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Research Article

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Unlocking the essence of EdTech integration: Elementary teachers' lived experiences with classroom technology

Heather Buschmann [1]*, Todd Fiore [1]

[1] University of Arizona Global Campus, Chandler, AZ, USA
***Corresponding Author:** educatortoday@yahoo.com

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ABSTRACT

Teachers are the primary source for teaching students using educational technologies to enhance elementary classroom education. Despite current transformations in educational technology in elementary classrooms, some limitations and concerns may hinder technological integration for teachers. Teachers remain the primary catalysts for educational technology integration yet encounter substantial barriers that hinder meaningful technological adoption. This study investigates elementary teachers' beliefs, perspectives, and experiences in overcoming barriers and presenting opportunities for sufficient technology integration. A qualitative phenomenological method was employed to understand elementary teachers' lived experiences with respect to obstacles integrating technology. Interviews with 12 participants revealed six themes to answer the study's three research questions. The study's primary findings included that elementary teachers acknowledge the balance of technology as an essential tool with benefits and challenges in teaching with time constraints and inconsistent support. Without support integrating technology, the transformative potential of educational technology may remain inconsistent in elementary classrooms, and the barriers found in this study will continue to obstruct digital educational progress.

Keywords: digital technology, educational technology, professional development, and technology integration

INTRODUCTION

In the United States, educational technology has been increasingly used in elementary classrooms to transform education (U.S. Department of Education, 2017). Educational technologies have become common in most classrooms in every grade and content area (Kormos, 2022). Students live and learn in a technologically driven society with rapid changes and abundant information, improving collaboration and critical thinking skills (Battelle for Kids, 2019). Students using digital tools interact with peers from various backgrounds and cultures around the globe, broadening mutual understanding and engaging learning (International Society for Technology in Education, 2021). Educational technologies have the potential to support, improve, and enrich opportunities and learning outcomes for all learners (Dogan et al., 2021). The success and effectiveness of technology in education mainly depend on teachers' understanding of pedagogical knowledge (PK), technological proficiency, and perspectives of technology in teaching to enhance learners' capabilities (Shonfeld et al., 2021). Technology's part in teaching is transforming, becoming one of the most influential educational factors (Prasojo et al., 2019). Due to the rapid development of technology, the expectation is for teachers to integrate technology into their teaching (Balchin & Bouzaki, 2022). Technological advancements have required teachers to modernize their skills and mindfulness to foster and integrate educational technology into their daily classroom activities (Orak & Inözü, 2021). However, challenges exist that can impede the implementation of educational technology.

Purpose

The purpose of this qualitative phenomenological study was to explore the lived experiences of elementary teachers concerning barriers that may hinder meaningful technological integration in elementary-level instruction. Effective technology integration may result from assorted reasons, but the central issue is some teachers' experience and belief in influencing instructional technology activities to meet student learning needs (Abel et al., 2022). Over 50% of teachers report needing more technology training, presenting a barrier to adoption (U.S. Department of Education, 2017). Teachers might refrain from using technology due to insufficient professional development, reluctance to learn modern technology skills, lack of necessary hardware or software, or the belief in ineffective use of teaching time (Westerlin & Vogt, 2022). Teachers may benefit from practical, steady

professional development focused on building knowledge, pedagogical beliefs, and skills in technology integration to empower their teaching and enhance student learning.

Literature Review

Educational technology empowers teachers and students with innovative digital tools, enriching the learning experience (International Society for Technology in Education, 2021). However, technology integration remains inconsistent across schools (Michigan Department of Education, 2017). Teachers need knowledge and skills to develop lessons aligned with learning objectives. Teachers' perspectives may have been overlooked in this process.

Understanding teachers' views on technology-based learning is crucial for achieving positive outcomes. Teachers may embrace technology despite barriers if they recognize its benefits (Anderson & Putman, 2020). A better understanding of teachers' technology integration practices can bridge gaps between teacher education and real-world application (Voithofer et al., 2019). The success of technology in education depends on teachers' PK, technological proficiency, and attitudes toward integration (Shonfeld et al., 2021).

Despite opportunities, several barriers hinder technology adoption. Ertmer (1999) identifies first-order barriers (e.g., access to technology, time, and support) and second-order barriers (e.g., pedagogical beliefs, attitudes, and self-efficacy). Prasojo et al. (2019) highlight that while first-order barriers have decreased, second-order barriers remain significant. Durff and Carter (2019) emphasize that second-order barriers impede technology integration in U.S. schools.

Teachers' perspectives are crucial for overcoming these barriers. Some teachers remain skeptical about the pedagogical benefits of digital tools (Pongsakdi et al., 2021). Others experience frustration or anxiety due to technology failure and discouraging use (Bai, 2019; Hartman et al., 2019). Fernández-Batanero et al. (2021) observe that teachers' apprehension toward technology underscores the importance of ongoing professional development focused on technological skills and pedagogical strategies.

Ongoing professional development is critical for overcoming barriers and developing competencies for effective technology integration. Schools must provide teachers targeted professional development to help teachers adapt their instructional practices (Abel et al., 2022). Research shows that professional development fosters collaboration and feedback, enhancing teachers' ability to adopt new methods (Joksimović et al., 2019). Collaborative learning environments boost teachers' confidence and self-efficacy as they exchange ideas and develop new knowledge (Williams et al., 2023). Training programs that combine technological support, practical application, and constructive feedback are particularly effective (Joksimović et al., 2019). Sain and Bowen (2022) note that collaborative problem-solving helps teachers build confidence and support one another.

High-quality professional learning should be content-focused, incorporate active learning, encourage collaboration, model best practices, and provide feedback (U.S. Department of Education, 2024). Durff and Carter (2019) emphasized that professional development programs help teachers overcome barriers by fostering collegial sharing, offering technical support without prescribing specific tools, and allowing time for skill development.

Rulyansah et al. (2023) suggest that teachers need support transitioning from teacher-centered to student-centered, technology-driven instruction. This support is essential for creating compelling, student-centered learning experiences (Chen & Tsai, 2021).

Ultimately, high-quality professional learning for teachers must be content-focused, support collaboration, and provide expert coaching and feedback (U.S. Department of Education, 2024). Information communication technology (ICT) in classrooms can succeed if schools offer updated professional development and equip staff with the necessary tools (Abel et al., 2022). Teachers who feel unprepared must receive guidance to integrate digital pedagogical approaches into their instruction effectively. Krishan and Al-Rsai (2023) conclude that practical training is essential for building teachers' expertise and motivation, ultimately benefiting student learning.

Conceptual Frameworks

The conceptual framework for this study includes the technological pedagogical content knowledge (TPACK) framework and self-efficacy theory. TPACK suggests that technology integration requires understanding technological, PK, and content knowledge (CK) domains and their intersections (Mishra & Koehler, 2006). Bandura's (1977) self-efficacy theory explains how self-belief of capability can influence actions, including teachers' use of technology. Together, these frameworks provide a lens to examine teachers' knowledge, attitudes, and experiences that may present barriers to better support for effective classroom technology integration.

Building on Shulman's (1986) initial framework of CK, PK, and pedagogical content knowledge (PCK), Mishra and Koehler (2006) expanded the model to include technological knowledge (TK), creating the TPACK framework. This model suggests that teachers must blend CK, TK, and PK to integrate technology effectively. Self-efficacy, or a teacher's belief in their ability to integrate technology, is also crucial for the success of such integration (Bandura, 1977).

Professional development programs that provide scaffolding to build technological skills and self-efficacy are essential. These programs enable teachers to gain the confidence and skills necessary to effectively incorporate technology into their teaching (Joshi, 2023; Pittas & Adeyemi, 2019). By focusing on both the technical aspects of technology use and teachers' beliefs in their ability to succeed, professional development can help reduce the barriers that hinder technology adoption (Heath, 2017; Kara, 2020).

Research into the connection between teachers' knowledge and self-efficacy beliefs is crucial for understanding how to improve technology integration outcomes (Joo et al., 2018). Mishra and Koehler (2006) noted the complexity of studying technology integration due to the diverse contexts in which teachers work. This finding underscores the importance of addressing knowledge and self-efficacy in teacher training to improve technology integration in classrooms. Zhakiyanova et

al. (2023) indicated a robust relationship between TPACK competencies and training self-efficacy beliefs, especially in elementary school teachers.

Knowledge Gaps

Multiple knowledge gaps were uncovered in this literature review. A knowledge gap persists between teachers' technological competencies and the practical application of technology in classrooms (Clipa et al., 2023). Previous studies have highlighted the integration of technology into elementary education, focusing on the challenges of integrating digital technology into teachers' curricula and the need for additional support to integrate digital tools and platforms into classrooms effectively (Jannah et al., 2020; Kormos, 2022).

Akram et al. (2022) identified barriers that hinder effective technology integration, including the need for appropriate pedagogical models, experience, classroom ICT competencies, professional development, and support. Singhavi and Basargekar (2019) stressed the need to comprehend teachers' practices, beliefs, and barriers in adopting modern technological teaching techniques. Clipa et al. (2023) explained that successful integration of technology into instructional processes heavily relies on teachers' skills and attitudes, which may limit consistent technology integration across educational settings. Scholars have underscored the critical need for a deeper understanding of teachers' technology integration practices and beliefs to bridge this gap effectively (Appova et al., 2022; Voithofer et al., 2019). Technology offers more flexibility and education support than traditional materials (U.S. Department of Education, 2024).

Current Research Study

Teachers are the primary source for teaching students using educational technologies to enhance elementary classroom education. As technology continues to increase rapidly, teachers must benefit from practical, steady professional development focused on building knowledge, pedagogical beliefs, and skills in technology integration to empower their teaching and enrich student learning. Teachers require a strong CK foundation across academic subjects to integrate technology and digital resources into their lessons effectively. Teachers must have opportunities to exchange best practices regularly to improve instructional outcomes. The effective integration and implementation of technology tools depend on teachers' support to facilitate beneficial and creative learning, which varies from teacher to teacher.

METHODOLOGY

The purpose of this qualitative phenomenological study was to explore the lived experiences of elementary teachers concerning barriers that may hinder meaningful technological integration in elementary-level instruction. The research questions for the study are:

RQ1: What are the lived experiences of elementary teachers regarding barriers faced by integrating educational technology into their classrooms?

RQ2: What meaning do elementary teachers ascribe to their experiences integrating educational technology into their classrooms?

RQ3: What recommendations would elementary teachers make concerning professional development and training to integrate educational technology in their classrooms?

Sample

Twelve participants were interviewed for this study, representing elementary teachers from kindergarten to fifth grade (K-5) in Oakland County, MI, USA. Oakland County has 28 community school districts and 262 public elementary schools (Oakland Schools, 2024; Public School Review, 2024). The study was conducted in Oakland County public school districts, chosen based on the school district's public commitment to providing continuous instruction and innovation for contemporary technology integration for teachers and students.

The three school districts serve students from kindergarten through fifth grade (K-5) in each elementary school, with a total enrollment of 300 to 400 students per school (Oakland Schools, 2024; Public School Review, 2024). The percentage of teachers in their first or second year differs across the districts, ranging from 1.8% to 8.3%. Despite the differences in gender distribution, teachers' experience, and student population, the school districts support teachers integrating technology with a common goal to help students navigate a technologically driven era.

Snowball sampling was used to yield the desired number of qualified participants. The snowball method allowed recruitment until data saturation was reached, which is suggested for qualitative studies (Gill, 2020). Participants were referred by colleagues who met the study's inclusion criteria, further expanding the pool of potential candidates. This method facilitated finding elementary teachers who integrated technology into their classrooms and with the specific characteristics required for the research to participate.

Data Collection

The primary data for this study was collected through semi-structured Zoom interviews conducted over six weeks between August and September 2024. Interviews lasted 30 to 45 minutes. As part of the informed consent process, all participants agreed to audio recordings of the interview. Each audio recording was transcribed using Microsoft Word Dictation within 24 to 48 hours.

After transcription, the transcripts were kept in a safe, password-protected file, different from the participants' real names, and stored in a separate file to protect privacy with no data stored in the cloud. The transcripts were organized for coding when the transcription and redaction processes were concluded to confirm the accuracy of the participant's replies while upholding ethical standards of confidentiality.

Data Analysis

The researcher manually coded all interviews and uploaded them to NVivo for additional analysis. Manual coding was organized by firsthand engagement with the data before transitioning to NVivo software, simplifying the organization

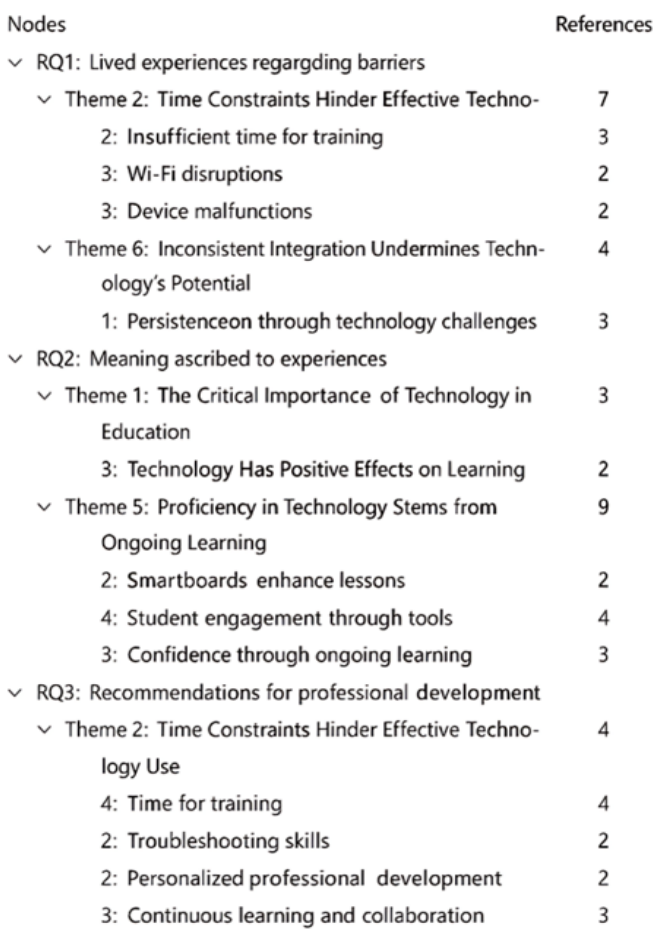

Figure 1. NVivo qualitative analysis screenshot displaying the hierarchical coding of research questions, themes, and codes (Source: Authors)

and cross-referencing codes. The codebook assisted in establishing the researcher's ability to refine throughout the manual phase through iterative analysis. Initial coding incorporated handwritten field notes to provide additional context to the interview responses and facilitated early monitoring of data saturation by capturing immediate reflections and non-verbal cues. Saturation was confirmed when no new themes or codes emerged from additional interviews, indicating that the data was thorough enough to address the three research questions.

Through member-checking, participants reviewed and verified the accuracy of their transcripts to enrich the credibility of the data and contributed to the accuracy of the themes that emerged from their data. This step supported the trustworthiness of the findings and lessened possible researcher bias. Inductive and deductive coding approaches were used during the thematic analysis to ensure the extensiveness of the findings.

NVivo stored, managed, and applied these codes through all twelve transcripts, allowing for efficient categorization of participants' replies. NVivo's software word and sentence query tools assisted with the cross-comparison of codes in justifying emerging themes between participants, ensuring that codes were utilized consistently and maintaining the research methodological rigor. The researcher examined all 12 transcripts several times before uploading them to NVivo to confirm that context-specific meanings were well comprehended and that uncertainties were resolved to ensure the integrity of the coding process.

The inductive and deductive coding confirmed that the analysis apprehended emergent understandings from the data. The codebook established refinement iteratively throughout the manual coding phase and the development of inductive and deductive codes to ensure the coding process was systematic, dependable, and methodologically rigorous. Following the coding phase, further thematic analysis was conducted to identify broader themes from the initial codes, grouping comparable codes, recognizing patterns, and from granular codes to abstract themes. The development from codes to themes exemplified the experiences and perspectives of teachers to deliver a practical understanding of the barriers to technological integration in elementary-level instruction.

The approach was revisited to sustain consistency and the trustworthiness of the analysis. The final coding and thematic analysis validated the initial manual coding and developed an understanding of elementary teachers' educational technology experiences. The approach is relevant to the study objective and the research content for interpreting how the identified themes address the fundamental challenges and opportunities in educational technology integration. To further illustrate the coding process and thematic organization, **Figure 1** presents a screenshot of the NVivo qualitative analysis results, showing the hierarchical structure of research questions, themes, and codes used in this study.

RESULTS

The findings from the qualitative phenomenological study were to understand the lived experiences of elementary teachers concerning barriers that may hinder meaningful technological integration in elementary-level instruction. Studying elementary teachers' lived experiences with technology integration may be informative in understanding the reluctance to embrace technological benefits, improve integration strategies, enhance student learning outcomes, and make recommendations for professional development.

While each elementary teacher's experiences, meanings, and recommendations may include differences, six common themes that emerged in this study revealed the prominent influence of technology integration to empower teaching and enhance learning by the teachers interviewed for this study:

(a) the critical importance of technology in education,

(b) time constraints hinder effective technology use,

(c) inconsistent integration undermines technology's potential,

(d) technology has positive effects on learning

(e) proficiency in technology stems from ongoing learning and

(f) perseverance is needed to adapt to new technologies.

The findings showed that many teachers need more time for effective technology integration, training, and ongoing professional development. The study participants often reported feeling overwhelmed by the elevated expectations for

technology use and needed more time and help to grasp innovative technologies. Each theme has an essential attribute, and participants gave the researcher a deep understanding of their roles and responsibilities that influence pedagogical beliefs, PK, and skills in technology use. The themes align with the three research questions that guided this study.

Theme One. The Critical Importance of Technology in Education

Most teachers use technology daily in classroom instruction with smartboards, Chromebooks, or iPads. These technology tools have emphasized characteristics that enhance and engage instruction and facilitate individualized learning, which is crucial for all elementary students in today's technological era. Smartboards and interactive whiteboards were predominantly used for instructional enhancement and all academic subject-specific integration, such as math and writing, while Chromebooks promoted student-centered learning.

Theme Two. Time Constraints Hinder Effective Technology

While technology offers numerous benefits, the lack of sufficient time for training presents one of the most prominent challenges to successful integration. A considerable challenge highlighted by participants as a need for more time exploring and practicing innovative technology tools. While teachers were frequently introduced to new technologies, they often needed more time to become familiar with these tools and build the confidence required for effective classroom implementation. A recurring concern was the expectation to integrate technology without sufficient time to experiment and fully understand how to use these tools.

Theme Three. Inconsistent Integration Undermines Technology's Potential

Inconsistent technology integration emerged as a barrier to the continuous use of educational tools in elementary classrooms. Barriers with unreliable Wi-Fi, malfunctioning devices, and insufficient technical support often disrupt instruction flow, forcing teachers to rely on backup methods, which affects lesson continuity. Elementary teachers' perspectives underscore the wide-ranging difficulties contributing to inconsistent technology. Teachers may plan and leverage technology by meeting educational standards in a digital society. Supportive administration is necessary to ensure that teachers use technology as an integral part of instruction more reasonably than simply as an added tool by addressing barriers regarding inconsistent digital education.

Theme Four. Technology Has Positive Effects on Learning

Participants in the study highly recognized the transformative effect of technology used in elementary classrooms. Digital tools are reshaping teaching and learning. Technology has become part of today's modern classroom practices through increased student engagement, enhanced learning tools, and independent and differentiated instruction support. Although with the challenges of technology integration, teachers emphasized technology's overwhelmingly positive and lasting effects on education. The findings underscore that when used effectively, technology has the potential to transform the educational learning experience. By promoting differentiated instruction, and encouraging independent learning, technology empowers students to take more control over their learning journey.

Teachers noted that the benefits of technology far outweigh the difficulties, emphasizing the positive and transformative effects of technology on education. When properly integrated technology has a profoundly positive effect on student learning. Integrating technology prepares every learner with essential skills for the future. However, to fully realize these benefits, teachers need the confidence and skills to navigate technological tools effectively.

Theme Five. Proficiency in Technology Stems from Ongoing Learning

Participants consistently found ongoing learning, adaptability, and experience as crucial factors in developing proficiency with educational technology. Teachers reported that their confidence in digital tools grew through repeated use, continuous professional development, and troubleshooting. This self-directed learning process highlights the importance of adaptability and problem-solving in mastering technological integration. Proficiency in educational technology is an ongoing process. Teachers continuously develop their skills through experience and peer collaboration. Adapting and problem-solving in educational technology requires support and collaboration for teachers to integrate technology into effective teaching practices. Teachers remain proficient in the face of frequent technical challenges.

Theme Six. Perseverance is Needed to Adapt to New Technologies

Overcoming barriers appeared as a theme, with participants communicating examples of their persistence and critical thinking skills with technology. Teachers underscored perseverance to overcome technological challenges while integrating technology into their teaching practices. Teachers' willingness to troubleshoot and collaborate with peers allows them to overcome barriers and continue using technology effectively. The persistent, adaptable, and collaborative measures that elementary teachers exemplify through perseverance guide the various obstacles of technology integration by building more dynamic, inclusive classrooms using a transformative education.

DISCUSSION

This research study investigated how teachers become overwhelmed with the expectation to integrate technology into their elementary-level instruction, which is distinct from traditional teaching. Teachers stressed the necessity for more technological training to refine educational technology integration in the classroom more effortlessly. Teachers showed resilience in overcoming device malfunctions and inadequate technical support. The findings discussed teachers' experiences, recommendations, and meanings toward

technology integration, perspectives on educational technology, and technology's influence on learning through elementary teachers' lived experiences.

Teachers provide technological integration for students, even during recurring setbacks. Adaptability and troubleshooting are essential skills that enable educators to integrate technology effectively despite challenges. These themes reflect the daily challenges, strategies, and recommendations that elementary teachers use to adapt to technology integration in their classrooms. While each elementary teacher's experiences, meanings, and recommendations may include differences, the six common themes that emerged in this study revealed the prominent influence of technology integration to empower teaching and enhance learning by the teachers interviewed for this study.

The findings showed that many teachers need more time for effective technology integration, training, and ongoing professional development. The study participants often reported feeling overwhelmed by the elevated expectations for technology use and needed more time and help to grasp innovative technologies. Each theme has an essential attribute, and participants gave the researcher a deep understanding of their roles and responsibilities that influence pedagogical beliefs, PK, and skills in technology use. The themes align with the three research questions that guided this study.

To underscore the originality and timeliness of this study, the discussion now incorporates recent research emphasizing the evolving demands of educational technology integration. The U.S. Department of Education (2024) highlights the growing need for flexible, technology-rich learning environments that extend beyond traditional instructional materials, underscoring the urgency for effective technology integration in classrooms. Similarly, Krishan and Al-Rsai (2023) stress the importance of sustained professional development in building teachers' capabilities and motivation to adapt to new digital tools, reflecting the perseverance identified among participants in this study. In addition, Rulyansah et al. (2023) advocate for professional development programs that balance technological mechanics with pedagogical strategies, aligning with participants' recommendations for ongoing, practical training. These contemporary findings reinforce this study's contribution to understanding how elementary teachers navigate and innovate with classroom technology amid rapid digital transformation.

Inconsistent Integration Undermines Technology's Potential

The study participants reported frustration due to slow internet and software glitches, creating delays during teaching. Researchers have shown that unreliable internet connectivity was a common obstacle teachers met when integrating technology into their instructional practices (Fernández-Batanero et al., 2021; Spiteri & Rundgren, 2020). The study participants explained that when the smartboard stops working, there is a constant worry about whether technology will cooperate. The study participants reported that they face obstacles when the network is down after planning a critical lesson, and they need help figuring out why it will not connect or pair with the Promethean board.

This finding supports the work by Dinc (2019), who emphasized that one of the critical first-order barriers was limited access to technology resources. The participants in this study also reported how this negatively affects the classroom when accessing the digital tools needed for those specific assignments and hinders the flow of lessons. Research has revealed that teachers may become frustrated and overburdened about technology failure, discouraging them from using technology (Bai, 2019; Hartman et al., 2019).

Perseverance is Needed to Adapt to New Technologies

Despite these challenges, participants displayed resilience in continuing to incorporate technology by seeking peer support and troubleshooting issues as they arose. Krishan and Al-Rsai (2023) noted that teacher training and collaboration were key to overcoming these hurdles. Participants emphasized the importance of persistence in mastering technology and adapting to new technology with support from colleagues and professional development programs. The study participants showed resilience to overcome device malfunctions and inadequate technical support.

The participants revealed that perseverance helped them overcome barriers and work with technology effectively. This finding supports the work by Durff and Carter (2019), who explained that teachers may overcome barriers to successful technology integration by providing professional development, fostering collegial sharing, offering technical support without mandating specific tools, allowing time for skill evolution, valuing technology in education, and encouraging departure from traditional lecture-based lessons. The solution to navigating technology integration by teachers' willingness to troubleshoot and collaborate with peers proves persistence.

The Critical Importance of Technology in Education

The participants reported using their smartboards, interactive whiteboards, and Chromebooks for academic subject-specific integration. Similarly, Zhao et al. (2021) found that educational technology may improve motivation and academic success. Participants also highlighted that technology has enabled a better interactive learning experience for their students. Research has revealed that classroom technology tools, such as interactive boards and online tools, offer multi-sensory learning activities, improving efficiency and providing immediate feedback and educational achievement (Mormah & Bassey, 2021).

This finding supports work by the U.S. Department of Education (2024), explaining that technology offers more flexibility and educational support opportunities than traditional materials. The study participants reported the daily use of smartboards, exemplifying how technology has become an essential part of their daily instructional routine. They also shared examples of how the first thing they do is as many teachers turn on their smartboards for the students until the end of the day. This finding supports the work by Anderson and Putman (2020), who discussed that teachers' perspectives may have been overlooked in this process, suggesting they might feel more motivated to persist in using technology despite

challenges when understanding the benefits that come from using it. Some participants enjoyed using technology all day for all subjects without teaching from a manual.

Technology Has Positive Effects on Learning

Participants described technology as a game changer that allows modification for students who need added support to move on to more challenging material. This finding supports the work by Lauricella and Jacobson (2022), who suggested that teachers adapt lessons, materials, and assessments to the unique needs of each student to foster differentiation instruction using technology with a more personalized and practical learning experience. Similarly, Serin (2023) has noted that technology in education builds engaging learning environments connected to concepts in the real world and fosters personalized learning where learners progress at their own pace. The study participants reported the positive effects of technology on education, particularly in increasing student engagement and independent learning.

Proficiency in Technology Stems From Ongoing Learning

The study participants reported that technological proficiency stems from ongoing learning to learn from other teachers and hands-on experience in successful technology integration. The findings support the work by Durff and Carter (2019), who emphasized that teachers with opportunities for professional training within their school district and at conferences increased their confidence level to engage in new strategies with their students, shared technology use, tips, and presentations to feel empowered to integrating technology into their classrooms. Similarly, the U.S. Department of Education (2024) supports teachers with high-quality professional learning for use models of effective practice, content-focused to incorporate active learning, support collaboration, provide coaching and expert support, and offer feedback and reflection opportunities. Participants noted that the positive effects of technology far outweigh the barriers, emphasizing the positive and transformative benefits of technology on education. Research has revealed that teachers need TK to integrate technology in their classrooms and present their students with the skills or opportunity to use technology in their education (Gocen et al., 2020; Tondeur et al., 2017).

Time Constraints Hinder Effective Technology Use

Participants emphasized the need for professional development, which includes dedicated time to exploring new technologies and practicing using them before integrating them into lessons. This echoes Hartman et al. (2019), who noted that more adequate time for professional growth is needed to improve effective technology use in classrooms. Teachers suggested that training should allow time for experimentation and address immediate concerns before applying new tools to students. Teachers needed continuous support, mentorship, and feedback to reinforce skills and encourage technology integration into everyday teaching.

The findings revealed that many participants need more time for a successful education to ensure integration. The study participants reported being unprepared to comprehensively integrate technology into their classroom instruction without the time to experiment with the unexplored technology tools. Similarly, Voithofer et al., 2019) found that developing a better understanding of teachers' technology integration practices and thoughts may help some of the existing gaps between teacher education and teachers' technology integration preparation needs. The participants in this study indicated that technology-based professional development and training needs to be more direct, relevant to their specific grade level needs, and allow adequate time for practice. Many noted that current professional development offerings must be revised to address the unique challenges they meet with technology integration.

Limitations

This research study met limitations that need to be noted. One challenge was the timing of the study, which was conducted in early August when elementary teachers were on summer vacation, which made it challenging to schedule Zoom interviews. The timing of the research study may have impacted on the validity of the findings. The elementary teachers were transitioning from summer vacation to the start of the new school year, potentially affecting the depth of their reflections as the school year approached. Many teachers checked their school email the week before school resumed in early September. However, as teachers returned to work, the researcher received signed consent forms and began scheduling interviews. Although data saturation was reached with eight interviews, added participants were more effortlessly recruited as the school year approached. The recruitment challenges and recurring themes that emerged across the interviews distinctly indicated the quality of the data collected.

The researcher also addressed potential bias through bracketing, acknowledging, and setting aside previous experiences or knowledge about the phenomenon during data collection and analysis. Bracketing is the conscious effort of the researcher to set aside potential biases (Husserl, 1970). The researcher used a reflexive journal to address the influence of bias on the study and documented personal reflections, thoughts, and potential biases throughout the research.

While the sample included teachers from different grade levels, kindergarten through fifth grade, the geographic scope restricts the extent to which the findings could be generalized to broader teacher populations or educational settings. In qualitative research, transferability rather than generalizability is emphasized, meaning readers have the potential to assess whether the findings apply to their contexts (Subedi, 2023). The research focuses on kindergarten through fifth grade (K-5) which may have further limited the representativeness of the results. This study may have benefited from expanding the sample to include a comprehensive range of teachers from kindergarten through twelfth grade (K-12), expanding recruitment to a broader geographic area with middle school and high school teachers, or recruiting participants from additional counties nationwide to provide a more comprehensive range of perspectives.

Recommendations

The literature review revealed the gaps concerning elementary teachers' technology barriers through lived

experiences. Singhavi and Basargekar (2019) stressed the need to understand teachers' experiences, beliefs, and barriers in adopting technological teaching practices. This study explored experienced kindergarten through fifth-grade teachers who shared real-life intricacies examining integrating technology in their elementary-level instruction. Clipa et al. (2023) explained that successful integration of technology into instructional practices heavily relies on teachers' skills and attitudes, which may limit consistent technology integration across educational settings. Researchers stressed the critical need for a deeper understanding of teachers' technology integration beliefs and practices to bridge this gap (Appova et al., 2022; Voithofer et al., 2019). While studies have underscored the importance of understanding teachers' experiences and perspectives, the current research study uniquely examined elementary teachers' lived experiences, integrating technology of teachers' practices and beliefs.

Qualitative research was the proper selection for this study. A qualitative phenomenological design provided a robust framework for investigating elementary teachers' lived experiences with technology integration in elementary-level instruction. Phenomenology describes the essence or meaning of a phenomenon or event (Prosek & Gibson, 2021). This qualitative phenomenological study comprehensively captured the essence of elementary teachers' lived experiences in integrating technology. However, Heitner and Sherman (2014) proposed that a quantitative approach efficiently measures constructs and examines relationships, comparisons, causes, and effects between variables. For instance, quantitative research conducted through online surveys and statistical analysis may propose an additional in-depth perception when comparing teachers who effectively integrate technology with those who do not.

Future research may expand this study by employing quantitative methods to investigate differences and patterns involving integrating educational technology across multifarious teacher populations and education environments. While this study provided practical comprehension of elementary teachers' experiences with technology integration, there is considerable potential for additional analysis. Future studies should consider including teachers from varying grade levels, such as middle and high school, to explore how technology integration challenges develop as learners progress through their education. Expanding the sample to private and charter schools, teachers may also reveal how school resources, policy, and administrative support influence technology adoption.

Further, geographical variation is an area worth exploring. Forthcoming research may examine how factors of networking infrastructure, funding, and professional development opportunities vary across locations and influence technology integration by including teachers from different urban and rural regions. This approach could offer a better exhaustive understanding of equity matters related to educational technology access. Future research may also benefit from using a mixed-methods approach. While qualitative phenomenology captured the essence of lived experiences, quantitative research through surveys and statistical analysis may assist in identifying patterns and correlations, such as the relationship between teacher training and successful technology integration. This may provide a vigorous understanding of the components contributing to or hindering effective classroom technology use.

Future research might also investigate the effectiveness of differentiated technological professional development programs tailored to meet the needs of educators at various teaching stages to ensure that beginner and veteran educators can effectively integrate new technologies into instruction. Expanding the population to include special education teachers and English language learners teachers may discover distinctive barriers to integrating technology by understanding the various instructional needs to inform the development of more tailored and inclusive professional development programs. By broadening the scope of future research in these ways, researchers may achieve a more profound awareness of the intricate dynamics of technology integration and provide explicit recommendations to support teachers' teaching for a technological transformation.

CONCLUSION

Findings from this research study justify a deeper look into how elementary teachers exemplify technological skills and pedagogical strategies when integrating technology effectively into their academic lessons with consistent professional training and technical support. Without such critical support, the transformative potential of educational technology may remain inconsistent in elementary classrooms, and the barriers found in this study will continue to obstruct digital educational progress. To address these challenges, schools and educational policymakers must prioritize accessible, comprehensive professional development that directly addresses the practical issues teachers face in the classroom. Many teachers are advocates for digital transformation to improve educational experiences technologically. While various technologies offer engaging and flexible learning experiences, the effective integration and implementation of such technology tools depend on teachers' support to facilitate beneficial and creative learning.

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Ethics declaration: The authors declared that the research was approved by the Institutional Review Board. To protect the privacy and the confidentiality of participants' data, the authors labeled the recordings and transcripts with pseudonyms and stored them separately from informed consent forms, the list of participants' names and code names, and other information about the participants' information.

Declaration of interest: The authors declare that they have no competing interests.

Availability of data and materials: The data supporting the study's findings are not publicly available due to confidentiality agreements with participants. The data will remain confidential and will be used exclusively for research purposes.

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