,

and generate knowledge. Similarly, the Ginting et al.(2024) notes that teachers who hold a deeper, process-oriented understanding of digitalization are more likely to implement student-centered lessons, whereas those with a tool-oriented view struggle to move past traditional teacher-centered lectures.

Across Sub-Saharan Africa, this conceptual understanding is strongly mediated by systemic constraints, as studies indicate that teachers often perceive digitalization through the lens of resource accessibility and technical functionality, defining digital teaching by the presence of hardware rather than its pedagogical integration (Lund and Aagaard, 2020). This material-centric view of digitalization is echoed in Rwandan literature, where studies show that while teachers appreciate the role of computers in facilitating learning, their conceptualization of digital teaching is heavily limited by a lack of equipped laboratories, leading many to equate digitalization with the personal possession of a laptop (Mugiraneza, 2021). Furthermore, research investigating smart classroom usage in Rwandan secondary schools has discovered a distinct mismatch between what teachers valued as important and what they practiced. While teachers conceptualized smart classrooms as vital spaces for sourcing and preparing lesson notes, actual classroom practices remained highly traditional due to a lack of clear operational guidelines and pedagogical confidence.

2.2.2 Teachers' Perceptions of the Influence of Digital Teaching on Student Engagement

The relationship between digitalized teaching and student engagement is widely debated in empirical literature, with researchers analyzing behavioral, emotional, and cognitive dimensions. Historically, global studies highlight that well-designed digital lessons consistently boost student engagement, arguing that children are naturally comfortable with technology, which makes transitioning conventional lectures into virtual or multimedia-rich formats far more fascinating. Internationally, Kurnaz (2025) found positive effects on student motivation when digital tools were used, though the author noted that these positive effects were highly dependent on how effectively the teacher facilitated the lesson.

In the African secondary school context, researchers have found that integrating interactive online curriculum and multimedia applications is far more engaging for students than old-school paper-and-pen activities, though these positive outcomes are easily undermined by structural challenges. Studies across Sub-Saharan Africa indicate that while digital teaching can spark high initial interest, unstable internet connectivity, sudden power cuts, and poor hardware maintenance frequently disrupt lessons, turning potential cognitive engagement into frustration and

behavioral disengagement for both teachers and students (Osmani & Tartari, 2024). In Rwanda, recent studies show positive trends regarding perceived student outcomes, confirming that smart learning tools effectively engage and motivate students. However, as highlighted by (Mudaheranwa and Ntivuguruzwa (2024), these positive outcomes are highly conditional, as teachers who possess low confidence or harbor anxieties about technology often struggle to maintain classroom control during digital sessions, which can lead to students using devices for non-academic distractions rather than active learning.

2.2.3 Strategies and Support Systems for Improving Digital Teaching Practices

The third major theme in empirical literature centers on identifying and implementing strategies to bridge the gap between digital policies and classroom realities. Globally, there is a strong consensus that providing hardware alone is an ineffective educational strategy, as Cambeses-Franco and Cambeses-Franco (2026) emphasizes that investments in digital infrastructure must be accompanied by robust teacher support systems. Empirical reviews indicate that schools with formal collaboration networks among teachers, combined with active support from school principals, show significantly higher levels of successful digital tool integration. At the regional level, Joseph et al.

(2025) stresses the importance of structural support, noting that African educational institutions must prioritize continuous, hands-on professional development over one-off technical workshops. Without ongoing pedagogical coaching, teachers quickly revert to traditional lecture methods once initial training sessions end.

In Rwanda, the need for systematic, continuous support is a dominant theme in recent educational research, showing that teachers' confidence and willingness to integrate technology are directly shaped by the continuous professional development (CPD) programs available to them (Nkundabakura et al., 2024). Teachers who participated in structured, collaborative training programs feel far more competent in creating engaging, interactive, and debate-oriented lessons. Furthermore, researchers recommend that Rwandan secondary schools establish clear school-level guidelines and structured timetables for smart classrooms to prevent scheduling conflicts and ensure that these resources are utilized equitably across all subject areas (J. de D. Mushimiyimana, 2021). Finally, educational experts emphasized that the Rwanda Basic Education Board must not only invest in physical infrastructure but also heavily fund the creation of localized, digital-curriculum content to make technology truly useful for local teachers.

2.2.4 Summary of the Empirical Synthesis and Research Gap

Specific Objective	Key Empirical Findings	Remaining Knowledge Gap
Teachers' Understanding	Teachers' views range from a "tool-substitution" perspective to a "pedagogical transformation" framework. In resource-limited contexts, definitions are often restricted to hardware availability.	Lack of qualitative studies exploring the subjective meaning of "digitalization" among teachers in rural, single-school contexts like GS Kagugu.
Perceived Influence on Engagement	Digital tools generally improve student interest and motivation, but outcomes are highly dependent on the teacher's confidence and technical stability.	Most studies rely on quantitative surveys measuring <i>perceived</i> engagement; there is a lack of deep, qualitative accounts of daily classroom interactions.
Suggested Strategies	Successful integration requires continuous professional development (CPD), school-level guidelines, administrative support, and localized digital content.	Limited research on teacher-driven, localized recommendations developed from the bottom-up within rural Rwandan secondary schools.

Ultimately, while the broader literature establishes the value of ICT integration, there remains a notable lack of qualitative research capturing the rich, contextual experiences of teachers navigating these changes within rural Rwandan secondary schools. This study directly addresses this empirical and contextual gap by conducting an in-depth qualitative case study at GS Kagugu.

3. Methodology

3.1 Research Paradigm, Approach, and Design

This study was situated within the interpretivist paradigm, which operates on the ontological assumption that reality was socially constructed, multiple, and subjective rather

than a single, objective truth. It posits that understanding human experiences requires exploring the subjective meanings that individuals assign to their lived experiences. This paradigm was highly appropriate because the study does not seek to measure variables quantitatively or establish universal laws, but instead aims to capture and understand the diverse, nuanced ways teachers at GS Kagugu perceive, interpret, and make sense of digital teaching practices in their everyday classroom environments.

To operationalize this interpretivist paradigm, the study adopted a qualitative research approach implemented through a single case study design. A qualitative approach was selected because it is uniquely suited for gathering rich, detailed, and descriptive accounts of participants' experiences and beliefs, allowing the researcher to address the "how" and "what" of teachers' realities in their natural setting. Within this approach, GS Kagugu is treated as a single, bounded case. This design allowed for an in-depth, holistic, and contextual exploration of educational digitalization as it naturally occurs within this specific school environment, prioritizing deep, context-specific insights over broad statistical generalizability.

3.2 Location and Context of the Study

The study was conducted at GS Kagugu, a public secondary school located in the Ruhuha Sector of Gasabo district, Rwanda. GS Kagugu serves as a highly relevant site for this research because it operates within Rwanda's national ICT integration framework, having received basic digital infrastructure such as computers, projectors, and internet access through government initiatives like the Smart Classroom Project. However, like many rural and semi-urban schools in Rwanda, it experienced localized challenges including unstable connectivity, hardware maintenance issues, and varying levels of teacher training, making it an ideal setting to explore the gap between digital policy and actual classroom practice.

3.3 Target Population, Sample, and Sampling Technique

The target population comprises all secondary school teachers currently employed at GS Kagugu, totaling approximately 30 educators who have firsthand experience with classroom technology integration. To ensure depth and information richness, a sample of approximately 5 teachers was selected. This small sample size aligned with qualitative case study standards that prioritize the quality of individual insights over numerical representation, and it includes educators from humanities, sciences, and languages to capture diverse, subject-specific viewpoints. The study utilized purposive sampling to deliberately select participants based on specific inclusion criteria,

which require active experience using or attempting to use digital tools in classroom instruction, a willingness to share detailed professional reflections, representation across different subject areas and grade levels, and a mix of both early-career and highly experienced teaching backgrounds.

3.4 Data Collection Methods

To ensure data triangulation and depth, the researcher employed two primary data collection methods, consisting of semi-structured interviews and document analysis. Semi-structured interviews serve as the primary data collection tool, designed to last 45 to 60 minutes and conducted in a private school setting in either English or Kinyarwanda, depending on the teacher's preference. Guided by a semi-structured interview protocol, this method offers the flexibility to probe deeply into teachers' conceptual understandings, observed changes in student engagement, and systemic challenges, with all interviews being audio-recorded with explicit participant consent for precise translation and transcription. This method was complemented by document analysis, where the researcher reviews relevant institutional documents such as school ICT policies, lesson plans, smart classroom usage logs, and teacher training materials to triangulate teachers' self-reported practices with documented school processes.

3.5 Data Analysis Methods

The qualitative data would be analyzed using thematic analysis, strictly following the six-phase framework established by Braun and Clarke (2021). In the first phase of familiarization, the researcher transcribed the interview recordings verbatim, translating Kinyarwanda responses into English where necessary, and repeatedly reads the transcripts alongside the document analysis notes to gain a deep conceptual overview of the data. During the second phase of generating initial codes, the dataset was systematically coded line-by-line to identify meaningful segments of text, involving both deductive codes informed by the Technology Acceptance Model and Constructivist Learning Theory, as well as inductive codes emerging directly from the participants' raw narratives.

In the third phase, the generated codes were organized and grouped into broader, overarching thematic patterns that directly address the research objectives. The fourth phase of reviewing themes involved cross-checking the candidate themes against the coded extracts and the entire dataset to ensure they are coherent, distinct, and accurately representative. In the fifth phase of defining and naming themes, each finalized theme was defined, bounded, and named to clearly convey its conceptual focus and its relevance to teachers' perceptions of student engagement. Finally, in the sixth phase of producing the report, the

analysis was compiled into an academic narrative that weaves together thematic interpretations with illustrative, direct quotes from the teachers to preserve their authentic voices and ensure confirmability.

3.6 Trustworthiness

The study ensured trustworthiness using Lincoln and Guba's (1985) criteria. Credibility was enhanced through data triangulation (interviews and document analysis) and member checking. Transferability was achieved by providing a rich description of the study context. Dependability was ensured through an audit trail documenting the research process, while confirmability was strengthened through reflexive journaling and supporting findings with participants' quotations.

3.7 Ethical Considerations

Prior to commencing the study, ethical clearance was granted by the appropriate university ethics committee, and authorization to conduct the research was obtained from GS Kagugu. Participation in the study was entirely voluntary, and all participants provided informed consent before taking part in the interviews. To safeguard their privacy, participants' identities were protected through the use of pseudonyms, and the information collected was treated with strict confidentiality. Research data were

securely maintained and utilized exclusively for academic purposes. Participants were also made aware that they could discontinue their involvement in the study at any stage without facing any penalty or adverse consequences.

4. Results and Discussion

4.1 Demographic Profile of the Participants

To contextualize the qualitative narratives of the study, it is essential to understand the diverse professional backgrounds of the participating educators. The sample comprised five secondary school teachers representing various academic disciplines, including the sciences, humanities, and languages. This disciplinary variety was purposefully designed to capture a broad spectrum of educational experiences, from hands-on laboratory simulations to text-based language instruction. The teaching experience of the participants ranged from four to fifteen years, providing a balanced mix of early-career energy and seasoned pedagogical wisdom. This variation in experience also yielded diverse levels of exposure to national ICT training programs, ranging from comprehensive pre-service university courses to brief, one-off professional workshops.

Table 1: Demographic and Professional Profiles of Participants

Participant Pseudonym	Subject Area Specialty	Teaching Experience	Primary Digital Tools Employed	Type of ICT Training Received
T1	Physics & Mathematics	8 Years	Laptops, PhET Simulations	One-off national training workshop
T2	English Language	12 Years	Projectors, Interactive Personal Projector, PDF Reading Materials	Informal peer-to-peer school mentoring
T3	Geography & History	4 Years	Google Maps, YouTube Videos, Ceiling Projector	Pre-service teacher training curriculum
T4	Chemistry & Biology	6 Years	Virtual Laboratory Programs	Smart Classroom induction program
T5	Kinyarwanda & Religion	15 Years	Basic Word Processing, Static Presentation Slides	School-level basic digital literacy training

4.2 Conceptual Understanding of Digitalization

The first objective of this research was to explore how secondary school teachers at GS Kagugu understand and conceptualize digitalization within their daily teaching

practices. The thematic analysis of the interview transcripts revealed a clear conceptual spectrum among the educators. Rather than sharing a single, uniform definition, the participants conceptualized digitalization in two distinct ways, shifting from a basic, material-focused perspective to a deeper, pedagogically transformative framework.

The "Material-Centric" Tool-Substitution Paradigm

For several teachers, particularly those with longer teaching tenures or limited access to continuous professional training, digitalization was conceptualized primarily as the physical replacement of traditional teaching tools with modern digital hardware. In these accounts, the transition to digital education was defined almost entirely by the physical presence of laptops, projectors, and screens in the classroom.

For example, T5 explained that digitalization to him represented a modern way of executing traditional tasks, noting that instead of spending a large portion of the lesson writing notes on the blackboard, he could type his materials beforehand and project them onto the wall for students to copy. Similarly, T2 viewed digitalization as a technological substitute for physical handouts, explaining that having digital copies of novels on her laptop saved the school the cost of printing physical paper.

These narratives suggest that under the material-centric paradigm, technology is used as a functional substitute that increases administrative efficiency but leaves the teacher's traditional, lecture-based instructional style completely unchanged. This conceptualization was further supported by the document analysis of lesson plans, which showed that digital tools were often listed simply as passive presentation aids rather than interactive learning instruments.

The "Pedagogically Transformative" Constructivist Paradigm

In contrast, teachers who possessed higher digital self-efficacy or had received recent ICT integration training conceptualized digitalization as a profound shift in classroom dynamics and knowledge delivery. These educators did not view technology merely as a substitute for chalk; instead, they understood it as a pedagogical catalyst that actively shifts the focus of the classroom from teacher-led lecturing to student-centered discovery.

T3 articulated this perspective by emphasizing that genuine digitalization goes far beyond projecting a PDF document or displaying static notes on a wall. He argued that true digitalization involves utilizing the internet, multimedia resources, and interactive platforms to bring complex, real-world concepts directly into the classroom, allowing students to explore geographic landforms or historical events dynamically.

This process-oriented view was shared by T4, who conceptualized digitalization as an instructional evolution where the teacher steps away from being the sole source of knowledge to become a facilitator who designs interactive, technology-mediated activities. This division in conceptual understandings highlights that physical access to technology is interpreted differently depending on a teacher's individual training and pedagogical beliefs.

Table 2: Contrast of Teacher Conceptualizations of Digitalization

Conceptual Paradigm	Core Meaning to Teachers	Classroom Application	Perceived Pedagogical Goal
Material-Centric Substitution	Replacing physical media with electronic devices.	Projecting static text notes, displaying PDFs.	Increasing teacher convenience and saving classroom time.
Pedagogical Transformation	Reorganizing instructional delivery to foster active discovery.	Facilitating interactive simulations, videos, and collaborative research.	Shifting from passive listening to learner-centered knowledge construction.

The present findings are consistent with Ginting et al. (2024), who found that teachers possessing deeper pedagogical understandings of digital technologies are more likely to implement learner-centered instructional practices. Similarly, Mugiraneza (2021) reported that many Rwandan teachers continue to associate digitalization primarily with the availability of digital devices rather than transformative teaching practices. However, the findings partially contradict assumptions that the mere provision of ICT infrastructure automatically promotes pedagogical transformation, as some teachers at GS Kagugu continued to utilize technology primarily for presenting static

instructional materials despite the availability of digital resources.

4.3 Perceived Influence of Digital Teaching on Student Engagement

The second objective sought to examine how teachers at GS Kagugu perceive the influence of digital teaching practices on their students' behavioral, emotional, and cognitive engagement. The qualitative findings indicate that the integration of digital tools has a powerful, multidimensional impact on student learning, though this

influence is highly sensitive to technical stability and teacher confidence.

Behavioral Engagement: Focus, Participation, and the Risk of Distraction

Teachers reported that the introduction of digital tools brought a noticeable improvement in students' basic behavioral classroom participation. When visual materials, such as historical documentaries or scientific animations, were projected, students displayed longer attention spans and a marked reduction in off-task classroom behaviors. T1 observed that the visual nature of digital projections kept students alert, noting that even those who typically sat quietly at the back of the room became more attentive and active during lessons.

However, the findings also revealed a behavioral vulnerability. When students were given direct access to laptops in the smart classroom, maintaining focus required intense teacher vigilance. T4 noted that some students tried to minimize their academic applications to browse unauthorized sites or play basic offline games, suggesting that when a teacher's digital classroom management skills are low, technology can quickly become a source of distraction rather than focus.

Emotional Engagement: Enthusiasm, Pride, and Technical Frustration

The emotional dimension of engagement was characterized by a surge in student enthusiasm and motivation. Teachers reported that students expressed a deep sense of pride when using laptops and projectors, explaining that it made them feel equal to peers attending privileged private schools in urban areas. T2 remarked that her students showed

immense excitement on days when digital tools were integrated, which made them more eager to participate in classroom discussions.

Despite this positive emotional energy, teachers highlighted that student enthusiasm is highly vulnerable to technological failures. At GS Kagugu, sudden power outages or unstable internet connections regularly cut digital lessons short. Teachers observed that when a lesson was abruptly interrupted by a technical failure, the students' excitement was instantly replaced by deep frustration and a general loss of motivation, demonstrating how closely emotional engagement is tied to basic infrastructural reliability.

Cognitive Engagement: Deep Conceptualization vs. Superficial Processing

The findings showed that the depth of students' cognitive engagement depended heavily on *how* the teacher integrated the digital tools. When technology was used purely for "tool-substitution" (such as projecting long paragraphs of text), students' cognitive processing remained superficial, mimicking traditional rote learning.

However, when teachers used digital tools to present complex, interactive simulations, students demonstrated deeper critical thinking and better retention. T1 shared that utilizing interactive simulations in Physics allowed students to visually manipulate variables and observe physical laws in real time, leading to a level of conceptual understanding that could never be achieved by simply reading a textbook. This indicates that when digital tools are integrated into a constructivist learning design, they allow students to actively construct mental models, leading to genuine cognitive growth.

Table 3: Perceived Impact on Dimensions of Student Engagement

Dimension of Engagement	Positive Observational Findings	Negative/Conditional Observational Findings
Behavioral Engagement	Increased attendance, longer attention spans, and active focus on visual resources.	Off-task digital browsing and distraction when teacher supervision is weak.
Emotional Engagement	Enhanced learner motivation, curiosity, and pride in using modern school technology.	Sudden drops in motivation and high frustration during power cuts or technical failures.
Cognitive Engagement	Deeper critical thinking and improved conceptual retention via interactive simulations.	Passive copying and superficial mental processing when tools are restricted to static text projection.

These findings agree with Kumari et al.(2026), who reported that digital tools positively influence students' motivation when effectively integrated into classroom instruction. Likewise, Mukeshimana and Andala (2024) found that interactive digital activities significantly

improve conceptual understanding among secondary school learners. Nevertheless, the present findings demonstrate that such positive outcomes remain highly dependent upon teachers' technological competencies and infrastructural stability, supporting the observations of

Mudaheranwa and Ntivuguruzwa (2024) and Yidana et al. (2023).

4.4 Suggested Strategies and Support Systems

The final objective aimed to identify practical, bottom-up strategies and support systems that teachers believe are necessary to improve digital teaching practices and enhance student engagement at GS Kagugu. Rather than requesting complex, unrealistic solutions, the participants proposed highly localized, practical interventions designed to address their daily classroom realities.

Redesigning Professional Development: A Shift to Peer-Led, Localized CPD

The most consistent recommendation made by the participants was a complete overhaul of how teacher professional development is conducted. Teachers criticized the standard practice of sending a single representative to an external, short-term training workshop, arguing that these sessions are too generic and fail to address the specific classroom conditions at rural schools like GS Kagugu.

Instead, they proposed the establishment of localized, subject-specific Peer Learning Communities (PLCs)

within the school. T2 suggested that teachers who are highly competent in ICT should run weekly, hands-on mentoring sessions for their colleagues, focusing on the practical integration of digital tools within specific subject areas. This approach would allow teachers to build their confidence and technical skills in a supportive, ongoing environment.

Technical and Operational Strategies

To bypass the constant challenges of unstable internet connectivity and power fluctuations, teachers recommended that school leaders focus on offline-capable educational resources. They suggested that the school should establish a localized server or database where teachers can download and cache interactive simulations, video tutorials, and educational software during periods of stable internet. This would allow teachers to run highly interactive digital lessons completely offline, ensuring instructional continuity regardless of connectivity issues.

Additionally, to prevent scheduling conflicts over the school's limited smart classrooms, teachers recommended developing a transparent, school-wide booking timetable. This collaborative administrative tool would ensure that all subject departments have equitable, scheduled access to digital resources, allowing for better lesson planning and more consistent technology integration across the curriculum.

Table 4: Summary of Teacher-Driven Challenges and Proposed Strategies

Identified Challenge	Classroom	Proposed Localized Strategy	Desired Operational Outcome
Generic, Infrequent Training	ICT	Launching peer-led, subject-specific mentoring groups and weekly, on-site CPD sessions.	Increased teacher confidence, technical self-efficacy, and pedagogical variety.
Unstable Power Outages	Internet and	Pre-downloading and caching interactive simulations and offline-capable digital curricula.	Uninterrupted digital lessons that are completely independent of live internet connectivity.
Limited Hardware and Smart Classroom Clashes		Designing a shared, school-wide digital reservation timetable for equitable resource distribution.	Consistent, planned access to digital learning spaces for all subject departments.
Foreign or Irrelevant Curricular Content		Collaborative curation of localized digital learning materials aligned with the national curriculum.	Culturally and contextually relevant lesson content that supports active student discovery.

The recommendations are consistent with Aflalo & Vaknin (2026), who emphasized that sustainable digital teaching practices require continuous pedagogical support. Antonio and Quirap (2025) similarly reported that isolated professional development workshops have limited effects on classroom practices. The emphasis placed by participants on localized and offline-capable resources further highlights the importance of context-sensitive

approaches to educational digitalization within resource-constrained settings.

The findings of this qualitative case study demonstrate that the transition to digital education at GS Kagugu is a complex, deeply human process. While the physical provision of technology through national initiatives has laid the groundwork for change, the actual impact on

student learning remains heavily dependent on the classroom teacher. Teachers' conceptual understandings of digitalization directly shape how technology is deployed, with constructivist approaches yielding significantly deeper cognitive and emotional engagement among students.

However, systemic challenges such as infrastructural instability and a lack of practical, continuous training continue to hinder consistent implementation. By advocating for peer-led mentoring networks, offline-capable resources, and structured scheduling, the teachers at GS Kagugu have provided a practical, realistic roadmap for closing the gap between national digital policies and daily classroom realities.

4.5 Discussion of Findings

4.5.1 Teachers' Conceptual Understanding of Digitalization

The first objective of this study was to explore how teachers at GS Kagugu understand and conceptualize digitalization in their daily teaching environments. The thematic analysis revealed a deep conceptual divide among educators, split between a material-centric "tool-substitution" view and a "pedagogical transformation" view.

For a segment of the participants, digitalization was defined primarily by the physical presence of hardware and the substitution of traditional instructional materials with digital screens. Under this "tool-substitution" lens, digitalization is treated as an administrative convenience that saves time but leaves the core teacher-centered pedagogy unchanged. This material-centric understanding reflects global and regional studies showing that in resource-constrained environments, teachers often conceptualize digitalization through the lens of physical resource availability and technical functionality. As highlighted by Sujariati et al.(2025), teachers without continuous pedagogical training tend to view technology merely as a substitution medium. This material focus also aligns with Rwandan literature, where teachers frequently conflate digital teaching with the personal possession of a laptop or the presence of hardware. Under the Technology Acceptance Model (TAM), this perspective points to a narrow interpretation of *Perceived Usefulness (PU)*, where the technology's perceived utility is limited to administrative ease, such as

displaying static notes faster, rather than transforming instruction.

Conversely, other teachers conceptualized digitalization as a process-oriented shift that fundamentally reorganizes the relationship between the learner, the teacher, and the learning material. This process-oriented understanding mirrors the OECD (2023) perspective, which notes that educators holding a deeper, process-oriented view of digitalization are more likely to design collaborative, student-centered lessons. This conceptualization is heavily grounded in Constructivist Learning Theory. As suggested by Chand (2023), when teachers view ICT not merely as a presentation tool but as an interactive mechanism for inquiry, exploration, and peer collaboration, they successfully transition from the sole transmitter of knowledge to a facilitator of learning

The findings of this study are largely consistent with previous empirical studies on educational digitalization. The conceptual divide identified among teachers between viewing digitalization as a tool for substituting traditional instructional materials and understanding it as a pedagogical transformation agrees with the findings of Ginting et al.(2024), who reported that teachers with deeper pedagogical understandings of digital technologies are more likely to adopt learner-centered instructional practices. Similarly, Mugiraneza (2021) found that many Rwandan teachers continue to associate digitalization primarily with the availability of digital devices rather than with transformative teaching practices. The present findings therefore reinforce the argument that teachers' conceptual understanding of technology significantly influences how digital tools are integrated into classroom practice.

However, the findings partially disagree with studies that implicitly assume that the provision of digital infrastructure automatically promotes pedagogical transformation. Although GS Kagugu has access to computers, projectors, and internet facilities, several teachers still employed technology merely for presenting static instructional materials. This suggests that access to technological resources alone is insufficient to guarantee meaningful technology integration unless accompanied by continuous pedagogical support and professional development.

To illustrate these conceptual differences, Table 5 contrasts the two primary paradigms of understanding observed among the participants.

Table 5: Comparative Paradigms of Digitalization Conceptualization

Conceptual Dimension	Tool-Substitution (Material-Centric)	Paradigm	Pedagogical Transformation Paradigm (Constructivist)
Primary Definition	Replacing physical tools (chalkboards, paper) with digital equivalents (projectors, PDFs).		Reorganizing instructional delivery to foster active student inquiry and collaboration.
Role of the Teacher	Transmitter of pre-packaged information using digital presentation aids.		Facilitator who designs interactive, technology-mediated learning experiences.
Role of the Student	Passive recipient of projected information, copying notes digitally or from screens.		Active constructor of knowledge through simulations, research, and peer discussion.
TAM Alignment	Focused on basic Perceived Usefulness (PU) for teacher convenience and time-saving.		Focused on high Perceived Usefulness (PU) for deepening student learning and engagement.

4.5.2 Perceived Influence on Student Engagement

The second objective examined teachers' perceptions of how digital teaching practices influence students' behavioral, emotional, and cognitive engagement. The findings indicated that using digital tools has a powerful, albeit highly conditional, influence on all three dimensions of engagement.

In terms of behavioral engagement, teachers generally reported a positive shift, characterized by increased classroom attendance, sharper attention spans, and lower rates of classroom disruption during digital sessions. However, teachers also observed a critical caveat: without continuous, close supervision, digital devices can lead to behavioral disengagement. In smart classrooms, some students attempted to manipulate laptops for non-academic browsing. This duality validates the findings of Mudaheranwa & Ntivuguruzwa (2024), who reported that while smart classroom tools can drive active participation, their success is highly dependent on the teacher's ability and confidence to monitor and facilitate digital learning environments.

For emotional engagement, teachers reported that digital lessons evoked high levels of student excitement, motivation, and positive learning attitudes. The feeling of working with modern technology gave students at GS Kagugu a sense of pride and connection to global standards. However, this emotional high is easily undermined by infrastructural deficits. Sudden power outages and unstable internet connections quickly turned student excitement into frustration. This matches the broader Sub-Saharan African literature, which shows that while digital lessons spark initial interest, sudden connectivity failures or poor hardware maintenance frequently disrupt pedagogical flow, leading to emotional

frustration for both teachers and students (Yidana et al., 2023).

Regarding cognitive engagement, the findings showed that the depth of mental processing was highest when teachers designed lessons around interactive digital activities, like simulations or virtual experiments, rather than passive slideshows. Merely projecting static notes does not deepen cognitive engagement; it simply digitizes rote learning. However, using interactive multimedia enables students to hypothesize, test, and construct knowledge dynamically.

Regarding student engagement, the findings are in agreement with Wigati et al. (2025), who found that digital tools positively influence student motivation when effectively facilitated by teachers. Similarly, Mukeshimana & Andala (2024) reported that interactive digital learning activities significantly enhance students' conceptual understanding and knowledge retention. Teachers in the present study observed increased attention, motivation, and participation among students when interactive simulations and multimedia resources were employed. These findings further support Constructivist Learning Theory, which emphasizes active learner participation and knowledge construction through meaningful learning experiences.

Nevertheless, the present findings reveal that the positive influence of digitalization on student engagement remains highly conditional. This observation aligns with Mudaheranwa and Ntivuguruzwa (2024), who found that teachers' technological confidence significantly determines the success of smart classroom implementation. Likewise, Yidana et al.(2023) reported that infrastructural challenges, including unreliable internet connectivity and power interruptions, frequently disrupt digital learning experiences in African educational contexts. In GS Kagugu, teachers reported that technological failures often

transform students' enthusiasm into frustration, thereby negatively affecting emotional engagement. These findings challenge overly optimistic perspectives in some

international studies that portray digital technologies as inherently engaging irrespective of contextual realities.

Table 6: Perceived Influence of Digitalization on Dimensions of Student Engagement

Engagement Dimension	Positive Perceived Outcomes	Negative/Conditional Realities
Behavioral Engagement	Enhanced classroom attendance, prolonged attention spans, and active focus on visual displays.	Risks of off-task digital distractions when teacher technological confidence and supervision are low.
Emotional Engagement	Increased student motivation, curiosity, and pride in utilizing modern learning technologies.	Sudden power outages and unstable internet connectivity cause immediate learner frustration.
Cognitive Engagement	Deeper conceptual understanding and critical thinking through interactive simulations.	Superficial learning and passive copying when tools are restricted to basic slide presentations.

4.5.3 Suggested Strategies and Support Systems

The third objective focused on gathering teacher-driven, bottom-up recommendations to bridge the gap between national policies and classroom realities at GS Kagugu. The participants universally critiqued the practice of "one-off" external workshops, calling instead for continuous, on-site, peer-led professional development (CPD). As highlighted by Kennedy (2025), short-term training workshops without long-term classroom coaching are largely ineffective because teachers easily revert to traditional teaching methods once the initial training concludes. Teachers instead suggested establishing localized peer learning networks and subject-specific digital mentoring within the school. This strategy directly addresses the *Perceived Ease of Use (PEOU)* component of the TAM model (Azuddin et al., 2024). By having local peers resolve everyday technical queries, teachers' anxiety decreases while their digital self-efficacy rises.

To resolve the issues of limited hardware and scheduling clashes at GS Kagugu, teachers emphasized the need for transparent school-level scheduling guidelines. This aligns with Rwandan research advocating for structured timetables and clear rules for smart classroom utilization to guarantee equitable resource access across all academic departments (MINEDUC, 2016). Furthermore, teachers' requests for offline-accessible materials and localized digital content are highly consistent with national educational research, which stresses that the Rwanda Basic Education Board (REB) must pair hardware distribution

with the deployment of localized, offline-capable digital curricula to make technology truly useful for local teachers.

The recommendations proposed by teachers are also supported by previous studies. Participants advocated for continuous, school-based professional development and peer-led mentoring initiatives rather than isolated training workshops. This finding agrees with Nanjundaswamy et al. (2021), who emphasized that sustainable improvements in digital teaching require continuous pedagogical support. Antonio and Quirap (2025) similarly argued that one-off professional development activities have limited long-term impact on teachers' instructional practices. Furthermore, teachers' recommendations concerning localized digital resources and structured access to smart classrooms are consistent with MINEDUC (2016), which advocates the pedagogically meaningful integration of ICT within Rwandan schools.

Interestingly, while many international studies emphasize large-scale infrastructural investments as primary drivers of educational digitalization, the findings of this study suggest that teachers prioritize localized and practical support mechanisms. Rather than requesting additional hardware, participants emphasized peer collaboration, continuous mentoring, and offline-accessible instructional resources. This divergence highlights the importance of adopting context-sensitive approaches to educational digitalization, particularly within resource-constrained settings.

Table 7: presents the key challenges identified by the teachers alongside their corresponding bottom-up strategies and theoretical alignments

Identified Challenge	Institutional	Proposed Bottom-Up Strategy	Theoretical Framework Alignment
Lack of Continuous Pedagogical Training		Establish peer-led mentoring networks and localized, subject-specific weekly CPD sessions.	TAM (PEOU): Lowic technical anxiety and building teacher self-efficacy.
Unstable Internet and Power Fluctuations		Pre-download and cache offline interactive resources, educational videos, and simulations.	TAM (PEOU & PU): Ensuring instructional continuity despite infrastructural gaps.
Scheduling Conflicts for Smart Classrooms		Develop a collaborative, school-wide booking timetable and equitable usage policy.	Constructivism: Creating consistent opportunities for active, digitalized lessons.
Lack of Relevant, Localized Materials		Collaborative curation of digital learning materials aligned directly with the REB curriculum.	Constructivism: Enabling contextualized, student-centered knowledge construction.

Ultimately, the findings and discussion of this study confirm that educational technology cannot be evaluated in isolation from the educators who utilize it. The integration of TAM and Constructivism provides a clear explanatory pathway for this phenomenon.

If a teacher does not perceive a digital tool as easy to use (PEOU) or useful for their immediate instructional tasks (PU), they will either reject the technology or use it purely for basic substitution. When institutional support, such as localized CPD and stable offline resources, reduces technical barriers, teachers' self-efficacy increases. This allows them to design constructivist, interactive, and collaborative lessons. It is this transition from passive presentation to active, technology-mediated facilitation that drives deep, multidimensional student engagement in the classroom. Physical access to ICT infrastructure is merely a prerequisite; the pedagogical beliefs and confidence of the classroom teacher remain the ultimate catalyst for educational transformation.

5. Conclusion and Recommendation

5.1 Conclusion

This study explored secondary school teachers' perceptions of the digitalization of teaching and its influence on student engagement at GS Kagugu in Gasabo District, Rwanda. The findings reveal that teachers' conceptualizations of digitalization significantly shape how technology is integrated into classroom practices and subsequently influence students' behavioral, emotional, and cognitive engagement. While some teachers perceive digitalization primarily as the substitution of traditional instructional tools with digital devices, others understand it as a

pedagogical transformation that promotes learner-centered and interactive teaching approaches. These differing perceptions influence the extent to which digital technologies are utilized to support meaningful learning experiences. The study further established that digital teaching practices positively influence student engagement when technology is integrated effectively. Digital tools enhance students' attention, motivation, participation, and conceptual understanding by creating interactive and collaborative learning environments. However, these positive outcomes remain conditional upon teachers' digital competencies, pedagogical confidence, and the availability of reliable technological infrastructure. Challenges such as unstable internet connectivity, power interruptions, limited hardware resources, and inadequate professional development opportunities continue to constrain the consistent implementation of digital teaching practices.

The findings also demonstrate that educational digitalization extends beyond the provision of technological infrastructure. Its success depends largely on teachers' perceptions, continuous pedagogical support, and institutional readiness. Teachers emphasized the importance of localized and continuous professional development, equitable access to digital resources, and the availability of offline-capable instructional materials. Therefore, achieving meaningful educational digitalization requires sustained investments not only in technological resources but also in teacher capacity building and supportive school-level systems that promote active and student-centered learning.

5.2 Recommendations

Based on the findings of this study, the following recommendations are proposed:

1. To School Leadership at GS Kagugu

School administrators should establish continuous, school-based professional development programs that focus on the pedagogical integration of digital technologies.

- Peer-led mentoring initiatives and subject-specific professional learning communities should be introduced to strengthen teachers' digital competencies and confidence in utilizing educational technologies effectively.
- Furthermore, transparent scheduling systems for smart classrooms and digital resources should be implemented to ensure equitable access across all subject areas.

2. To the Rwanda Education Board (REB) and the Ministry of Education (MINEDUC)

- National educational stakeholders should complement investments in digital infrastructure with sustained teacher support programs.
- Continuous Professional Development (CPD) initiatives should emphasize practical, classroom-based applications of technology rather than one-time technical workshops.
- In addition, REB should develop and disseminate localized, curriculum-aligned, and offline-accessible digital learning materials suitable for schools experiencing connectivity challenges.

3. To Teachers

- Teachers should embrace digitalization as a pedagogical transformation rather than merely a technological substitution process.
- They are encouraged to adopt learner-centered instructional approaches that utilize interactive simulations, multimedia resources, and collaborative digital activities to promote deeper student engagement.
- Collaborative knowledge sharing among teachers should also be strengthened to facilitate continuous professional growth in digital pedagogy.

4. To Future Researchers

- Future studies should extend this research by investigating students' perceptions of digitalized teaching practices and their influence on learning outcomes across multiple schools and districts.
- Comparative studies employing mixed-methods approaches may provide broader insights into the relationship between teacher perceptions, technology integration, and student achievement within Rwanda's educational context.

- Longitudinal studies are also recommended to examine how continuous professional development influences teachers' digital competencies and instructional practices over time.

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