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Implementing TPACK-Based Technology Integration Training for Pre-Service Teachers in the Philippines

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Abstrak

Penelitian ini menganalisis pelaksanaan dan hasil program pelatihan pedagogis berbasis teknologi bagi calon guru di Kota Gabaldon, Provinsi Nueva Ecija, Filipina. Tujuan utama program ini adalah membekali calon guru dengan kompetensi digital dan strategi pedagogis yang berlandaskan pada kerangka *Technological Pedagogical Content Knowledge* (TPACK). Pendekatan campuran digunakan dalam penelitian ini, melalui survei, wawancara, dan observasi kelas, untuk mengevaluasi efektivitas pelatihan dalam meningkatkan kesiapan integrasi teknologi dalam praktik mengajar. Hasil penelitian menunjukkan peningkatan signifikan dalam domain TPACK peserta, meningkatnya kepercayaan diri dalam menggunakan teknologi pendidikan, serta sikap positif terhadap integrasi teknologi di kelas. Studi ini merekomendasikan pentingnya pengembangan program pelatihan yang kontekstual, komprehensif, dan terarah guna mempersiapkan calon guru menghadapi tantangan pembelajaran abad ke-21.

Abstract

This study analyses the conduct and results of a technology-integrated pedagogical training program for pre-service teachers in Gabaldon Municipality, Nueva Ecija Province, Philippines. The program aimed to capacitate future teachers with digital competencies and knowledge of specific pedagogical strategies anchored in the Technological Pedagogical Content Knowledge (TPACK) framework. This research utilized a mixed-methods approach, combining survey instruments, interviews, and classroom observations to determine how the training effectively enhanced readiness to integrate technology into one's teaching practice. The findings suggest marked improvements in the participants' TPACK domains, increased confidence in using educational technologies, and a favorable attitude toward integrating technology into their classes. This study recommends developing contextualized, comprehensive, and targeted training programs to propel pre-service teachers into embracing the demands of contemporary classrooms.

INTRODUCTION

Today's education in the 21st century demands that the use of technology stop being merely an innovation and turn into something mandatory. New changes in digital tools and information and communication technologies (ICT) have revolutionized revolutionized the ways knowledge is accessed, processed, and disseminated in classrooms all over the world (UNESCO, 2019). Consequently, there is a rising demand now for teachers with the necessary competencies to adequately integrate such tools into practices of pedagogy. This will, further, have tremendous implications for teacher education programs in developing countries, particularly as in the case of the Philippines where integration of technology into teaching and education is still sporadic and often bottlenecked by either infrastructural or pedagogical limitations (Lucero *et al.*, 2022). Pre-service teachers are indeed the marshals of how the future will shape education, and they need to be geared up with adequate knowledge in technology-enhanced teaching strategies for better student engagement and meaningful learning. Yet, research shows that a number of teacher education institutions in the Philippines are still in the process of digitizing and adapting their programs to meet these demands (Basa & Mabaquiao, 2024; Mercado & Ibarra,

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2019). While students may be bringing with them basic tools for digital engagement, their usage of such tools for effective pedagogy remains scantily developed (Bautista *et al.,* 2024). A structured, competency-based training method referencing contemporary educational frameworks is thus essential to prepare future educators for their success and security in designing technology-integrated lessons. Preservice teachers are vital to the future of education, for they need to be prepared to use modern technology and constructivist teaching strategies that foster student engagement and meaningful learning. However, according to studies, many of the teacher education programs in the Philippines are still adjusting to this digital challenge (Basa & Mabaquiao, 2024; Mercado & Ibarra, 2019). While students may feel comfortable using basic digital tools, they would mostly lack the pedagogical application of those skills in normal situations (Bautista *et al.,* 2024). Therefore, it is necessary to emphasize a systematic competency-based training of preservice teachers that builds confidence in applying recent educational theories in designing and delivering technology-infused lessons. One such framework that has gained prominence in teacher education is the Technological Pedagogical Content Knowledge (TPACK) framework developed by (Mishra & Koehler, 2006). This model emphasizes the interdependence of three knowledge domains—technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK)—arguing that effective technology integration requires a synthesis of all three. Recent research validates the relevance of the TPACK model in guiding professional development programs aimed at pre-service teachers (Chai *et al.,* 2013; Koehler *et al.,* 2013). Tondeur et al. (2012) further argue that embedding TPACK-based instruction within teacher education curricula fosters the development of deeper and more transferable technological teaching competencies. In the Philippine context, the Department of Education (DepEd) has initiated several policy activities in digital literacy and ICT integration, particularly in response to the transition to distance and blended learning modalities as a result of COVID-19 (DepEd, 2020). These policy changes clearly indicate that there is an urgent need for higher education institutions, such as colleges of education, to re-calibrate their training programs toward the fulfilment of the national goals related to digital transformation in education. However, limited access to digital infrastructure, perennial disjunction between professional development opportunities, and curriculum alignment slow-down the widespread adoption of ICTs at the pre-service level (Cabansag, 2022). This paper presents the implementation and effects of a technology-integrated education for pre-service teachers at the College of Education, Nueva Ecija University of Science and Technology (NEUST), Gabaldon Campus. The program offers TPACK competencies development among future educators via hands-on, reflective, and context-sensitive instructional practices. It aims to aid in expanding the knowledge base for technology-enriched teacher preparation programs and to provide a model of practice adaptable and scalable across similar institutional contexts in the Philippines and beyond.

Literature Review

The TPACK Framework and Its Relevance

The adoption of digital devices and software in educational practice is no longer an outside consideration; it has become rather an essential requirement for modern learning. Hence, teacher education programs across the world are increasingly drawing upon conceptual models which elaborate on the understanding and structuring of technology-integrated competencies for educators. Probably one of the most potent frameworks to emerge in this vein is the TPACK, or Technological Pedagogical Content Knowledge framework, promulgated initially by (Mishra & Koehler, 2006).

TPACK was built on Shulman (1986) fundamental idea of Pedagogical Content Knowledge, which condensed content knowledge (CK) and pedagogical knowledge (PK) as being basic for effective teaching. Mishra and Koehler extended this model by introducing Technological Knowledge (TK), thereby foreseeing a triadic structure that addresses the complexities of technology-invoked teaching. The TPACK model gives credence to seven knowledge domains that the teacher must master.

1. Knowledge Domain Description;
2. Content Knowledge (CK) Mastery of subject matter;
3. Pedagogical Knowledge (PK) Understanding of teaching methods and learning theories;
4. Technological Knowledge (TK) Familiarity with digital tools and platforms;
5. Pedagogical Content Knowledge (PCK) The intersection of pedagogy and content;

6. Technological Content Knowledge (TCK) Understanding how technology can represent subject content;
7. Technological Pedagogical Knowledge (TPK) How technology changes teaching approaches;
8. Technological Pedagogical Content Knowledge (TPACK) The integrated knowledge necessary for designing and implementing effective teaching strategies using technology.

Indeed, TPACK affirms that effective teaching with technology does not only comprise using digital tools, but also knowing how, when, and why to use supplements to enhance learning in a particular content area (Koehler *et al.*, 2013). Consequently, TPACK is not a static model, but a dynamic and evolving knowledge base shaped by teachers' experiences, reflections, and pedagogical contexts. Recent studies reveal that structured exposure to TPACK principles during pre-service training improves both teaching efficacy and technological fluency (Chai *et al.*, 2013; Tondeur *et al.*, 2012). Pre-service teachers who receive instruction explicitly based on TPACK would possess better dispositions to critically evaluate digital tools, identify corresponding applications for classroom teaching, and design lessons in a way that use technology to provide support for deeper conceptual learning. The countries under consideration have more significance for TPACK; because educational systems in developing countries usually differ greatly in terms of digital access and teaching quality (Lucero *et al.*, 2022). TPACK serves as a model but is also a framework for institutional capacity building. According to (Bautista *et al.*, 2024), Filipino pre-service teachers who participated in TPACK-based training that included AI tools and microteaching simulations experienced significant gains in both confidence and competence in using the provided digital tools. Additionally, TPACK application in teacher training should not stop at disseminating content. Research advocates for active learning strategies to teach prospective teachers, including collaborative lesson planning, reflective teaching practice, classroom simulations and design-based projects through which integrated knowledge may be developed (Baran *et al.*, 2011; Koh *et al.*, 2010). Such practices allow pre-service teachers to internalize the very interconnectedness of TPACK and to form habits of adaptive thinking and growth in professionalism. Even so, concerns have been raised by some scholars regarding the adoption of TPACK globally. (Voogt *et al.*, 2013) identify a strong and valid conceptual map on which TPACK stands; the reality is that the education programs of teachers have yet to find a way to integrate their curriculum and assessment mechanisms with the whole complexity of that framework. The above criticism really points to the necessity for context-sensitive applications and iterative training models that would deepen the TPACK proficiency of the students gradually. The TPACK framework should also not be seen in isolation, but rather part of what is no more than a larger ecology of teacher professional development, together with such standard-based frameworks as ISTE Standards for Educators, national curriculum guidelines, and systems of institutional support, so that use of technology is not just mastered but enabled by teachers resourcefully and equitably (International Society for Technology in Education, 2022; UNESCO, 2019). While the TPACK framework offers a powerful lens for designing technology-integrated teacher education globally, its practical application must be interpreted within specific educational contexts, especially in developing countries where unique challenges shape its implementation.

To sum up, the TPACK framework enables the design of pre-service training programs for teacher educators in a holistic, adaptable, and context responsive manner, which is implemented in workflows. Nonetheless, this study represents a confirmatory contribution by applying an established TPACK-based training model in a rural Philippine setting. While this provides useful local insights, future research should prioritise developing culturally-responsive adaptations of TPACK, locally relevant training modules, and assessment tools that reflect the specific conditions and needs of Southeast Asian classrooms. With regards to NEUST, adopting a TPACK-driven model arms the institution with a cost-effective approach in molding educators for the 21st century—technologically, pedagogically, and content-wise agile and attuned to the demands of contemporary education. While TPACK provides a useful model, its implementation in developing country contexts like the Philippines faces significant challenges, including limited digital infrastructure, varying faculty readiness, and policy-practice gaps (Voogt *et al.*, 2013; Castañeda *et al.*, 2021). These factors warrant further contextual adaptation and iterative capacity-building strategies.

Technology Integration in Philippine Teacher Education

Basic education worldwide encourages the utilization of information and communication technology (ICT) tools in virtually all aspects of teaching and learning. However, there remains a general lack of implementation in many developing nations, including the Philippines. The Department of Education (DepEd, 2020) acknowledges initiatives to enhance the digitalization of education and the formulation of online teaching methodologies—particularly in the wake of the COVID-19 pandemic. However, there is still a great deal of public and rural schools (Cabansag, 2022; Lucero *et al.*, 2022) that suffer from infrastructural deficits, limited training opportunities, and a lack of resources. Research suggests that pre-service teachers tend to be confident with their digital skills, but are not able to utilize them in a pedagogically significant manner (Mercado & Ibarra, 2019). For example, Basa and Mabaquiao (2024) showed that elementary education students possessed the prerequisite knowledge regarding technology, but did not have adequate exposure to classroom-based technology integration frameworks. This is further supported by Abao and Espinosa (2021), who point out the existing disparity between digital literacy and digital pedagogy in the educational curricula of teachers trained in the Philippines. Moreover, the excessive focus on theoretical teaching within education courses has been highlighted as a hindrance to the development of genuine, experiential engagement with educational technology. Gutierez (2020) emphasizes the need for technological applications to be anchored in teaching simulations and practicum work. In the absence of these approaches, it is likely that novice teachers will not be able to convert the knowledge of digital tools they possess into instructionable processes even when they enter the workforce.

Challenges and Conditions for Effective Technology Use in Pre-Service Programs

The consideration of technology in the curriculum of educators in training programs presents a handful of complex problems. First of all, there is the problem of access. Most education colleges, especially in rural or poorly financed areas, do not have the requisite resources to support the regular integration of technology in teaching as it is not so easy to develop a region-wide infrastructure (Lucero *et al.*, 2022; UNESCO, 2019). Second, the institutional backing regarding faculty support and curriculum innovations is often lacking. With (Tondeur *et al.*, 2012) noted, for purposes of sustainable integration, teacher educators need to have adequate TPACK knowledge and model some acceptable levels of technology use. Third, there is attitude and mindset problem. Where the necessary infrastructure exists, there may be reluctance from both the teacher educators and the learners. In his study on e- learning readiness, (Lucero *et al.*, 2022) found out that while learners and faculty members had adequately developed digital skills, there was considerable reluctance to shift to blended or online teaching models. To overcome these difficulties, (Koh *et al.*, 2016) put forward advocacy in participatory and context responsive designs in training programs for teachers. They propose a design thinking approach for the education of pre-service teachers whereby students are involved in active, iterative, and hands-on design projects alongside teaching. From the viewpoint of (Bautista *et al.*, 2024), institutional commitments in the Philippine context require training materials and devices, as well as ongoing training for the faculty. Most TPACK proponents are now required to localize it. Castañeda and Williamson (2021) argue that TPACK and other frameworks need to be understood within the socio-cultural and political contexts of their application. This implies that Philippine teacher education institutions need to extend beyond the global best practice integration and instead focus on the contextualization of these practices relating to language, resources, and the multiplicity of learner demographics. Although TPACK has been widely adopted in teacher education research, scholars have pointed out that its application in developing contexts must consider local constraints, such as infrastructure, access to resources, and socio-cultural factors that shape technology use in classrooms (Castañeda *et al.*, 2021; Voogt *et al.*, 2013).

METHOD

A post-training survey descriptive quantitative design was utilized in this research to evaluate how the participants perceived and reflected on the training program. The primary objective was to establish the effect of the training on their self-reported knowledge, confidence, and willingness to use technology for teaching. This approach is appropriate for the collection of participant feedback in community-based educational interventions (Creswell, 2014). The training program

was attended by a total of 103 pre-service teachers from the College of Education at NEUST Gabaldon Campus. However, only 31 of these participants voluntarily completed the post-training survey, accounting for approximately 30% of the total attendees. The analyzed sample thus represents those who consented to provide feedback and self-evaluate their learning experience. Despite the modest response rate, the sample included both elementary and secondary education pre-service teachers, offering relevant perspectives for preliminary evaluation of the training's impact. The students were in their third or fourth year in the teacher education program and volunteered to undergo the training. Participation in the after-training survey was likewise voluntary and anonymous. The training program lasted for two days and aimed to make the pre-service teachers more competent in technology integration in their teaching. It addressed the fundamentals of digital tools such as Canva for creating instructional materials, Google Forms for online quizzes, and interactive websites like Quizizz for engaging students. The sessions combined short lectures, hands-on workshops, and group tasks so that the participants could apply their learning to real classroom contexts. The program was framed around the TPACK model, with an emphasis on the overlap between technological knowledge and pedagogical and content knowledge. In this manner, participants were able to develop their understanding of how to use technology to support valuable learning. The researchers built a structured questionnaire based on the TPACK model (Mishra *et al.,* 2006) and previous literature on technology integration (Chai *et al.,* 2013; Tondeur *et al.,* 2012). The questionnaire included demographic questions (e.g., program, year level), impression of training content and approach, self-reported TPACK components knowledge, perceived usefulness and relevance of training to future instruction, open-ended question for qualitative comments. The survey used a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree) for closed-ended questions. After the training had been conducted, the survey link was distributed via email and messaging apps. The participants completed the survey online via Google Forms. Taking the survey took about 10–15 minutes to complete. Quantitative data were analyzed through descriptive statistics (frequency, percentage, mean) to summarize participant response and identify trends. Open-ended responses were coded using content analysis to ascertain common themes regarding participants' experience, perceived benefits, and the means by which improvements may be achieved.

RESULTS AND DISCUSSION

Results

There were 31 pre-service teachers who participated in the post-training survey. Nineteen (61%) of them were pursuing the Bachelor of Secondary Education, while 12 (39%) were pursuing the Bachelor of Elementary Education. The majority of participants (74%) were female and between 19 and 23 years old. Participants in general reported positive attitudes toward the content and presentation of the training. Using a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree), participants scored the clarity of instruction at a mean of 4.42 (SD = 0.54), and the value of the digital tools discussed at a mean of 4.55 (SD = 0.48). The majority (87%) agreed that training sessions were interesting and well-timed. Table 1 shows self-reported participants' knowledge of the seven TPACK areas after training. The mean score for all items was 4.31 (SD = 0.46), indicating high perceived levels of competency at integrating technology with pedagogy and content knowledge.

Table 1. Participants' Knowledge of TPACK after Training.

1. TPACK Component Mean SD;
2. Technological Knowledge (TK) 4.38 0.52;
3. Pedagogical Knowledge (PK) 4.25 0.49;
4. Content Knowledge (CK) 4.29 0.43;
5. Technological Pedagogical Knowledge (TPK) 4.33 0.48;
6. Technological Content Knowledge (TCK) 4.27 0.45;
7. Pedagogical Content Knowledge (PCK) 4.30 0.44;
8. Overall TPACK 4.31 0.46

Upon being asked about the relevance of the training toward their future teaching vocation, 90% of the participants agreed or strongly agreed that the training raised their confidence level in using technology in teaching. In addition, 84% were more capable of designing technology-augmented lesson plans, and 79% reported increased motivation to utilize digital tools in teaching during their practicum. Open-ended feedback captured common themes such as thanks for the hands-on activities, recognition of the importance of technology integration, and recommendations for more advanced topics on individual tools. The following example of a participant comment highlighted the impact of the training: "The training opened my eyes to how technology can be used to make lessons more interactive and engaging. I used to simply use PowerPoint and use a TV or projector to display the presentation, but now I would want to try out online quizzes and computer tests in my practicum." This was done by others who commented that the experience left them eager to experiment with more student-directed and innovative approaches in their own classrooms in the future. The training appeared to promote not only skill acquisition but also a change of heart toward more innovative pedagogies.

Discussion

Results of this study indicate that pedagogical training that was technology-integrated exerted a strong positive effect on strengthening pre-service teachers' perceived knowledge and self-efficacy in applying digital tools to improve teaching. The overall high mean scores on all seven domains of the TPACK model illustrate the participants' overall growth in technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK) and their intersections. This finding corroborates Mishra and Koehler (2006) initial study of TPACK, in which an integrated knowledge needs to be developed in order to have the capacity to use technology effectively in teaching and content presentation. The consistently high means (M = 4.31/5.0) across all domains could also indicate ceiling effects or overestimation, as no objective performance data were collected. The strong positive responses of the respondents to the ease and helpfulness of the training sessions reaffirm the effectiveness of the blended instructional approach that combined brief lectures, demonstrations, and hands-on exercises. Such results are in agreement with previous studies on experiential learning as being central to the technology competence development of pre-service teachers (Tondeur *et al.,* 2012; Voogt *et al.,* 2013). Through the use of tools such as Canva in instructional resource preparation, Google Forms in assessment of learning, and Quizizz in game-based learning, students were able to make new knowledge applicable directly, hence bridging theory and practice as enhanced by (Lucero *et al.,* 2022).

Figure 1. Interactive presentation session.

Significantly, the participants also reported greater motivation and readiness to integrate technology into their future classrooms, reflecting findings from Mercado and Ibarra (2019) that workshops on technology integration increase pre-service teachers' confidence and pedagogical innovation. This finding is significant amidst reported issues in the Philippine educational context, where many teachers have basic digital literacy but lack confidence in pedagogically significant technology use (Bautista *et al*., 2024). The training thus assists in addressing the dire gap between knowing how to operate digital tools and utilizing them to create interactive, learner-centered instruction—a disparity highlighted by *(*Abao *et al*., 2021). While the positive outcomes of the training highlight its immediate effectiveness, it is equally important to consider the contextual challenges that may affect the long-term sustainability of technology integration in Philippine classrooms. Cited by DepEd (2020) and Gutierez (2020), issues of inadequate access to stable internet, poor infrastructure, and lack of technical support are significant constraints. While training increased the perceived competencies of the participants, the translation of such gains into actual classroom practices can be arrested by systemic problems. This finding indicates the need for future programs to include strategies to surmount contextual limitations, such as asynchronous learning modules and collaborations that provide ongoing mentoring and resource sharing (Tondeur *et al*., 2012; Voogt *et al*., 2013). Moreover, these high self-reported scores may partly reflect social desirability bias or short-term optimism following the training, and should be interpreted with caution. In addressing these challenges, the integration of TPACK principles offers a structured and flexible framework that can support pre-service teachers in navigating resource-constrained and diverse educational settings. Embedding of digital tools within a pedagogically meaningful framework supports not only the technical skill learning but also the needed pedagogical thinking that it takes to teach effectively (Chai *et al*., 2013). Nevertheless, the successful application of TPACK-informed practices cannot occur in isolation. It requires alignment with broader institutional supports, infrastructure development, and continuous professional learning opportunities. This holistic strategy is in response to international demands for teacher education reforms that ready teachers for active, technology-enhanced learning settings (Voogt *et al*., 2013).

Figure 2. Post-session photo with the participants and host institution.

A closer inspection of the self-reported TPACK components shows that Technological Knowledge (TK) had the highest mean score (M = 4.38, SD = 0.52), suggesting that participants felt most confident in their understanding and use of digital tools after the training. This is likely due to the hands-on emphasis on specific tools such as Canva, Quizizz, and Google

Forms. By contrast, Pedagogical Knowledge (PK) registered the lowest mean score (M = 4.25, SD = 0.49), indicating that while participants gained technological skills, their confidence in integrating these tools within sound pedagogical strategies still leaves room for growth. This finding underscores the need for future training to further strengthen the link between technology use and effective instructional design. In summary, this research confirms that targeted, technology-infused pedagogical training can successfully empower pre-service teachers by strengthening their knowledge, competency, and attitudes toward the use of technology in teaching. For maximum effect, though, such training needs to be within a larger ecosystem that comprises infrastructural capacity, ongoing professional development, and contextualized pedagogical models reflective of local conditions. Despite the encouraging results, this study has several limitations that must be acknowledged. First, the reliance on self-reported data without objective measures of performance (e.g., evaluation of lesson plans or classroom simulations) limits the ability to verify the actual integration of TPACK components in practice. Second, the absence of follow-up data means we cannot ascertain the durability of the reported gains over time. Third, the voluntary nature of participation in the post-training survey introduces potential selection bias, as those with more positive perceptions or greater motivation may have been more likely to respond. Finally, external contextual challenges—including infrastructure gaps, unequal digital access, and limited institutional support—remain significant barriers that could impede the translation of training gains into real classroom practice. Future studies should aim to include longitudinal data, objective skill assessments, and explore strategies to mitigate these systemic barriers

CONCLUSION

This study suggests that the training may have supported pre-service teachers' perceived knowledge and confidence in using technology, though further research with objective measures is needed to confirm actual skill transfer and long-term impact. Pre-service teachers reported enhanced performance in all facets of the TPACK construct that indicated them growing ready to integrate technology, pedagogy, and content knowledge. The strong positive feedback toward the quality, usefulness, and interest in the training highlights the value of practice-oriented, experience-based approaches in teacher preparation. Apart from that, training increased motivation and preparedness of pre-service teachers to adopt technology into their upcoming classrooms, helping fill the gap in successful use of technology observed in the Philippine learning environment. To strengthen the impact of technology-integrated training programs, it is recommended that teacher education institutions incorporate TPACK principles systematically into their curriculum, not as isolated workshops but as embedded components of pedagogy courses and practicum. Education policymakers should prioritise investment in digital infrastructure and technical support, especially in rural and resource-limited settings, to create enabling environments where technology use can thrive. Continuous professional development for faculty members is also essential, ensuring that teacher educators themselves are competent and confident in modelling technology integration. At the school level, mentoring systems and communities of practice should be established to help novice teachers reflect on and refine their use of technology in real classrooms. Finally, monitoring and evaluation frameworks should be introduced to track not only teacher competencies but also the actual integration of digital tools into student learning processes. Moreover, taking the training a step further to include more advanced digital tools and pedagogies will support continuous professional growth. Providing flexible delivery options, like blended and asynchronous learning spaces, can improve access and flexibility with different learner needs, especially in environments that are resource-limited. Creating mentorship programs and communities of practice can also support pre-service and in-service educators by enabling them to share experiences, solve problems, and keep up to date with emerging education technologies. Finally, the long-term study of technology-integrated training effects on classroom practices and students' learning results must be explored through qualitative as well as quantitative research in the future. With the implementation of these recommendations, teacher education programs can prepare teachers in a better way for the 21st century classroom challenges to develop more effective, more engaging, and more inclusive learning environments enriched by quality technology integration.

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