



Bridging Professional Learning and Classroom Practice: Digital Capacity Development among Rural Early Childhood Educators

Nandang Rukanda^{1,*}, Sri Nurhayati¹, Udeme Samuel Jacob²

¹Master's Program in Community Education, IKIP Siliwangi, Indonesia

³Department of Special Education, University of Ibadan, Nigeria

ARTICLE INFO

Article History:

Received: 19 June 2026

Accepted: 03 July 2026

Published: 09 July 2026

Keywords:

Digital professional learning opportunities;
Educator inequality;
Digital teaching practices;
Early childhood education;
Professional learning ecosystems

*Corresponding Author:

nandangrukanda@ikipsiliwangi.ac.id

ABSTRACT

Digital transformation in education has expanded opportunities for educator professional learning; however, access to and implementation of digital professional learning opportunities remain uneven across educational contexts. This study investigates patterns of inequality in educators' access to digital professional learning opportunities and examines how participation is translated into classroom practice in rural early childhood education settings. The study further explores conditions that support or constrain sustained implementation of digital teaching practices. This research employed a qualitative exploratory design involving 13 early childhood educators from multiple institutions in Desa Cijenuk, Kabupaten Bandung Barat. Data were generated through semi-structured interviews, observation, and document study concerning educators' participation in digital professional learning and implementation experiences. Data were analyzed through iterative thematic interpretation to identify recurring patterns across access, participation, implementation, and perceived support needs. The findings reveal three interrelated patterns. First, access to digital professional learning opportunities was distributed unevenly, with six educators having participated in digital literacy or numeracy professional learning and seven reporting no prior participation. Second, available professional learning frequently emphasized exposure to digital tools rather than sustained pedagogical integration, reducing opportunities for meaningful instructional transformation. Third, participation in professional learning did not automatically translate into continuous classroom implementation. Educators selectively adapted practices based on infrastructural conditions, institutional support, digital confidence, and local teaching realities. At the same time, classroom observations indicated increased child engagement during digitally supported activities but provided no evidence of improved learning outcomes. These findings suggest that inequalities emerge not only in access to professional learning but also in educators' capacity to enact and sustain digital teaching practices.

To cite this article:

Rukanda et al. (2026). Bridging professional learning and classroom practice: Digital capacity development among rural early childhood educators. *Pedagogy Review*, 5(3), 282-300. doi: <https://doi.org/10.61436/pedrev/v5i3.pp282-300>

This is an open access article under the CC BY SA licence (<https://creativecommons.org/licenses/by-sa/4.0>).

■ INTRODUCTION

Digital transformation has increasingly reshaped expectations surrounding teacher professionalism and instructional practice across educational sectors, including early childhood education (ECE). Rather than functioning solely as an external technological shift, digitalization has altered how educators learn, adapt, and continuously improve their pedagogical practices in response to changing educational environments (Nurhayati & Judijanto, 2026). In ECE contexts, digital competence is no longer understood merely as

the ability to operate technological tools but as a broader professional capability involving pedagogical decision-making, digital literacy, data-informed reflection, and context-sensitive instructional adaptation. As educational technologies continue to evolve, teachers are expected not only to access professional development opportunities but also to translate professional learning into meaningful and sustainable classroom practices (Nurhayati, Sholihah, et al., 2025). Recent scholarship increasingly positions professional learning as a central mechanism through which digital

transformation becomes pedagogically meaningful rather than technologically symbolic (Madsen et al., 2023; Shuey et al., 2019; Yao & Liu, 2024).

In this study, digital professional learning opportunities are understood as structured or semi-structured training, mentoring, or professional learning activities that support educators' use of digital tools, digital media, online resources, and technology-supported strategies for PAUD literacy and numeracy instruction. This definition includes learning activities related to Canva, e-books, websites, digital visual media, big books, and simple digital resources for early literacy and numeracy activities. Therefore, the study does not treat digital professional learning as merely basic graphic design training, but as a broader process through which educators learn to adapt digital resources to developmentally appropriate PAUD literacy and numeracy practices.

Contemporary literature suggests that professional development (PD) in ECE is undergoing a conceptual transition from episodic training events toward ongoing, collaborative, and practice-oriented professional learning. Traditional workshop-based approaches are increasingly criticized for producing limited long-term instructional change due to weak contextual alignment and insufficient follow-up support (Musa et al., 2024). In contrast, effective professional learning is described as continuous, reflective, collaborative, and embedded in teachers' daily practice (Vekić-Kljaić & Mlinarević, 2022; Zabeli & Gjelij, 2020). This shift is reinforced by growing attention to professional learning communities, collaborative inquiry, and practitioner agency, where teachers become active participants in shaping their own learning trajectories rather than passive recipients of training content (Farisia & Syafi'i, 2024; Kim & Yu, 2023). Digital platforms, online learning environments, pedagogical documentation, and emerging AI-supported ecosystems further strengthen the view that professional growth increasingly occurs as an iterative process of experimentation, reflection, and refinement (Nurhayati, Taufikin, et al., 2025; Wang, 2024).

Although the move toward continuous professional learning has gained broad support, important questions remain regarding how learning opportunities are accessed and translated into actual instructional practice. Existing studies frequently emphasize participation rates, teacher satisfaction, technology acceptance, or gains in digital competencies, while paying less attention to the

mechanisms through which professional learning becomes embedded within classroom routines (Marsegi et al., 2023; Winarti et al., 2022). This issue is particularly evident in ECE, where instructional practices are strongly influenced by contextual realities, resource availability, teacher beliefs, and institutional support structures (Susanto et al., 2025). Studies consistently indicate that sustainable change requires opportunities for experimentation, feedback, collaborative reflection, and alignment with authentic teaching conditions rather than isolated exposure to new ideas (Schachner et al., 2024). In PAUD literacy and numeracy instruction, such translation requires educators to connect digital media with developmentally appropriate indicators such as vocabulary recognition, story listening, symbol recognition, number recognition, counting, quantity matching, and object classification.

The challenge becomes more pronounced in rural and underserved educational settings. Access to professional learning opportunities in such contexts is frequently constrained by geographic isolation, infrastructure limitations, uneven connectivity, limited institutional support, and competing professional demands (Kaziya, 2025; Ström et al., 2024; Susanti & Nurhayati, 2024). This issue is particularly relevant in Kabupaten Bandung Barat, where rural education is situated in a geographically dispersed district with a population of approximately 1.907 million, a poverty rate of 9.87%, and uneven access to educational and digital infrastructure across subdistricts (BPS Kabupaten Bandung Barat, 2024). At the early childhood level, official education statistics record 235 kindergartens, 914 kindergarten teachers, and 9,636 kindergarten pupils in Kabupaten Bandung Barat, indicating a substantial ECE service base that still depends heavily on local institutional capacity and educator support systems (BPS Kabupaten Bandung Barat, 2024). In Desa Cijenuk, Kecamatan Cipongkor, these broader district conditions are reflected in the limited availability of digital devices, unstable internet access, and uneven participation in professional learning reported by participating PAUD educators. Even when professional learning opportunities are available in online or blended formats, participation alone does not necessarily lead to sustained classroom implementation. Translation into practice depends on contextual relevance, opportunities for adaptation, access to support systems, and time for reflection and experimentation (Esch et al., 2025; Kanwal et al., 2023). Consequently, the central challenge in rural

digital transformation is increasingly understood not as technology adoption itself but as the capacity to connect professional learning with everyday teaching practice.

Several solutions have been proposed to address this challenge. One major direction emphasizes designing professional development as an ecosystem rather than a single intervention. Research consistently argues that sustainable digital capacity development requires combinations of online and offline modalities, embedded mentoring, collaborative inquiry, and opportunities for iterative application and feedback (Musa & Nurhayati, 2024; Suwartono et al., 2025). Community-based approaches, professional learning communities (PLCs), and communities of practice (CoPs) are increasingly promoted for enabling educators to co-construct knowledge, exchange practical solutions, and adapt innovations to local realities (Musa & Nurhayati, 2026). Such approaches reposition professional learning from a delivery mechanism into an ongoing infrastructure for professional growth.

Another strand of literature highlights situated and practice-based perspectives as mechanisms for strengthening implementation. Situated learning perspectives argue that teacher learning occurs through participation in authentic work environments and collaborative problem-solving rather than detached instructional sessions (Yang et al., 2022). Studies on instructional coaching demonstrate that observation, modeling, feedback loops, and reflection support teachers in converting abstract ideas into daily instructional routines

(Damiani et al., 2024; Schachner et al., 2024). At the same time, emerging frameworks emphasize teacher agency, emotional readiness, and digital self-efficacy as important enablers of sustained implementation (Dhamotharan & Loh, 2019; Ye et al., 2024). These findings suggest that digital capacity development is shaped not only by the availability of learning opportunities but also by how educators negotiate those opportunities within their own professional environments.

Recent scholarship further expands this discussion by emphasizing digital literacy, pedagogical documentation, and data-informed practice as ongoing dimensions of professional work rather than isolated competencies. Teachers are increasingly expected to collect, interpret, and act upon evidence generated through everyday teaching activities while continuously refining instruction through documentation and reflection (Nurhayati & Musa, 2025; O'Sullivan & Ring, 2024). Parallel discussions around AI, educational technologies, and digital content creation similarly emphasize that meaningful innovation depends on sustained learning infrastructures capable of supporting adaptation, governance, and pedagogical alignment (Farisia & Syafi'i, 2024; Nurhayati, Taufikin, et al., 2025). Nevertheless, despite growing theoretical support for continuous and situated professional learning, empirical evidence on how professional learning opportunities translate into classroom practice remains limited, particularly in rural ECE contexts. Table 1 summarizes the present study's position relative to selected prior studies and clarifies

Table 1. Positioning of the present study within prior literature

Prior Study	Main Focus	Remaining Gap	Contribution of the Present Study
Winarti et al. (2022)	Digital competence of PAUD educators	Less attention is paid to how professional learning translates into classroom routines.	Examines the pathway from access to professional learning, tool exposure, classroom adaptation, and implementation constraints.
Nuryanti et al. (2024)	Efforts to improve early childhood educators' digital literacy	Limited discussion is provided on rural implementation gaps and classroom-level translation.	Focuses on rural PAUD educators and the conditions that shape the implementation of digital literacy and numeracy.
Farisia and Syafi'i (2024)	Professional development for ECE teachers' digital literacy	Digital literacy professional development is discussed broadly, with limited attention to classroom adaptations in literacy and numeracy.	Specifies how digital professional learning is adapted for PAUD literacy and numeracy activities.
Susanti and Nurhayati (2024)	Rural digital literacy and self-directed learning	The study does not specifically examine PAUD educators' professional learning and classroom practice.	Adds evidence on rural PAUD professional learning ecosystems and classroom translation.

the specific research gap it addresses.

This study addresses this gap by examining digital capacity development among rural early childhood educators through the lens of professional learning and classroom translation. Rather than evaluating training effectiveness or measuring technological outcomes, this study investigates how educators access professional learning opportunities, interpret learning experiences, adapt acquired knowledge, and attempt to integrate these experiences into teaching practice. Specifically, this study is guided by the following research questions: (1) How do rural early childhood educators access digital professional learning opportunities related to literacy and numeracy teaching? (2) How do educators interpret and translate these professional learning experiences into classroom practice? (3) What contextual conditions support or constrain the sustained implementation of digital teaching practices in rural PAUD settings? Drawing on empirical evidence from rural early childhood education settings, the study advances the argument that digital capacity development should be understood as an ongoing process of professional learning rather than as a direct outcome of training participation. The novelty of the study lies in its focus on the translation pathway from access to digital professional learning to exposure to digital tools to pedagogical adaptation to, finally, classroom implementation in rural PAUD literacy and numeracy instruction. The study contributes by extending current discussions on digital professional development toward a community-based, practice-oriented understanding of teacher capacity development and by providing empirical insights into the mechanisms that connect learning opportunities to classroom implementation in underrepresented rural contexts.

■ METHOD

Research Design

This study employed a qualitative exploratory design to examine how rural early childhood educators develop digital capacity through professional learning opportunities and how that learning translates into classroom practice. A qualitative approach was selected because the study focused on educators' reported experiences, interpretations, adaptations, and perceived constraints rather than measuring predetermined outcomes (Nurhayati, Judijanto, et al., 2025). The exploratory design was considered appropriate because the study sought to understand how educators made sense of digital professional

learning within their own institutional and classroom realities, rather than testing a predetermined intervention model.

Research Site and Context

The study was conducted in rural early childhood education institutions located in Desa Cijenuk, Kecamatan Cipongkor, Kabupaten Bandung Barat, West Java, Indonesia. The context was selected because rural PAUD institutions often operate under limited access to infrastructure, professional development opportunities, and digital learning resources. These conditions made the setting relevant for examining how digital professional learning is accessed and translated into practice in under-resourced educational communities. The institutional settings included different forms of early childhood education provision, namely SPS, TK, KB, RA, and integrated PAUD institutions. This variation allowed the study to capture professional learning experiences across diverse early childhood education arrangements within the same rural area. By focusing on institutions within the same rural village area, the study examined variation in educators' digital professional learning experiences while maintaining a shared local context of infrastructure, institutional support, and community-based PAUD provision. The inclusion of different institutional types also allowed the analysis to consider whether formal and non-formal PAUD settings differed in access to infrastructure, professional learning information, and classroom implementation support.

Participants

The participants were 13 early childhood educators working in rural PAUD institutions. They represented different institutional types and educational backgrounds. The participants included educators from SPS, TK, KB, RA, and PAUD settings. Their educational backgrounds ranged from senior high school equivalent qualifications to undergraduate degrees. Participants were selected using purposive sampling based on the following inclusion criteria: (1) being an active educator in a PAUD institution in Desa Cijenuk or the surrounding rural PAUD service area, (2) having direct experience in planning or implementing early childhood learning activities, (3) having direct responsibility for preparing or implementing PAUD literacy and/or numeracy learning activities, and (4) being actively involved in classroom teaching during the data collection period. Willingness to participate and informed consent were treated as ethical requirements rather than purposive sampling criteria.

Educators who were not actively teaching during the data collection period or who did not complete the interview instrument were excluded from the final analysis. To protect

Table 2. Demographic profile of participants

Participant Characteristic	Category	Number of Participants
Total participants	Rural PAUD educators	13
Institution type	SPS/PAUD/SPS	4
	TK	2
	KB	4
	RA	2
	PAUD	1
Educational background	Senior high school equivalent	5
	Bachelor's degree	8
Participation in digital literacy or numeracy training	Had participated	6
	Had not participated	7

confidentiality in the article, participant identities were anonymized using codes T01–T13. These codes were also used to report interview excerpts and to support qualitative evidence, strengthening source traceability without revealing participant identity.

Data Collection

The study used three main data sources. The primary data consisted of responses to a semi-structured interview. The second source consisted of participant and institutional non-participatory observation data. The third source consisted of supporting documentation related to professional learning or classroom practice, such as photos, daily learning implementation plan (*Rencana Pelaksanaan Pembelajaran Harian*, RPPH), and other documents submitted by participants. Data were collected through a semi-structured interview comprising 15 main questions. The instrument was designed to explore five domains: professional learning experience, content of professional learning, digital tools or media introduced, classroom implementation, and evaluation or constraints. The use of semi-structured interviews allowed participants to describe their experiences in their own words, including the forms of training they had accessed, the digital tools introduced, the ways they

attempted to use these tools in classroom activities, and the barriers they encountered during implementation. Each teacher was observed twice, with each observation lasting approximately two hours. In total, the study involved approximately 52 hours of non-participatory classroom observation across the 13 teachers. Observation focused on media use, literacy and numeracy activities, teacher facilitation, child engagement behaviors, classroom management, device availability, and constraints affecting classroom implementation.

RPPH documents were reviewed to identify whether digital media were planned for literacy or numeracy activities. The document review focused on learning objectives, media listed in the lesson plan, planned literacy or numeracy activities, and the pedagogical function of digital or visual media. This documentation was used to compare educators' interview accounts with planned instructional practices and observed classroom implementation. Child engagement was observed through behavioral indicators rather than achievement measures. These indicators included visual attention to learning media, verbal responses, participation in teacher-guided activities, asking or answering questions, peer interaction, and the need for teacher redirection. These indicators were used only to support cautious claims about teacher-perceived and observation-supported engagement, not to claim measured improvement in children's literacy or numeracy outcomes.

Data Analysis

The data were analyzed using qualitative thematic analysis informed by the interactive model of Miles and Huberman (1994), which includes data condensation, data display, and conclusion drawing/verification. The analysis began with repeated reading of all participant responses to gain familiarity with the dataset. During the data condensation stage, the researchers identified meaningful units from participants' responses and assigned initial codes to segments related to access, training content, digital tools, classroom use, implementation barriers, and support needs. Examples of initial codes included "no training access," "Canva exposure," "occasional use," "lack of laptop," "positive child response," "limited supervision," and "need for ongoing training." During the data display stage, related codes were organized into matrices comparing participants by institutional type, training participation, forms of digital exposure, classroom implementation, and perceived

Table 3. Summary coding tree from initial codes to final themes

Initial Codes	Categories	Final Themes
No training access; limited training invitation; uneven device access	Access inequality	Unequal access to digital professional learning
Canva exposure; e-book; website; visual media; big book	Digital exposure	Exposure to digital tools without sufficient pedagogical integration
Occasional use; when needed; no implementation; classroom trial	Classroom translation	Selective translation into classroom practice
Lack of laptop; unstable internet; limited confidence; limited preparation time; classroom management difficulty	Implementation constraints	Continuing implementation gap
Village-level training, mentoring, peer support; need for follow-up	Support needs	Community-based professional learning ecosystem

constraints. After open coding, related codes were grouped into broader categories. These categories were then compared across participants to identify recurring patterns and differences. During the conclusion-drawing and verification stage, the researchers iteratively reviewed the categories to develop final themes and checked whether each theme was supported by sufficient evidence across participants. The final themes were developed inductively from the data but guided by the study's focus on professional learning and classroom practice. This process allowed the analysis to move beyond a descriptive summary of responses toward an interpretation of how professional learning was accessed, negotiated, and translated into classroom practice in rural PAUD settings. The analysis was conducted manually using systematic coding matrices. Because no CAQDAS software was used, the manuscript does not claim software-assisted analysis. To strengthen transparency, a summary coding tree in Table 2 was included in the main text to illustrate the progression from initial codes to categories and final themes. Interview quotations reported in this article were translated from Indonesian into English by the researchers. To preserve contextual meaning, all translations were cross-checked against the original transcripts during coding and member checking.

Data Trustworthiness

Several strategies were used to strengthen the trustworthiness of the qualitative findings. First, data source triangulation was conducted by comparing participants' interview responses with observation data, RPPH, and other supporting documentation related to professional learning or classroom practice. Second, member checking was carried out by

returning summarized interpretations to selected participants to confirm whether the researchers' interpretations reflected their intended meanings. For example, one participant clarified that the difficulty was not only a lack of digital skills but also a lack of repeated guided practice after training. Based on this clarification, the initial code "limited digital competence" was refined into the broader category "need for guided practice and follow-up mentoring." Third, peer debriefing was conducted among the research team to discuss coding decisions, refine emerging categories, and reduce individual interpretive bias. Fourth, an audit trail was maintained by documenting coding notes, category development, member-checking feedback, observation summaries, RPPH review notes, and analytical decisions throughout the interpretation process. These procedures were used to enhance credibility and dependability and to confirm the qualitative analysis.

Ethical Considerations

Since the research involved human subjects, appropriate ethical protocols were adhered to during the data collection process. Participants were informed about the purpose of the study, the voluntary nature of their participation, the type of information requested, and their right to decline or withdraw without consequence. Verbal informed consent was obtained before participants completed the interview. To ensure anonymity, all participant and institutional names were removed from the manuscript and replaced with participant codes T01–T13. The data were used only for research purposes, and any supporting documents or photographs were reviewed to ensure that no personally identifying information was disclosed.

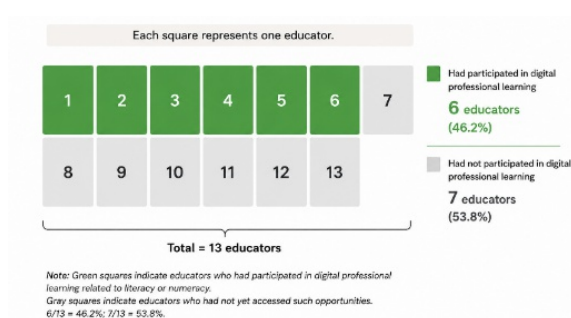


Figure 1. Distribution of access to digital professional learning opportunities among rural paud educators (n=13)

■ RESULT AND DISCUSSION

Unequal Access to Digital Professional Learning

The data indicate that digital capacity development among rural early childhood educators begins with a patterned inequality in access to professional learning rather than merely a difference in individual motivation. Although the distribution shows that six of the 13 educators had participated in digital professional learning related to literacy or numeracy, while seven had not yet accessed such opportunities, the more important issue lies in the unequal institutional pathways through which educators became connected, or remained disconnected, from structured learning opportunities. Access appeared to depend on local institutional networks, the availability of training invitations, digital infrastructure, and the extent to which educators were supported by their PAUD institutions in joining professional learning activities. Before teachers can translate digital learning into classroom practice, they must first be positioned within an accessible professional learning ecosystem. To avoid restating raw numbers in textual form, Figure 1 visualizes the proportional distribution of access to digital professional learning among participating educators using a waffle chart in which each unit represents one educator. Classroom observations supported these interview findings. Educators who had previously participated in digital professional learning were generally observed using a wider range of visual learning media, including digital images, projected illustrations, or teacher-prepared printed materials derived from digital resources. In contrast, educators without prior participation relied predominantly on conventional printed materials and oral instruction. Observation notes also indicated that differences in classroom implementation were associated with access to learning

opportunities rather than teacher motivation alone, thereby corroborating the interview evidence through data source triangulation.

Figure 1 shows that access to digital professional learning was not yet a shared professional condition among the participating rural PAUD educators. The pattern supports studies arguing that access to digital professional learning opportunities is shaped by infrastructure, school context, policy environment, and institutional support (Amiri et al., 2025; Nuryanti et al., 2024; Pachori, 2026). It also reflects the distinction between physical access and the “usage divide,” in which educators may lack the skills, support, and institutional conditions required to benefit from digital resources even when technologies are nominally available (Reynolds et al., 2022). Theoretically, this finding reframes digital capacity as a socially situated achievement rather than an individual possession. Educators do not develop digital pedagogical capacity in isolation; they enter, or fail to enter, professional learning networks shaped by institutional opportunities. Thus, the inequality observed in this study should be read not simply as a numerical gap between trained and untrained educators, but as evidence of uneven access to the professional, institutional, and infrastructural conditions that enable digital capacity development. The implication is that policy interventions should not begin with assumptions about teacher deficits. Instead, they should ask why access to professional learning remains uneven and how rural educators can be brought into sustained, locally relevant digital learning systems.

Exposure to Digital Tools Without Sufficient Pedagogical Integration

Among educators who had accessed professional learning, the data show exposure to various digital tools and learning resources, including Canva, laptops, websites, e-books, big books, digital literacy content, and early literacy or numeracy activities. However, only three educators reported direct practice with digital media during training. This suggests that the professional learning available to participants often operated at the level of exposure rather than deep pedagogical integration. To reduce repetition and clarify the relationship between tools and pedagogical adaptation, Table 3 summarizes these findings in a compact, network-style format that links types of digital exposure to their classroom adaptations and constraints. Selected interview excerpts are retained with participant codes to preserve qualitative traceability. A review of RPPH documents further indicated that digital

Table 4. Network summary of digital tool exposure and pedagogical integration

Digital Professional Learning Exposure	Representative Evidence	Participant	Pedagogical Adaptation	Observed Constraint
Canva, websites, e-books, and digital learning media	“During the training, I was introduced to simple digital tools such as Canva, websites, e-books, and learning media that could be used to prepare materials for young children.” (T03)		Visual learning materials for literacy activities	Mostly introduced during training without sustained classroom mentoring
Introduction to coding and digital learning concepts	“I once joined a training session where coding for young children was introduced. It was still at the introductory level, but it helped me realize that digital learning can also be connected to early childhood activities.” (T07)		Increased awareness of emerging digital learning approaches	Exposure remained conceptual rather than classroom-based
Digital media for literacy and numeracy	“The training helped me understand that digital media can be used to support literacy and numeracy, for example by preparing visual materials, number games, or learning plans that are more attractive for children.” (T01)		Preparation of literacy materials and simple numeracy activities	Adaptation depended on individual teacher confidence
Limited hands-on practice	“In the training, I did not get much opportunity to practice directly with digital applications. I mostly received explanations, so I still needed more guidance to use the tools confidently in class.” (T11)		Limited transfer from training to classroom practice	Lack of guided practice and mentoring
Hands-on practice using laptops and Canva	“I had the opportunity to practice using a laptop and Canva to prepare learning materials. It was helpful because I could see how digital media might make the lesson more visual and interesting for children.” (T05)		Development of visually supported learning resources	Continued implementation depended on facility availability
Visual classroom activities	“After the training, I tried to use digital media by showing pictures, animals, flowers, and short educational stories. The children seemed more interested because the activities were more visual and varied.” (T08)		Visual storytelling and classroom engagement	Used selectively rather than routinely
Canva-based numeracy games	“I used Canva to create a simple number game. The activity helped children recognize numbers more playfully, although I still need more practice to develop better digital materials.” (T04)		Play-based numeracy learning	Need for continuing pedagogical support
Digital lesson planning	“I started using digital media to prepare learning plans and organize classroom activities. It made the preparation more interesting, but I still need better skills and facilities to use it regularly.” (T06)		Integration into lesson preparation (RPPH)	Regular implementation constrained by limited competence and facilities

Infrastructure limitation	“One of the main challenges is the lack of digital facilities. We do not always have enough laptops or stable internet access, so it is difficult to apply what we learned from the training.” (T10)	—	Device availability and internet connectivity
Limited digital competence	“The problem is not only the availability of tools. Some teachers, including myself, still have limited knowledge about digital technology, so the implementation has not been optimal.” (T12)	—	Low confidence and limited digital capability
Need for sustained professional learning.	“We need more continuous training, especially training that allows us to practice directly. It would be helpful if teachers could learn how to make digital media, animations, or simple web-based materials.” (T09)	Expectation of continuous pedagogical improvement	One-off workshops considered insufficient
Need for local access.	“It would be better if this kind of training could be held regularly and closer to the village level, so more PAUD teachers could participate without facing access difficulties.” (T13)	Community-based professional learning	Access barriers related to distance and opportunity

Note. Interview excerpts were translated by the authors from Indonesian into English and lightly edited for readability while preserving the original contextual meaning. During the analysis, translations were repeatedly checked against the original Indonesian transcripts to ensure semantic equivalence. Participant identities are anonymized using codes T01–T13. A review of selected RPPH documents indicated that digital media were primarily intended to support storytelling, picture recognition, vocabulary development, and simple numeracy activities, which was consistent with the interview findings

resources were generally planned to support storytelling, picture recognition, early literacy, and simple numeracy activities rather than as stand-alone instructional objectives. Observation records likewise showed that teachers tended to adapt only selected digital resources deemed feasible within existing classroom conditions.

As presented in Table 4, professional learning experiences were concentrated more strongly on exposure to digital resources than on structured pedagogical integration. This finding speaks directly to a central critique in the literature: digital professional learning that remains tool-centric or episodic rarely produces sustained practice change. Prior studies argue that effective digital professional learning must emphasize digital pedagogy, instructional design, content integration, and classroom application rather than merely introducing tools (Crouch & Slade, 2022; Musa et al., 2025). The present findings support that critique. Teachers were introduced to digital resources, but the data do not show consistent evidence of structured pedagogical redesign, mentoring, or systematic classroom experimentation. The

absence of sustained practice opportunities is especially important in PAUD because digital tools cannot be transferred directly into classroom use without considering play-based learning, concrete materials, children’s attention span, and developmental appropriateness.

The educational significance is that professional learning should not be judged by whether teachers know the names of applications. The more important question is whether they can transform those tools into age-appropriate learning experiences. For PAUD educators, this is especially crucial because digital activities must remain developmentally suitable, playful, concrete, and responsive to children’s learning characteristics. The data suggest that some teachers began this translation, but the pathway remained fragile and uneven. This indicates that digital professional learning for rural PAUD educators should move from “application introduction” toward guided instructional design, classroom modeling, collaborative reflection, and follow-up mentoring.

Table 5. Qualitative patterns of translating professional learning into classroom practice

Pattern of Classroom Translation	Representative Participant Excerpt	Observation/Document Support	Pedagogical Interpretation
Limited or no classroom implementation	"I have not used digital media in class because I do not yet feel ready and I am still confused about how to use the application." (T11)	Classroom observation showed conventional learning materials without digital media use during the observed session.	Professional learning did not automatically translate into classroom implementation because some educators still lacked confidence and practical guidance.
Occasional implementation	"We have only tried to apply it twice in one month because we still need to adjust the time and the available devices." (T05)	Observation indicated that digital media were used only during selected activities rather than throughout the lesson.	Digital implementation remained experimental rather than routine.
Selective use when needed	"I use the media only when it is needed in the lesson." (T08)	RPPH listed digital media only for specific literacy or numeracy sessions, rather than as regular lesson components.	Teachers selectively adapted digital practices according to classroom needs and feasibility.
Visual and playful classroom adaptation	"I used digital media to show pictures of animals, flowers, and educational stories so that the children could learn through more varied activities." (T03)	Observation confirmed children's visual attention and participation during picture-based storytelling activities.	Teachers translated digital exposure into developmentally appropriate visual learning experiences.
Digital numeracy adaptation	"I used Canva to create a simple number game for children." (T04)	RPPH included simple number-recognition activities supported by teacher-prepared digital materials.	Digital tools were adapted into playful numeracy instruction.
Infrastructure-related constraint	"The lack of digital media, such as laptops, is still a challenge." (T10)	Observation confirmed limited availability of devices across several classrooms.	Infrastructure-constrained sustained implementation.
Connectivity and facility constraint	"Facilities such as laptops and internet access are still limited." (T13)	Internet access was unavailable during several observed learning sessions.	Digital learning depended on institutional infrastructure.
Digital skill and confidence constraint	"Teachers' knowledge of digitalization is still limited, so the implementation has not been optimal." (T12)	Observation suggested hesitation in operating digital media independently during classroom preparation.	The implementation gap reflected both limited competence and limited confidence.

Note. Interview excerpts were translated from Indonesian into English and lightly edited for readability while preserving their original meaning. Participant identifiers (T01–T13) are reported to strengthen qualitative traceability. Observation support refers to non-participatory classroom observations and RPPH review conducted as part of data triangulation.

Selective Translation from Professional Learning into Classroom Practice

The strongest empirical pattern is the gap between professional learning and classroom implementation. Some educators reported using digital tools or ideas for visual learning, Canva-based activities, big book production, simple numeracy games, digital learning plans, or general use of smartphones and computers. However, implementation was frequently

described as occasional, "when needed," not routine, or not yet implemented. Because the study used a qualitative exploratory design, closed- or categorical-ended indicators such as "0," "No," or "Not yet" were not treated as findings in isolation. Instead, they were interpreted through participants' narrative explanations of why classroom use did or did not occur. These interview findings were further triangulated through non-participant

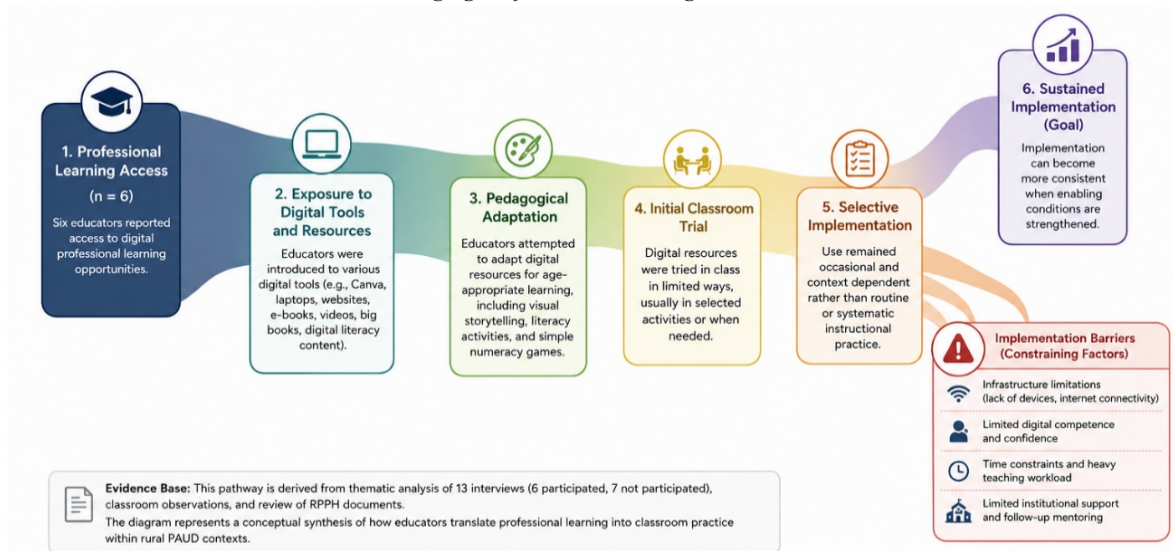


Figure 2. Translational pathway from professional learning to classroom practice among rural PAUD educators

classroom observations and a review of RPPH documents, allowing the consistency among reported practices, observed classroom implementation, and planned instructional activities to be examined. Table 5, therefore, presents the patterns of classroom translation through qualitative evidence and interpretive meaning.

Table 5 shows that implementation was frequently selective, occasional, and context-dependent. The interview findings were consistently supported by classroom observations and review of RPPH documents, which demonstrated that digital resources were generally incorporated only during selected literacy or numeracy activities rather than as routine instructional practice. Observation records further indicated that implementation varied according to teachers' confidence, classroom readiness, and the availability of digital facilities. These triangulated findings strengthen the interpretation that the observed implementation gap reflects both contextual constraints and educators' selective pedagogical adaptation rather than simple resistance to technology. This finding supports the argument that participation in digital professional learning does not guarantee sustained classroom implementation. Studies emphasize that practice change depends on infrastructure, curriculum alignment, leadership, sustained funding, and ongoing support (Avedzi, 2025; Costa et al., 2023). The current study adds a rural PAUD-specific insight: even when teachers value digital teaching and attempt classroom adaptation, implementation often remains dependent on local feasibility. Theoretically, this challenges linear models of teacher development.

Professional learning should not be viewed as a simple input that produces classroom change as output. A more appropriate interpretation is a translational one: teachers reinterpret professional learning within the constraints of their classroom ecology. In rural PAUD settings, translation involves deciding whether tools are available, whether activities fit children's needs, whether teachers feel confident, whether they perceive themselves as sufficiently prepared to manage digital learning, and whether the institution can support continued use. To synthesize this non-linear process, Figure 2 presents a Sankey diagram illustrating the narrowing progression from access to professional learning to tool exposure, classroom trials, occasional use, and sustained practice.

Teacher-Perceived Child Engagement and the Continuing Implementation Gap

Educators who used digital strategies often perceived positive child responses, including interest, enjoyment, enthusiasm, and greater attention. However, this should be interpreted cautiously. The data do not measure children's literacy or numeracy achievement; they only capture teachers' perceptions of children's responses during digital or visually enriched activities. These perceptions were further supported by non-participant classroom observations, which documented behavioral indicators such as sustained visual attention, active participation, verbal responses, and willingness to engage during digitally supported learning activities. Nevertheless, these observations were not intended to assess children's academic achievement or developmental outcomes. This is an important

Table 6. Implementation supports and constraints supported by qualitative evidence

Category	Specific Condition	Representative Participant Excerpt	Observation/Document Support	Analytical Interpretation
Teacher-perceived enabling condition	Children showed interest and enjoyment during digitally supported or visually enriched activities.	“The children were happy when we used the learning strategy.” (T08)	Observation showed that children maintained visual attention and participated willingly during digitally supported storytelling.	Teachers perceived digital or visual media as increasing children's engagement. Findings reflect teacher-perceived and observational engagement rather than learning outcomes.
Teacher-perceived enabling condition	Children appeared more enthusiastic when activities became more varied.	“The children were very enthusiastic because the activities were more varied and not monotonous.” (T05)	Observation recorded more active verbal responses and participation during visual learning activities.	More varied learning experiences appeared to encourage classroom participation.
Pedagogical enabling condition	Digital media helped teachers prepare more attractive learning materials.	“I used digital media to show different animals, flowers, and educational stories, such as the story of the mouse deer and the crocodile.” (T03)	RPPH documented the planned use of visual digital resources for storytelling activities.	Teachers translated digital exposure into developmentally appropriate classroom practice.
Pedagogical enabling condition	Digital tools were adapted for simple numeracy activities.	“I used Canva to create a number game for children.” (T04)	RPPH included simple number-recognition activities using teacher-developed visual media.	Digital tools supported playful numeracy learning.
Institutional enabling condition	Institutional encouragement supported implementation.	“The institution supported us in applying the training.” (T06)	Observation indicated administrative encouragement for classroom experimentation.	Institutional support strengthened implementation readiness.
Structural constraint	Limited digital devices.	“The lack of digital media, such as laptops, is still a challenge.” (T10)	Observation confirmed limited device availability.	Infrastructure remained a major implementation barrier.
Structural constraint	Limited internet connectivity.	“Facilities such as laptops and internet access are still limited.” (T13)	Internet connectivity varied across observed classrooms.	Digital implementation depended on infrastructure availability.
Professional constraint	Limited digital competence and confidence.	“Teachers’ knowledge of digitalization is	Observation indicated hesitation when operating digital media	Limited competence reduced

		still limited, so the implementation has not been optimal.” (T12)	independently.	confidence to sustain implementation.
Classroom management constraint	Managing children during digital activities.	“One challenge is disciplining children when they participate in the activity.” (T09)	Observation noted that teachers frequently redirected children’s attention during activities.	Digital pedagogy also requires classroom management skills.
Sustainability constraint	Need for continuous professional learning.	“Training like this should be held regularly.” (T01)	Multiple participants consistently requested follow-up mentoring.	One-off workshops were insufficient for sustained practice.
Local access constraint	Village-level professional learning.	“The training should be held in the village forum.” (T11)	Participants consistently preferred locally accessible training opportunities.	Community-based professional learning may improve participation and sustainability.

Note. Interview excerpts were translated by the researchers from Indonesian into English and lightly edited for readability while preserving their original contextual meaning. Participant identities are anonymized using identifiers T01–T13. Classroom observation evidence refers to behavioral indicators of engagement (e.g., visual attention, participation, and verbal response) rather than assessments of children’s literacy or numeracy achievement. References to RPPH documents indicate planned instructional activities identified during document review as part of methodological triangulation.

analytical distinction. Positive engagement is pedagogically meaningful, but it is not equivalent to learning impact. The finding suggests that digital media may help create more engaging classroom conditions, but the study cannot claim improved learning outcomes. This cautious interpretation avoids the common overclaim in digital education research where engagement is too quickly equated with effectiveness. At the same time, the finding should not be dismissed. In early childhood education, attention, curiosity, and enjoyment are important conditions for learning. Therefore, the reported enthusiasm is interpreted in this study as teacher-perceived engagement supported by classroom observations rather than as evidence of measurable learning improvement. This aligns with literature suggesting that digital professional learning should support pedagogical use of technology, not simply tool adoption (Amiri et al., 2025; Crouch & Slade, 2022; Kim & Yu, 2023). However, the same data also show why positive classroom response is insufficient for sustained implementation. Teachers continued to report limited laptops, weak internet access, low digital skills, limited confidence in applying digital tools independently, limited supervision, and uneven institutional support. This supports

studies emphasizing that infrastructure, leadership, and ongoing support mediate whether digital teaching becomes a durable practice (Kristiyanti & Nurhayati, 2024; Kurniawati et al., 2024; Nuryanti et al., 2024). To clarify the conditions shaping implementation, Table 6 presents enabling factors and ongoing constraints, along with required excerpts from participant responses.

Educators’ Needs Point to a Community-Based Professional Learning Ecosystem

The most theoretically significant finding concerns what educators identified as necessary for future development. Their responses did not simply request “more training.” They called for regular, free, practice-oriented, and locally accessible opportunities, including village-level training, basic and advanced digital literacy/numeracy support, IT mastery, web or animation training, and device support. This finding suggests that educators understand, at least implicitly, that digital capacity development requires an ecosystem rather than an event. Their needs point toward continuity, locality, affordability, practice, infrastructure, and support. This aligns with research on community-based professional learning, which argues that sustainable educational change in rural settings depends on professional learning

networks, communities of practice, cross-school collaboration, mentoring, and locally grounded leadership (Friesen & Brown, 2024; Prenger et al., 2020). Theoretically, this pattern can be interpreted through Wenger's Communities of Practice perspective, in which professional learning develops through participation, shared practice, mutual engagement, and collective meaning-making rather than through isolated knowledge transfer. More specifically, the findings reflect Wenger's three structural elements of a Community of Practice. The educators' shared aspiration to strengthen digital literacy and numeracy represents the domain that gives meaning to their collective learning. Their requests for village-level training, peer exchange, and mentoring illustrate the community through which professional interaction can occur. Meanwhile, their emphasis on classroom experimentation, adaptation of digital resources, and exchange of practical teaching experiences represents the practice that enables professional knowledge to develop and circulate across rural PAUD settings. From this perspective, rural PAUD educators' requests for village-level training, peer exchange, mentoring, and device support indicate a need for a community-based learning ecology that enables educators to learn with and from one another while adapting digital practices to local classroom realities. Educators' reported support needs were synthesized into the thematic map presented in Figure 3.

As shown in Figure 3, educators' expectations extend beyond the provision of training to interconnected forms of support that enable long-term professional growth. The

implication is clear: rural PAUD teachers should not be expected to carry out digital transformation on their own. Capacity development must be distributed across institutions, communities, leadership structures, and policy supports. Programs should therefore combine training with mentoring, classroom-based experimentation, peer exchange, infrastructure provision, and follow-up evaluation. The findings also indicate that sustainable digital capacity development requires support for teachers' professional confidence and opportunities for continuous reflective practice, not merely improved access to digital facilities. This finding is consistent with international literature on rural and under-resourced education contexts, which shows that digital professional learning becomes sustainable when it is embedded in peer networks, school-based support, and locally responsive implementation structures rather than delivered as one-off training (Friesen & Brown, 2024; Prenger et al., 2020; Ström et al., 2024). The present study extends this discussion by showing that, in rural Indonesian PAUD settings, the community-based ecosystem must also address early childhood-specific needs, including playful pedagogy, concrete visual resources, and developmentally appropriate uses of digital media. Taken together, these findings suggest that community-based professional learning should be organized as an integrated support model combining recurring local training, peer mentoring, classroom-based experimentation, infrastructure support, and continuous reflection to strengthen long-term digital pedagogical capacity.

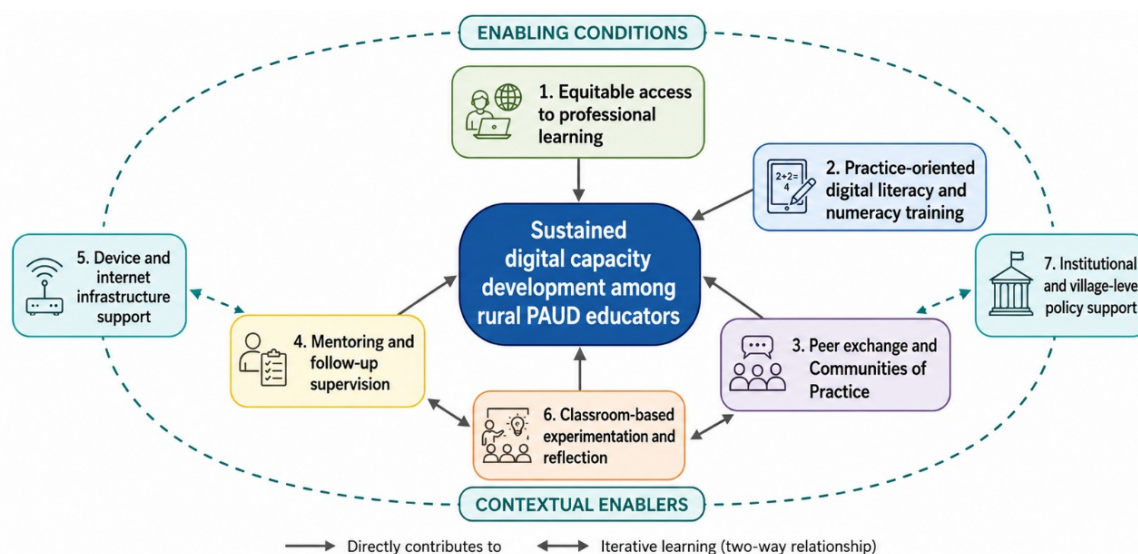


Figure 3. Community-based digital capacity development ecosystem

Key Implications for Educational Practice and Research

The findings suggest three key implications. First, digital professional learning must be designed as an equity intervention. Since seven of the 13 educators had not yet accessed digital professional learning opportunities, policy should prioritize inclusive access before measuring implementation outcomes. Second, professional learning should move beyond tool introduction toward pedagogical integration. Teachers need opportunities to design, test, revise, and reflect on age-appropriate digital practices. Third, rural PAUD settings require community-based support ecosystems. Village-level forums, PAUD networks, professional associations, and local institutions may function as practical infrastructures for sustaining digital capacity. Consistent with Wenger's Communities of Practice perspective, these local networks may function not only as training providers but also as collaborative communities where educators develop a shared domain of digital pedagogy, exchange practical experiences, and strengthen collective professional practice through continuous interaction.

For local education offices and PAUD managers, these findings suggest the need to develop subdistrict- or village-level digital professional learning programs that combine basic digital literacy, PAUD-specific instructional design, mentoring, device-sharing mechanisms, and follow-up supervision. Dinas Pendidikan and local PAUD networks should not only provide training invitations but also ensure that rural educators have practical opportunities to try digital resources, receive feedback, and share classroom adaptations with peers. Drawing on the empirical findings of this study, an operational community-based professional learning model should integrate five complementary components: (1) recurring village-level professional learning, (2) peer mentoring and Communities of Practice, (3) classroom-based experimentation using developmentally appropriate digital resources, (4) institutional support through infrastructure and device accessibility, and (5) continuous reflection and follow-up supervision to sustain classroom implementation.

For research, the findings indicate the need for longitudinal and design-based studies tracing how educators move from exposure to sustained practice. Future research should also examine which forms of support: mentoring, communities of practice, infrastructure provision, or leadership support, most strongly influence classroom translation. Future qualitative and mixed-method studies may also

investigate how teacher confidence, reflective practice, and local professional collaboration contribute to the sustainability of digital pedagogical implementation. This study does not claim that digital professional learning improves child outcomes. Its contribution is more specific: it shows that the central challenge lies in bridging professional learning and classroom practice under rural constraints.

■ CONCLUSION

This study examined how educators in rural early childhood education (PAUD) settings access, experience, and translate digital professional learning opportunities into classroom practice, with particular attention to literacy and numeracy teaching. The study identified three interconnected findings. First, access to digital professional learning remained uneven. Only six of the 13 participating educators had accessed professional learning in digital literacy or numeracy. At the same time, seven had not, indicating that professional learning opportunities are not distributed equally across local educational contexts. Participation appeared to depend not only on teacher initiative but also on institutional networks, availability of programs, and access to infrastructure and support systems. This suggests that digital capability should not be understood as an individual attribute alone, but as a condition shaped by broader educational ecosystems. Second, where training opportunities existed, they frequently emphasized exposure to digital tools rather than sustained pedagogical integration. Educators reported familiarity with selected applications and digital resources, yet opportunities for guided practice, instructional redesign, and structured implementation remained limited. The findings therefore reinforce growing concerns in digital professional development literature that technology-oriented training without pedagogical grounding rarely generates durable changes in teaching practice. Third, the study revealed a substantial translation gap between participation in professional learning and sustained classroom enactment. Although several educators adapted selected practices into teaching activities and reported teacher-perceived child engagement supported by classroom observations, implementation remained selective, occasional, and highly dependent on local conditions. Constraints related to device availability, connectivity, confidence, institutional follow-up, and continuing support frequently interrupted sustained use. These findings suggest that participation in digital professional learning should not be treated as evidence of

instructional transformation unless it is accompanied by opportunities for guided classroom experimentation, sustained mentoring, and institutional support.

Taken together, the study contributes to existing scholarship by extending discussions of digital professional learning into underexamined rural early childhood contexts and by showing how inequalities operate across the full pathway from access to implementation. Rather than conceptualizing professional development as a linear process in which training automatically leads to changes in practice, this study proposes a more ecological interpretation in which teachers continuously interpret, adapt, negotiate, and sometimes limit implementation in light of contextual realities. The findings also carry practical implications. Efforts to strengthen digital teaching capacity in PAUD should move beyond isolated workshops and instead develop sustained professional learning ecosystems that combine equitable access, pedagogically focused training, mentoring, collaborative communities of practice, infrastructure support, and institutional follow-up. Localized and community-based approaches may be particularly important for ensuring that digital transformation is educationally meaningful rather than merely technologically symbolic. At the policy level, Dinas Pendidikan and related local authorities should prioritize village- or subdistrict-based digital professional learning programs for rural PAUD educators, especially in areas where access to training, devices, and internet connectivity remains uneven. Based on the findings, such programs should be organized around an operational community-based professional learning model that integrates recurring local training, peer mentoring, classroom-based experimentation, infrastructure support, and continuous reflective follow-up. Such programs should not be limited to one-time technical workshops. However, they should also include basic and advanced digital literacy, PAUD-specific digital pedagogy for literacy and numeracy, post-training mentoring, peer-sharing forums, and mechanisms for monitoring classroom implementation. At the institutional level, PAUD managers should facilitate regular teacher collaboration, provide shared access to available devices, document good practices, and connect educators with local PAUD networks or professional communities. These practical steps may help ensure that digital professional learning becomes a sustained support system rather than an isolated training experience. Future research may extend this work through longitudinal and design-based

approaches that trace how educators sustain—or discontinue—digital practices over time. Future studies should also investigate how teacher confidence, reflective professional practice, leadership, and community-based support interact to influence the long-term translation of digital professional learning into classroom practice.

■ DECLARATION OF AI USAGE

During the drafting of this manuscript, the authors used ChatGPT 5 to refine sentence structure and translate text. Following the use of this tool, the authors reviewed and revised the content as necessary and accept full responsibility for the final content of the article.

■ REFERENCES

- Amiri, S. M. H., Goswami, P., Islam, M. M., Kabir, M. S., Hossen, M. S., Barmmon, C. K., & Amiri, S. M. H. (2026). The Future of Learning is Hybrid: Exploration of EdTech's Role in Shaping the Post-Pandemic Educational Landscape. *SocioEdu Sociological Education*, 7(1), 1–16.
- Avedzi, J. E. (2025). *Educational Technology, Teaching Practices, and Learning Outcomes in Sub-Saharan Africa: Empirical Insights From Ghana's Basic Education Classrooms*. <https://doi.org/10.21203/rs.3.rs-7330474/v1>
- BPS Kabupaten Bandung Barat. (2024). Kabupaten Bandung Barat Dalam Angka 2024. In *Badan Pusat Statistik: XV*. <https://bangkakab.bps.go.id/publication/download.html>
- Costa, A. C. F., Silva, A. M. de B., Espuny, M., Rocha, A. B. T. da, & Oliveira, O. J. d. (2023). Toward Quality Education: Contributions of EdTech to the Achievement of the Fourth United Nations Sustainable Development Goal. *Sustainable Development*, 32(3), 1634–1651. <https://doi.org/10.1002/sd.2742>
- Crouch, L., & Slade, T. S. (2022). 5. Reducing Inequality in Education Using “Smaller, Quicker, Cheaper” Assessments. *Learning, Marginalization, and Improving the Quality of Education in Low-income Countries*, 149.
- Damiani, M. L., Unick, B. V., & Schultz, K.-J. (2024). A Collaborative Approach to Professional Development on Inclusive Practices Aligned to Preschool Mandates. *School-University Partnerships*, 17(3), 303–321. <https://doi.org/10.1108/sup-08-2023-0026>
- Dhamotharan, D. M. D., & Loh, C. M. (2019). Continuing Professional Development for

- ECCE Teachers in Selected States in Malaysia: What Teachers and Operators Say. *Advances in Social Sciences Research Journal*, 6(4), 301–315. <https://doi.org/10.14738/assrj.64.6471>
- Esch, K. S. V, Betancourt, C., Thompson, J., Varghese, M., Li, H., & Venegas-Weber, P. (2025). Recontextualization in Multilingual Science Teacher Professional Learning. *Science Education*, 109(4), 1072–1089. <https://doi.org/10.1002/sce.21940>
- Farisia, H., & Syafi'i, I. (2024). Professional Development on Digital Literacy for Teachers in Early Childhood Education in the Digital Era. *Tafkir Interdisciplinary Journal of Islamic Education*, 5(3), 360–375. <https://doi.org/10.31538/tijie.v5i3.820>
- Friesen, S., & Brown, B. (2024). Knowledge Brokering Pivotal in Professional Learning: Quality Use of Research Contributes to Teacher-Leaders' Confidence. *Frontiers in Education*, 9. <https://doi.org/10.3389/educ.2024.1430357>
- Kanwal, A., Zahid, A. T. M. Z. R., & Afzal, A. (2023). Investigating the Benefits and Challenges of Blended Learning Approaches at the University Level. *Qlantic Journal of Social Sciences and Humanities*, 4(3), 76–89. <https://doi.org/10.55737/qjssh.546834164>
- Kaziya, K. (2025). *A Systematic Review of Technology Integration in Mathematics Education: Perspectives From Rural Zambia in Kalomo District*. <https://doi.org/10.21203/rs.3.rs-6374363/v1>
- Kim, M. S., & Yu, F. (2023). 'Teacher Data Literacies Practice' Meets 'Pedagogical Documentation': A Scoping Review. *Review of Education*, 11(2). <https://doi.org/10.1002/rev3.3414>
- Kristiyanti, L., & Nurhayati, S. (2024). Crafting effective PAUD teaching modules: a training needs assessment for posyandu cadres in Bandung. *Jurnal Visi Ilmu Pendidikan*, 16(2), 255. <https://doi.org/10.26418/jvip.v16i2.74644>
- Kurniawati, A., Nurhayati, S., & Rukanda, N. (2024). Enhancing Early Childhood Education Teachers' Creativity through Professional Development Training Program. *Aulad: Journal on Early Childhood*, 7(1), 141–149. <https://doi.org/10.31004/aulad.v7i1.537>
- Madsen, S. S., O'Connor, J., Janeš, A., Klančar, A., Brito, R., Demeshkant, N., Konca, A. S., Krasin, S., Saure, H. I., Gjesdal, B., Ludgate, S., Jwaifell, M., Almuhtadi, R., & Thorvaldsen, S. (2023). International Perspectives on the Dynamics of Pre-Service Early Childhood Teachers' Digital Competences. *Education Sciences*, 13(7). <https://doi.org/10.3390/educsci13070633>
- Marsegi, S. M., Nurhayati, S., Ansori, A., & Hendriana, H. (2023). Digital-Based Portfolio Assessment Competence of Early Childhood Educators. *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*, 7(1), 251–259. <https://doi.org/10.31004/obsesi.v7i1.3360>
- Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook* (2nd ed.). sage.
- Musa, S., & Nurhayati, S. (2024). Educators' Resilience Amidst Digital Era Challenges: Case Study in Indonesia. *Journal of Electrical Systems*, 20(4s), 832–840. <https://doi.org/10.52783/jes.2121>
- Musa, S., & Nurhayati, S. (2026). From Activation to Transformation: A Multi-Site Case Study of Digital Competence Development in Indonesian Non-Formal Teacher Professional Learning Communities. *International Journal of Learning, Teaching and Educational Research*, 25(4), <https://www.ijter.org/>
- Musa, S., Nurhayati, S., & Wasliman, I. (2025). Digital Literacy Training Efficacy for Improving Educators and Educational Workforces' Digital Skill. *Korean Conference on Education 2024, (IAFOR)*, 549–558. <https://doi.org/10.22492/issn.2759-7563.2024.43>
- Musa, S., Suherman, A. M., Sujarwo, S., & Nurhayati, S. (2024). Continuous Professional Growth: A Study Of Educators' Commitment To Lifelong Learning. *Jurnal Cakrawala Pendidikan*, 43(2), 502–512. <https://doi.org/10.21831/cp.v43i2.66654>
- Nurhayati, S., & Judijanto, L. (2026). Pedagogical Positioning of Digital Technology in Childhood Literacy and Numeracy Instruction: A Qualitative Multi-Site Study in Indonesia. *International Journal of Learning, Teaching and Educational Research*, 25(2), 721–741.
- Nurhayati, S., Judijanto, L., Sriwardiningsih, E., Syarifah, S., Juniarti, A. P., Hidayat, C., & Jakaria, Y. (2025). *Desain Riset dan Literasi Data*. Green Pustaka Indonesia. <https://www.greenpustaka.com/2025/07/desain-riset-dan-literasi-data.html>
- Nurhayati, S., & Musa, S. (2025). Teaching With Purpose: Indonesian Educators'

- Response to The Challenges of Society 5.0. *International Conference on Research in Education and Science*, (ISTES), 360–372. <https://www.scopus.com/record/display.uri?eid=2-s2.0-85217702992&origin=resultslist>
- Nurhayati, S., Sholihah, H., Tri, A., Maemunah, R., Moreb, M., & others. (2025). Holistic Learning through Qur'anic-Integrated STEM: Innovations in Early Childhood Pedagogy. *Kiddo: Jurnal Pendidikan Islam Anak Usia Dini*, 6(2), 490–509.
- Nurhayati, S., Taufikin, T., Judijanto, L., & Musa, S. (2025). Towards Effective Artificial Intelligence-Driven Learning in Indonesian Child Education: Understanding Parental Readiness, Challenges, and Policy Implications. *Educational Process International Journal*, 15(1), e2025155. <https://doi.org/10.22521/edupij.2025.15.155>
- Nuryanti, R., Nurhayati, S., Musa, S., Rukanda, N., & others. (2024). Efforts and Outcomes in Enhancing Early Childhood Educators' Digital Literacy at PAUD Institutions. *Judika (Jurnal Pendidikan Unsika)*, 12(1), 25–36.
- O'Sullivan, L., & Ring, E. (2023). On the path to developing a high-quality inclusive preschool system in the Irish context: Outcomes from a systemic focus on structural and process quality dimensions. In *Recent perspectives on preschool education and care*. IntechOpen.
- Pachori, R., Devarakonda, R. V., & Kumar, R. (2026). From crisis to transformation: Evaluating the implementation of DIKSHA in India's EdTech landscape. *British Journal of Educational Technology*.
- Prenger, R., Poortman, C. L., & Handelzalts, A. (2020). Professional Learning Networks: From Teacher Learning to School Improvement? *Journal of Educational Change*, 22(1), 13–52. <https://doi.org/10.1007/s10833-020-09383-2>
- Reynolds, R., Aromi, J., McGowan, C., & Paris, B. (2022). Digital Divide, Critical-, and crisis-informatics Perspectives on K-12 Emergency Remote Teaching During the Pandemic. *Journal of the Association for Information Science and Technology*, 73(12), 1665–1680. <https://doi.org/10.1002/asi.24654>
- Schachner, A., Yun, C., Melnick, H., & Barajas, J. (2024). *Coaching at Scale: A Strategy for Strengthening the Early Learning Workforce*. <https://doi.org/10.54300/984.909>
- Shuey, E. A., Kim, N., Cortázar, A., & Pobleté, X. (2019). *Curriculum Alignment and Progression Between Early Childhood Education and Care and Primary School*. <https://doi.org/10.1787/d2821a65-en>
- Ström, K., Pettersson, G., & Wickman, K. (2024). Remote Special Educational Consultation in Swedish Rural Schools. *Australian and International Journal of Rural Education*, 34(1), 108–121. <https://doi.org/10.47381/aijre.v34i1.713>
- Susanti, M., & Nurhayati, S. (2024). Exploring Digital Literacy Usage For Self-Directed Learning: Rural Adolescents' Perspectives. *Jurnal Visi Ilmu Pendidikan*, 16(1), 1. <https://doi.org/10.26418/jvip.v16i1.67216>
- Susanto, S., Ansori, A., & Nurhayati, S. (2025). Improving Tutors' Pedagogical Competence Through Online Interactive Learning (Setara Daring) Platform Optimization Training. *Jurnal Visi Ilmu Pendidikan*, 17(1), 69–82. <https://doi.org/10.26418/jvip.v17i1.82288>
- Suwartono, T., Nurhayati, S., Mustari, M., & Erlawati, E. (2025). The adaptability and resilience of Indonesian EFL teachers during emergency online education. *Edelweiss Applied Science and Technology*, 9(2), 1071–1081.
- Vekić-Kljaić, V., & Mlinarević, V. (2022). Professional Development of Educators' Online Learning During the COVID-19 Pandemic in the Republic of Croatia. *Sn Social Sciences*, 2(10). <https://doi.org/10.1007/s43545-022-00527-0>
- Wang, C. (2024). Exploring students' generative AI-assisted writing processes: perceptions and experiences from native and non-native English speakers. *Technology Knowledge and Learning*. <https://doi.org/10.1007/s10758-024-09744-3>
- Winarti, W., Nurhayati, S., Rukanda, N., Musa, S., Jabar, R., & Rohaeti, E. E. (2022). *Analisis Kompetensi Digital Guru PAUD dalam Mengelola Pembelajaran Daring Anak Usia Dini* [Analysis of Early Childhood Education Teachers' Digital Competencies in Managing Online Learning for Early Childhood Education]. *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*, 6(6), 5621–5629. <https://doi.org/10.31004/obsesi.v6i6.3111>
- Yang, K.-K., Hong, Z.-R., Lee, L., & Lin, H.-S. (2022). Supportive conditions and mechanisms of teachers' professional development on inquiry-based science teaching through a learning community.

- Research in Science and Technological Education*, 40(1), 127–148. <https://doi.org/10.1080/02635143.2020.1779051>
- Yao, W., & Liu, D. (2024). Discussion on the Construction and Application of Virtual Reality-Based Curriculum Resources for Kindergarten Education. *Journal of Contemporary Educational Research*, 8(4), 114–119. <https://doi.org/10.26689/jcer.v8i4.6516>
- Ye, X., Ahmad, N. A., Burhanuddin, N. A. N., Na, M., & Li, D. (2024). Preschool Teachers' Emotional Competence and Teacher Self-Efficacy Towards Preschool Performance in Zhejiang Province of China. *Behavioral Sciences*, 14(4), 280. <https://doi.org/10.3390/bs14040280>
- Zabeli, N., & Gjelaj, M. (2020). Preschool teacher's awareness, attitudes and challenges towards inclusive early childhood education: A qualitative study. *Cogent Education*, 7(1). <https://doi.org/10.1080/2331186X.2020.1791560>