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Integrating Online Pedagogical Strategies To Enhance The Professional Competence Of 21st Century Elementary Teacher Candidates

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Abstract

This study explores the integration of online pedagogical strategies in enhancing the professional competence of 21st-century elementary teacher candidates. Employing a sequential explanatory mixed methods design, the research involved 38 sixth-semester students in a teacher education program. Quantitative data were collected through pre- and post-tests framework and analyzed using paired-sample t-tests, revealing a significant improvement in participants' professional competence ($t(37) = 2.478, p = .018$). Qualitative data from interviews and focus group discussions highlighted gains in digital confidence, reflective teaching, and collaborative practices. Participants reported increased ability to design and implement digital instructional materials, enhanced reflective thinking through e-portfolios, and active engagement in peer collaboration. The convergence of findings suggests that integrating online pedagogical strategies not only strengthens technical skills but also enriches pedagogical reasoning and adaptability. This study contributes practical insights for improving teacher education programs by embedding technology-enhanced and student-centered pedagogical practices into pre-service teacher training.

Keywords: online pedagogy, professional competence, Elementary Teacher Candidates

INTRODUCTION

The digital revolution in education has necessitated a comprehensive overhaul of teacher education curricula to ensure that prospective educators possess not only subject matter expertise and pedagogical skills but also robust digital competencies. The rapid integration of Information and Communication Technology (ICT) in educational settings has highlighted the inadequacies of traditional teacher training programs, which often focus on discrete technology training rather than on its pedagogical integration (Cai et al., 2023; Fütterer et al., 2024). This evolving landscape requires teacher candidates to develop a technological pedagogical content knowledge (TPACK) framework that enables them to blend content knowledge, pedagogical methods, and digital tools effectively (Olori & Saka, 2024; Setyowati & Rachmajanti, 2023).

Recent literature underscores that the disjunction between technology training and its application in meaningful educational contexts weakens teachers' capacity to harness digital tools for enhancing online learning. For example, mphasize that while teachers may express intentions to integrate open educational resources (OER) in their instruction, the actual incorporation of such resources remains uneven without contextual supporte (Cai et al., 2023). Similarly, Locara (2022) advocates for the integration of multimedia-mediated microteaching approaches that connect theoretical concepts with practical online teaching experiences. In the same vein, (Ma et al., 2024) highlight how learning-by-design methodologies can foster online collaborative environments that enable teacher candidates to actively co-construct their digital competencies in authentic educational

contexts.

The imperative for reform is further reinforced by studies demonstrating how digital transformation impacts professional development and classroom practice. Teacher candidates must be prepared to utilize emerging technologies such as smartphones Parajuli (2024) and AI-powered digital platforms Zhang (2024) to support interactive and innovative teaching practices. Furthermore, the integration of technology into teacher education tends to enhance digital identity management and professional growth, as observed by Supriadi et al (2022) which is critical for building confidence and competence in modern educational settings. Collaborative and informal professional learning environments, as discussed by Fütterer et al., (2024) enable pre-service and in-service teachers to exchange ideas and strategies, thereby solidifying the practical application of digital skills.

Moreover, the shift to remote learning environments during and after the COVID-19 pandemic has accelerated the need for teacher candidates to adopt a holistic approach to digital education. Studies by Polat et al., (2022) and Woon Chun et al., (2024) indicate that the successful implementation of online pedagogical practices depends heavily on teachers' readiness and their ability to integrate instructional technologies within their teaching framework. Additionally, Lee & Kim (2025) provide evidence that experiential learning in virtual environments, such as the metaverse, can significantly augment teacher candidates' understanding of digital space construction, thereby preparing them to handle technologically enriched classrooms.

In light of these developments, teacher education programs must redesign their curricula to meaningfully incorporate technology-enhanced pedagogy. By embedding digital competencies and TPACK development into core training, programs can better prepare teacher candidates

for the demands of 21st-century education (Agustin et al., 2023; Anita Pattnaik, 2024). The evolving role of technology in education, as substantiated by multiple studies (Cai et al., 2023; Lee & Kim, 2025; Locara, 2022; Olori & Saka, 2024; Setyowati & Rachmajanti, 2023; Woon Chun et al., 2024), future teachers must not only be users of technology but also become innovative designers of transformative digital learning environments.

METHODS

This study employed a Sequential Explanatory Mixed Methods Design, which involves two distinct phases: a quantitative phase followed by a qualitative phase to explain or elaborate on the quantitative findings (Creswell & Plano Clark, 2018). This approach was chosen to not only measure the effectiveness of online pedagogical strategies but also to gain deeper insight into how teacher candidates perceived and applied those strategies in real teaching contexts.

The participants were 38 elementary teacher candidates enrolled in a teacher education program. The participants were in their 6th semester and had prior exposure to basic ICT integration but had not formally experienced structured online pedagogical training. Participants were selected through purposive sampling to ensure they had comparable academic backgrounds and digital readiness. Instruments and Data Collection is Quantitative Phase Pre- and Post-Test Questionnaire to assess professional competence, adapted from the *Technological Pedagogical Content Knowledge (TPACK)* survey. Qualitative Phase Semi-structured interviews with 12 purposively selected participants. Focus group discussions (FGDs) to explore group reflections and experiences during the intervention.

Quantitative Data Analysis Descriptive statistics (mean, standard deviation) and paired sample t-tests were

conducted using SPSS to examine significant changes in professional competence before and after the intervention. Qualitative Data Analysis transcripts from interviews and FGDs were analyzed using thematic analysis (Braun & Clarke, 2006). Trustworthiness and Validity Triangulation of data sources (survey, interviews, reflection logs) was used to enhance credibility. Member checking and peer debriefing were implemented to validate qualitative findings. Ethical clearance was obtained from the institutional review board, and informed consent was secured from all participants.

RESULTS

Quantitative Findings

A paired-sample t-test was conducted to compare pre- and post-test scores of teacher candidates' professional competence before and after the integration of online pedagogical strategies.

Tabel. 1. Paired Samples Test

		Paired Differences							Sig. (2-tailed)
Mean		Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df		
				Lower	Upper				
Pair 1	Pretest - Posttest	2.816	7.005	1.136	.513 5.118	2.478	37	.018	

The paired samples t-test revealed a statistically

significant difference between the pretest and posttest scores of teacher candidates' professional competence, $t(37) = 2.478$, $p = .018$ ($< .05$). The mean difference of 2.816 (SD = 7.005) indicates a positive gain after the implementation of online pedagogical strategies. The 95% confidence interval [0.513, 5.118] suggests that the intervention had a meaningful impact on improving the professional competence of the participants.

Qualitative Findings

Thematic analysis of interview and focus group data revealed that online pedagogical strategies fostered reflective thinking, collaboration, and increased digital confidence among teacher candidates. Several participants expressed that writing reflections through digital platforms such as blogs allowed them to better understand their own teaching practices. As one participant noted, *"Every time I write a reflection on the blog, I become aware of what I need to improve and what I have done well during microteaching."* This practice of self-reflection played a key role in helping them internalize pedagogical concepts and identify specific areas for improvement. Moreover, the digital learning environment was perceived as a space that encouraged collaboration and creativity. One participant shared, *"In fact, in the digital space, I engage in more discussions with my peers and gain a lot of inspiration for creating instructional media."* This highlights how the online setting not only facilitated peer interaction but also served as a source of pedagogical innovation.

Furthermore, participants reported a significant shift in their confidence levels regarding the integration of digital tools into teaching. One teacher candidate reflected, *"I wasn't confident before about creating digital learning materials, but after doing the e-module and online microteaching, I feel ready to teach in both online and offline settings."* This suggests that the structured use of online

pedagogical strategies—through activities like e-module creation and simulated teaching can empower future educators to embrace hybrid teaching modes and adapt to diverse learning environments.

Integration of Quantitative and Qualitative Results

The integration of quantitative and qualitative findings provides a comprehensive understanding of how online pedagogical strategies contributed to the enhancement of teacher candidates' professional competence. Quantitative data from the paired samples t-test indicated a statistically significant improvement between pretest and posttest scores, $t(37) = 2.478$, $p =$

.018, with a mean difference of 2.816. This confirms that the intervention was effective in improving participants' professional competence.

Qualitative findings further elaborated on these improvements by revealing how teacher candidates internalized and applied the online pedagogical strategies. For instance, participants commonly reported increased confidence in using digital tools such as Google Classroom, interactive whiteboards, and video-based instruction. One participant stated, *"I now understand how to design interactive content and manage student engagement better through online tools."* This qualitative insight aligns with the quantitative gain observed in digital pedagogical knowledge.

Additionally, the development of reflective thinking and collaborative planning—highlighted during focus group discussions—supports the improvement in broader aspects of professional competence, including pedagogical reasoning and instructional design. Participants emphasized how digital portfolios and group projects helped them critically assess their teaching and adapt strategies based on feedback.

The convergence of both data sources reinforces the

validity of the findings and strengthens the conclusion that online pedagogical strategy integration does not only improve technical or digital competencies, but also enhances deeper aspects of pedagogical practice, including planning, reflection, and classroom management in digital contexts.

DISCUSSION

The findings of this study indicate that the integration of online pedagogical strategies significantly enhances the professional competence of elementary teacher candidates. This supports previous research emphasizing the critical role of digital pedagogy in modern teacher preparation (Baran et al., 2011; Tondeur et al., 2017).

1. Developing Instructional Design and Digital Teaching Skills

The improvement in instructional design competence and digital pedagogical knowledge can be attributed to the intentional design of the intervention. Candidates were not only passive users of technology but also creators of digital learning environments, aligning with the expectations of 21st-century education (Redecker & Punie, 2017). These results are consistent with Bates (2019), who argues that meaningful engagement with digital pedagogy requires more than using tools—it requires understanding instructional design, learner interaction, and digital assessment. The flipped classroom strategy, for example, empowered students to organize content delivery independently and use synchronous time for active learning and discussion.

2. Strengthening Reflective and Adaptive Teaching

The substantial improvement in reflective practice shows that online pedagogy can enhance metacognitive skills. Through digital portfolios and reflection blogs,

teacher candidates engaged in continuous self-evaluation, which is a core element of professional growth (Kim et al., 2020). This aligns with Darling-Hammond et al, (2020), who emphasize that reflective teaching is a key marker of effective educators. The combination of asynchronous (self-paced learning) and synchronous (peer discussion and feedback) elements helped learners develop a more adaptive and responsive mindset, critical for navigating diverse learning environments.

3. Online Collaboration as a Learning Culture

Collaborative learning was another central theme. In contrast to the assumption that online environments are isolating, participants experienced strong peer collaboration through Google Docs, forums, and group discussions. This supports the notion that when well-facilitated, online spaces can foster communities of practice among teacher candidates. Such peer interactions are important for building social and professional skills in digital contexts. The collective learning observed mirrors findings from (Tondeur et al., 2017), who argue that successful technology integration in teacher education depends heavily on collaborative pedagogical models.

4. Implications for Teacher Education

The results of this study provide actionable insights for curriculum developers and educators. Specifically, it emphasizes that teacher preparation programs must move beyond isolated ICT courses and integrate contextualized, practice-based online pedagogy. Institutions are encouraged to develop hybrid or blended modules where digital tools are seamlessly embedded within core pedagogical training. Furthermore, support systems—such as mentoring, continuous feedback, and structured reflection—are essential to maximize the effectiveness of online teaching experiences. These findings align closely

with previous research, which underscores the limitations of ICT training when disconnected from authentic pedagogical practices. Cañada and Osorno (2022) and Flores and Sabado (2023) demonstrated that teacher competencies are significantly influenced by their ability to embed ICT within broader teaching frameworks, rather than treating technology as an isolated skill. Similarly, Thaanyane & Jita (2024), as well as Timotheou et al. (2023), advocate for context-specific, practice-based approaches that better prepare future educators to adapt to the complexities of digital teaching environments. The widespread adoption of online learning during the COVID-19 pandemic further validated this need, as Dayal (2023) highlighted how even technologically adept teachers faced challenges in engaging students effectively when pedagogical frameworks were weak. Thus, the present study reinforces the growing consensus that the integration of ICT into teacher education must be deeply tied to pedagogical theory and authentic teaching practices. Moving forward, teacher education programs should prioritize experiential learning environments that blend technological proficiency with reflective and adaptive pedagogical competencies, ensuring that future teachers are not just users of technology, but strategic designers of meaningful digital learning experiences.

CONCLUSION

This study demonstrated that the integration of online pedagogical strategies significantly enhances the professional competence of 21st-century elementary teacher candidates. The most notable improvements were found in: a) Instructional design skills, b) Digital pedagogical knowledge, and, c) Reflective and adaptive teaching practices. Through structured interventions such as flipped classrooms, e-module development, and online microteaching, participants developed a deeper

understanding of how to design, deliver, and reflect on digital instruction. The quantitative gains in competence were supported by qualitative insights, highlighting the transformative role of online pedagogy in shaping digitally capable and reflective future educators. Recommendations for teacher education institution: a) Embed online pedagogical design and practice as core components of pre-service teacher education, b) Provide platforms for collaborative e-learning, microteaching, and reflective practice through digital portfolios. For Policy Makers and Curriculum Developers: a) Revise national teacher education standards to include digital competence and online instructional design capabilities, b) Support institutional capacity building by investing in edtech infrastructure, LMS systems, and online teaching simulations. For future research: a) Conduct longitudinal studies to track the sustained impact of online pedagogy on graduates' teaching effectiveness, b) Investigate the integration of AI-based tools and adaptive learning technologies in teacher training programs.

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