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STRENGTHENING DIGITAL LEARNING IN INDONESIAN PRIMARY SCHOOLS: A QUALITATIVE STUDY OF PPG GRADUATES

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Abstract
Digital transformation in primary education requires teachers to possess integrated technological and pedagogical competencies in order to design effective learning environments. However, disparities in digital readiness remain a significant challenge in many primary schools. This study aims to describe the role of graduates of the Teacher Professional Education Program (PPG) in strengthening digital learning practices in primary schools, to identify the challenges they encounter, and to examine the strategies employed to optimize the use of instructional technology. This research adopted a descriptive qualitative approach, with data collected through classroom observations, in-depth interviews, and documentation. Data were analyzed using an interactive analysis process consisting of data reduction, data display, and conclusion drawing and verification. The findings indicate that PPG graduates contribute to improving the quality of digital lesson planning, the use of interactive learning media, and the implementation of technology-based assessment that supports students' conceptual understanding and engagement. Digital learning practices also enhance instructional clarity and enrich students' learning experiences through the use of diverse digital learning resources. Nevertheless, limited access to digital devices, unstable internet connectivity, and insufficient continuous professional development remain major barriers to effective digital learning implementation. This study concludes that PPG graduates play an important role as agents of digital transformation in primary education; however, the effectiveness of this role is highly dependent on systemic school support, infrastructure readiness, and the sustainability of teachers' professional development.
Keywords: *Digital Learning; Primary Education; Profesional Education Program (PPG)*

Abstrak
Transformasi digital dalam pendidikan dasar menuntut guru memiliki kompetensi teknologi dan pedagogi yang terintegrasi untuk merancang pembelajaran yang efektif. Namun, kesenjangan kesiapan digital masih menjadi tantangan di banyak sekolah dasar. Penelitian ini bertujuan untuk mendeskripsikan peran lulusan Program Pendidikan Profesi Guru (PPG) dalam memperkuat praktik pembelajaran digital di sekolah dasar, mengidentifikasi tantangan yang dihadapi, serta mengkaji strategi yang diterapkan dalam mengoptimalkan pemanfaatan teknologi pembelajaran. Penelitian ini menggunakan pendekatan deskriptif kualitatif dengan teknik pengumpulan data berupa observasi, wawancara mendalam, dan dokumentasi. Analisis data dilakukan secara interaktif melalui tahapan reduksi data, penyajian data, dan penarikan kesimpulan/verifikasi. Hasil penelitian menunjukkan bahwa lulusan PPG berperan dalam meningkatkan kualitas perencanaan pembelajaran digital, pemanfaatan media interaktif, serta penerapan penilaian berbasis teknologi yang mendukung pemahaman konsep dan keterlibatan siswa. Pembelajaran digital yang diterapkan juga berkontribusi pada kejelasan penyampaian materi dan pengayaan pengalaman belajar melalui sumber belajar digital. Meskipun demikian, keterbatasan perangkat, akses internet yang tidak stabil, dan kurangnya pengembangan profesional berkelanjutan masih menjadi hambatan utama dalam implementasi pembelajaran digital. Penelitian ini menyimpulkan bahwa lulusan PPG berperan sebagai agen transformasi digital dalam pendidikan dasar, namun efektivitas perannya sangat bergantung pada dukungan sistem sekolah, kesiapan infrastruktur, dan keberlanjutan pengembangan kompetensi guru.
Kata Kunci: Digitalisasi Pembelajaran; Sekolah Dasar; Program Profesi Guru

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Introduction

The rapid advancement of digital technology has fundamentally transformed the landscape of education, making digital competence an essential requirement for teachers in the 21st century. In primary education, where learning foundations are formed, the integration of technology is no longer optional but necessary to support meaningful, engaging, and student-centered learning. Nevertheless, despite increasing access to digital tools, many elementary school teachers in Indonesia remain insufficiently prepared to implement technology effectively in classroom practice, resulting in a persistent gap between technological potential and instructional reality.

This challenge is closely aligned with both national and global education agendas. The Merdeka Curriculum emphasizes innovative and flexible learning that responds to students' needs through the integration of digital technology. At the global level, Sustainable Development Goal (SDGs)-4 underscores the importance of inclusive, equitable, and quality education supported by technology-enhanced learning (United Nations, 2020). In response to these demands, the Indonesian government has implemented the Teacher Professional Education Program (PPG) to prepare professional educators who are pedagogically competent, adaptive to technological developments, and capable of responding to contemporary educational challenges. PPG graduates are expected not only to master subject matter but also to design and implement technology-based learning and utilize digital platforms as part of instructional innovation.

However, empirical evidence suggests that the expectations placed on teachers and PPG graduates have not been fully realized in school practice. Studies in Indonesian elementary schools indicate that many teachers experience difficulties in integrating digital tools due to limited digital literacy, low self-efficacy, and inadequate infrastructure (Aryani et al., 2023). National and local studies report that fewer than half of primary school teachers consistently integrate digital technologies into daily instruction, with the majority still relying on traditional, teacher-centered approaches (Putra & Ningsih, 2022). These findings raise critical concerns regarding the extent to which professional education programs, including PPG, adequately equip teachers to address the challenges of digital learning in real classroom contexts.

Research on teachers' digital competence has increasingly adopted the Technological Pedagogical Content Knowledge (TPACK) framework, which conceptualizes effective technology integration as the dynamic interaction between technological, pedagogical, and content knowledge (Koehler & Mishra, 2009). Beyond individual competence, international research highlights the importance of collaborative and supportive school environments. Tondeur et al. (2017) emphasize that sustainable technology integration requires continuous, practice-based professional development embedded within Professional Learning Communities (PLCs). In the Indonesian context, studies show that while PPG graduates tend to be more adaptive to innovation, their effectiveness is strongly influenced by school culture, leadership support, and opportunities for collaboration (Hairunisa & Asrial, 2021; Mardhatillah & Surjanti, 2023).

Despite the growing body of literature, several empirical gaps remain evident. First, existing studies predominantly focus on teachers' individual digital skills or infrastructural constraints, with limited attention to the systemic role of PPG graduates as agents of change in

schools. Second, the relationship between teachers' digital competence and collaborative school cultures—particularly within PLC frameworks—remains underexplored in Indonesian primary education. Third, prior research often examines these aspects in isolation, resulting in fragmented insights that do not fully capture the complexity of digital transformation in schools.

Addressing these gaps, this study adopts an ecosystem-based perspective by examining how graduates of the Teacher Professional Education Program function as catalysts for digital transformation in elementary schools. Unlike previous studies, this research integrates three analytical dimensions simultaneously: (1) digital pedagogical practices grounded in the TPACK framework, (2) technology-based instructional design enacted in authentic classroom contexts, and (3) the role of collaborative school culture in sustaining digital learning initiatives. By linking individual competence with institutional collaboration, this study offers a more comprehensive understanding of how digital learning can be strengthened in primary education settings.

Accordingly, the purpose of this study is to examine the role of PPG graduate teachers in strengthening digital learning in elementary schools. Specifically, this study seeks to address the following research questions: (1) To what extent do PPG graduate teachers contribute to the strengthening of digital learning in elementary schools? (2) Are the competencies acquired during the PPG sufficient to address the challenges of digital learning implementation? (3) How do PPG graduates contribute to the development of learning environments that are adaptive to technological advancements? (4) What factors support or hinder the role of PPG graduate teachers in strengthening digital learning in schools?

Research Methods

This study employed a qualitative descriptive research design to examine the role of Teacher Professional Education Program (PPG) graduates in strengthening digital learning in elementary schools. A qualitative approach was selected because it allows for an in-depth exploration of teachers' experiences, practices, and contextual challenges in real educational settings, particularly in relation to digital pedagogy and school culture (Creswell & Poth, 2023). The descriptive design was used to systematically portray the phenomenon without manipulating variables, which is appropriate for exploratory educational research (Sugiyono, 2022). The study was conducted in public and private elementary schools located in the Greater Jakarta area, Indonesia (DKI Jakarta, Tangerang Selatan, and Depok). These settings represent urban and semi-urban school contexts with varying levels of digital infrastructure. Data collection was carried out over a six-month period, from January to June 2025, enabling prolonged engagement and iterative data verification, which are essential for enhancing qualitative research credibility (Nowell et al., 2021).

The participants consisted of 15 PPG graduate teachers as primary informants, supported by 5 school principals, 10 students, and 5 parents to enrich the data through multiple perspectives. Participant selection was conducted using purposive sampling, which is commonly applied in qualitative research to select individuals with direct experience and relevance to the research focus (Palinkas et al., 2020).

The inclusion criteria for PPG graduate teachers were as follows: 1) completion of the PPG program within the last year, 2) active employment as elementary school teachers, and 3) regular implementation of digital learning practices in classroom instruction.

Data were collected using three complementary techniques to ensure depth and methodological triangulation.

1. **Semi-structured interviews** were conducted with all participant groups to explore teachers' roles, digital competencies, instructional practices, and contextual challenges related to digital learning. This interview format allows flexibility while maintaining alignment with the research questions (Creswell & Poth, 2023).
2. **Classroom observations** were carried out to examine the actual implementation of digital pedagogical practices and technology-based instructional design. Observational data provided direct evidence of teaching behaviors and learning interactions that may not be fully captured through self-reported data (Sugiyono, 2022).
3. **Document analysis** included lesson plans, digital learning materials, and samples of students' work. Document review served as supporting evidence and contributed to data triangulation by linking planned instruction with enacted practices (Miles et al., 2020).

Data analysis followed the interactive model of Miles, Huberman, and Saldaña (2020), consisting of data reduction, data display, and conclusion drawing. All interview and observation data were transcribed verbatim and analyzed using NVivo 15 to support systematic coding and thematic analysis.

To ensure trustworthiness, the study applied several validation strategies, including source and technique triangulation, member checking with selected participants to confirm interpretations, and peer debriefing with qualitative research experts to enhance analytical rigor (Nowell et al., 2021; Creswell & Poth, 2023).

Table 1. Research Focus Indicators Aspect

Aspects	Indicator	Obsevation Focus
Pedagogical	Digital learning planning & implementation	The teacher prepares digital teaching materials (lesson plans, media)
Professional	TPACK mastery	The teacher uses interactive applications appropriate to the material
Social	Digital interaction	The teacher provides feedback through online platforms
Personal	Digital ethics & attitude	The teacher models wise and responsible use of technology
Impact	Student response	Students appear enthusiastic and actively use digital media

Table 1 presents the analytical indicators used to examine the role of PPG graduate teachers in strengthening digital learning in elementary schools. The indicators are organized into pedagogical, professional, social, personal, and impact aspects, reflecting key dimensions of teacher digital competence and its implementation in classroom practice. The pedagogical and professional aspects focus on how teachers plan, implement, and integrate digital learning through instructional design and TPACK mastery. The social and personal aspects highlight teachers' digital interaction, ethical awareness, and attitudes in technology-mediated learning environments. Meanwhile, the impact aspect captures students' engagement as an observable outcome of digital learning practices. Overall, Table 1 functions as a concise analytical framework that links teachers' digital competencies with instructional processes and student responses, providing a basis for evaluating the contribution of PPG graduate teachers to adaptive and effective digital learning in elementary schools.

Results and Discussion

The thematic analysis identified five major themes describing the experiences of PPG graduates in implementing digital learning in primary schools. These themes reflect instructional practices, professional preparation, contextual challenges, learning impacts, and teacher development.

Table 2. Summary of Themes and Supporting Respondent Quotes

Theme	Subtheme	Respondent Quote
Digital learning enhances teaching	Improved lesson planning	*"Digital tools make it easier for me to design structured and engaging lessons."* (R1)
	Increased student engagement	*"Students become more active when I use interactive applications."* (R3)
PPG supports digital competence	Strengthened digital literacy	*"PPG taught me how to use digital platforms effectively in class."* (R2)
	Better pedagogical design	*"I learned to plan digital-based learning more systematically."* (R4)
Challenges in implementation	Limited infrastructure	*"Not all schools have stable internet access."* (R5)
	Lack of training	*"We still need continuous workshops on digital learning."* (R1)
Positive Impacts	Improved learning outcomes	*"Students understand concepts faster with digital resources."* (R3)

Based on the results presented in Table 2, five major themes emerged from the NVivo analysis, each illustrating different dimensions of teachers' experiences in implementing digital learning after completing the Teacher Professional Education Program (PPG). The following explanation summarizes and interprets each theme:

Theme 1: Digital Learning Enhances Teaching (Coverage 32.4%)

This dominant theme indicates that digital learning contributes meaningfully to improved instructional quality in primary classrooms. Teachers described clearer lesson organization, more varied instructional strategies, and higher levels of student engagement when digital tools were integrated into teaching. Digital resources such as instructional videos, animations, interactive applications, and online quizzes enabled teachers to structure lessons more systematically and present learning materials in ways that were easier for students to understand.

Several participants emphasized that digital media helped them translate abstract concepts into concrete representations suitable for young learners. In practice, digital learning was not perceived merely as a technological addition, but as a pedagogical support that encouraged more active student participation and interaction during lessons.

Theme 2: PPG Supports Digital Competence (Coverage 24.1%)

Participants consistently reported that the Teacher Professional Education Program (PPG) played a critical role in strengthening their digital competence. This included improved digital literacy, enhanced lesson planning skills, and greater confidence in integrating technology pedagogically. Teachers highlighted that PPG training emphasized practical applications rather than technical skills alone, enabling them to align digital tools with learning objectives and student needs.

Importantly, participants perceived PPG as providing a structured foundation for technology integration, particularly through lesson design, media selection, and assessment planning. This suggests that professional preparation programs can function as an entry point for developing pedagogically grounded digital practices in primary education.

Theme 3: Challenges in Digital Implementation (Coverage 19.7%)

Despite improved competence, teachers encountered persistent contextual challenges in implementing digital learning. Limited access to digital devices, unstable internet connectivity, and the absence of sustained mentoring after PPG completion were frequently mentioned. These constraints affected the consistency and quality of digital learning across different school contexts.

Teachers noted that while they were motivated and capable of implementing digital learning, school-level infrastructure and systemic support often did not keep pace with their professional readiness. As a result, digital learning practices were sometimes adapted in simplified or hybrid forms rather than fully implemented as planned.

Theme 4: Positive Impacts on Learning Outcomes (Coverage 15.6%)

Teachers perceived that digital learning positively influenced students' motivation, participation, and conceptual understanding. Digital media were described as making lessons more engaging and helping students grasp concepts more quickly through visual and interactive representations. Participants observed that students showed greater enthusiasm, asked more questions, and participated more actively during digitally supported lessons.

Although these perceptions were primarily based on classroom observations rather than standardized measurements, they indicate that digital learning has the potential to enrich learning experiences when aligned with pedagogical goals.

Theme 5: Teacher Emotional and Professional Growth (Coverage 8.2%)

This theme reflects the affective dimension of teachers' professional development. Teachers reported increased confidence, professional satisfaction, and a stronger sense of readiness to integrate technology into their teaching. For several participants, successful digital learning experiences reinforced their professional identity as adaptive and innovative educators.

Although this theme had the smallest coverage, it highlights an important aspect of digital transformation: teachers' emotional readiness and self-efficacy, which influence their willingness to adopt and sustain new pedagogical practices.

The finding that digital learning enhances teaching practices confirms previous studies highlighting the role of interactive digital media in improving instructional clarity and student engagement (Selwyn, 2020; Church et al., 2024). These results indicate that digitalization not only transforms instructional tools but also reshapes pedagogical approaches toward more student-centered and interactive learning environments. In primary education, such shifts are particularly important as digital media support clearer explanation, visualisation, and active participation among young learners.

Similarly, the contribution of the Teacher Professional Education Program (PPG) to teachers' digital competence aligns with the TPACK framework, which emphasizes the integration of technological, pedagogical, and content knowledge as a foundation for effective digital instruction (Mishra & Koehler, 2006). This finding reinforces previous evidence that structured and practice-oriented professional development programs strengthen teachers'

confidence and capacity to integrate technology meaningfully into classroom instruction (Tondeur et al., 2018; OECD, 2021).

Beyond confirming existing research, this study extends prior findings by demonstrating that PPG supports not only teachers' technical digital skills but also systematic pedagogical planning for digital learning. The emphasis on instructional design, digital assessment, and learner engagement suggests that PPG contributes to a more coherent digital pedagogy rather than fragmented technology use. In addition, the emergence of teacher confidence and professional satisfaction highlights the importance of affective readiness—an aspect that has received comparatively limited attention in earlier studies on teacher digital competence.

From a regional perspective, these findings are consistent with recent studies conducted in Southeast Asia. Research in Malaysia shows that teachers who participate in formal professional education programs demonstrate stronger alignment between digital tools and pedagogical objectives than those relying on self-directed learning (Razak et al., 2021; Noor et al., 2022). Similarly, studies in Thailand report that professional teacher preparation enhances teachers' ability to design structured and student-centered digital learning, particularly in primary school contexts where instructional scaffolding is critical (Srisawasdi et al., 2022). These regional insights strengthen the argument that professional teacher education programs play a key role in supporting digital transformation in developing education systems.

However, the infrastructural constraints and lack of sustained post-program mentoring identified in this study reveal a divergence from idealized models of digital learning that assume adequate technological resources and continuous institutional support. These findings support global reports by OECD (2021) and UNESCO (2022), which emphasize that successful digital transformation depends not only on individual teacher competence but also on systemic readiness, including infrastructure, leadership, and ongoing professional development. This study therefore contextualizes digital pedagogy within the practical realities of Indonesian primary schools.

This study has several limitations. First, the sample was limited to a specific group of PPG graduates, which may restrict the generalizability of the findings. Second, the data relied primarily on self-reported perceptions and were collected within a relatively short period following program completion. Future research is encouraged to involve larger and more diverse samples across different regions of Indonesia. Comparative studies between PPG and non-PPG teachers, as well as longitudinal research examining the sustainability of digital pedagogical practices, would provide deeper insights into the long-term impact of professional teacher education programs.

Conclusion

This study provides empirical evidence on the role of the Teacher Professional Education Program (PPG) in supporting the implementation of digital learning in Indonesian primary schools. The findings indicate that PPG graduates are able to enhance instructional quality through the purposeful integration of digital tools, which contributes to clearer lesson organization, increased student engagement, and more interactive learning environments.

From a theoretical perspective, this study extends the application of the Technological Pedagogical Content Knowledge (TPACK) framework and digital pedagogy theory within the context of primary education. It demonstrates that professional teacher preparation programs such as PPG not only develop technical digital skills but also strengthen pedagogical decision-making and teachers' confidence in integrating technology into classroom practice. This

contribution addresses a gap in previous studies that have largely focused on secondary or higher education contexts.

Practically, the findings suggest that sustained institutional support is essential to maximize the impact of digital learning. Schools and policymakers should provide continuous professional development, mentoring, and adequate technological infrastructure to ensure the consistent implementation of digital pedagogy. Without systemic support, teachers' digital competencies may not be fully translated into effective classroom practices.

Despite its contributions, this study is limited to a specific regional context. Future research is recommended to examine the long-term impact of PPG graduates' digital teaching practices on students' learning outcomes, to compare different teacher education programs or regions, and to explore the effectiveness of specific digital tools for young learners. Such studies would further strengthen the development of context-sensitive digital pedagogy models for primary education.

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