



Training Needs for Early Childhood Teachers in Improving Technological, Pedagogical, and Content Knowledge Competencies

Salma Nurillah^{1✉}, Endang Herawan², Eka Prihatin³ & Asep Dikdik⁴

^{1✉} Universitas Pendidikan Indonesia, salma.nrllh13@upi.edu, Orcid ID: [0009-0005-4884-2711](https://orcid.org/0009-0005-4884-2711)

² Universitas Pendidikan Indonesia, endangh.upi@gmail.com, Orcid ID: [0009-0003-5616-3714](https://orcid.org/0009-0003-5616-3714)

³ Universitas Pendidikan Indonesia, ekaprihatin@upi.edu, Orcid ID: [0000-0001-5040-9451](https://orcid.org/0000-0001-5040-9451)

⁴ Universitas Pendidikan Indonesia, asep.dikdik@upi.edu, Orcid ID: [0009-0001-2653-0742](https://orcid.org/0009-0001-2653-0742)

Article Info

History of Article

Received:

27 March 2025

Revised:

09 April 2025

Published:

15 April 2025

Abstract

To identify training needs for early childhood education teachers in technology integration is essential to improve learning quality. This study aims twofold: first, to analyze the training needs for early childhood education teachers in the use of technology, and second, to design a TPACK model-based training program that can assist teachers in improving the quality of learning. The present study employed a mixed methods approach, integrating both quantitative and qualitative methodologies. Data were collected through a Training Needs Survey (TNS) and subsequently analyzed utilizing SPSS. The results indicated a substantial competency discrepancy, with an average score of 39.12, falling short of the ideal score of 53. The analysis revealed that teachers continue to encounter various obstacles, including a deficiency in the development of digital teaching materials, constraints in the utilization of hardware and software, and a paucity of experience in employing interactive learning applications. These findings underscore the necessity for Technological Pedagogical Content Knowledge (TPACK)-based training to facilitate effective integration of technology in the learning process. The TPACK model enables educators not only to acquire technological mastery but also to utilize it to enhance children's interaction and engagement in the learning process. The implications offer insight for policymakers, educators, and training institutions in designing more effective training programs to improve the quality of early childhood education in the Karangpawitan Subdistrict of Garut Regency.

Keywords:

Early Childhood Teachers, TPACK-Based Training, Training Needs Analysis

How to cite:

Nurillah, S., Herawan, E., Prihatin, E., & Dikdik, A. (2025). Training needs for early childhood teachers in improving technological, pedagogical, and content knowledge competencies. *EduBasic Journal: Jurnal Pendidikan Dasar*, 7(1), 46-61.

Info Artikel

Riwayat Artikel

Diterima:

27 Maret 2025

Direvisi:

09 April 2025

Diterbitkan:

15 April 2025

Abstrak

Mengidentifikasi kebutuhan pelatihan guru PAUD dalam integrasi teknologi penting untuk meningkatkan kualitas pembelajaran. Penelitian ini bertujuan untuk dua hal: pertama, menganalisis kebutuhan pelatihan guru PAUD dalam penggunaan teknologi; dan kedua, merancang program pelatihan berbasis model TPACK yang dapat membantu guru dalam meningkatkan kualitas pembelajaran. Penelitian ini menggunakan pendekatan mixed methods dengan kombinasi metode kuantitatif dan kualitatif, data dikumpulkan melalui Training Needs Survey (TNS) dan dianalisis menggunakan SPSS. Hasil penelitian menunjukkan bahwa kesenjangan kompetensi yang signifikan, dengan skor rata-rata 39,12, lebih rendah dari skor ideal 53. Guru masih menghadapi berbagai kendala, termasuk rendahnya keterampilan dalam menyusun bahan ajar digital, keterbatasan dalam mengoperasikan perangkat keras dan lunak, serta kurangnya pengalaman dalam menggunakan aplikasi pembelajaran interaktif. Temuan ini mengindikasikan perlunya pelatihan berbasis Technological Pedagogical Content Knowledge (TPACK) agar guru dapat mengintegrasikan teknologi secara efektif dalam pembelajaran. Model TPACK memungkinkan guru tidak hanya menguasai teknologi, tetapi juga menggunakannya untuk meningkatkan interaksi dan keterlibatan anak dalam proses belajar. Implikasi penelitian ini adalah memberikan masukan bagi pembuat kebijakan, pendidik, dan lembaga pelatihan dalam merancang program pelatihan yang lebih efektif guna meningkatkan kualitas Pendidikan anak usia dini di Kecamatan Karangpawitan, Kabupaten Garut.

Kata Kunci:

Guru Anak Usia Dini, Pelatihan Berbasis TPACK, Analisis Kebutuhan Pelatihan

Cara Mensitasi:

Nurillah, S., Herawan, E., Prihatin, E., & Dikdik, A. (2025). Training needs for early childhood teachers in improving technological, pedagogical, and content knowledge competencies. *EduBasic Journal: Jurnal Pendidikan Dasar*, 7(1), 46-61.

INTRODUCTION

Technological advancements in the digital era have had a considerable impact on various aspects of life, including the field of education (Adiyono et al., 2024). Early childhood education, a foundational stage in the development of children's character and skills, must adapt to technological advancements to enhance the quality of learning (Anggraeni & Listiana, 2023). The integration of technology in early childhood education has been shown to enhance teaching methods and increase children's interaction and involvement in the learning process (Oliveira et al., 2024; Subasman, 2024). However, the integration of technology in the early childhood education sector encounters numerous challenges, particularly regarding educators' competencies in effectively incorporating technology within the classroom environment (Gcabashe, 2024). Consequently, there is a necessity for structured training to enhance early childhood education teachers' proficiency in leveraging technology to facilitate quality learning.

One approach that can be used in the design of early childhood teacher training is the Training Need Assessment (TNA) (Nurhayati & Novianti, 2024), which aims to identify skill gaps as well as specific needs in the use of technology (Ashraf et al., 2023). The TNA concept was first developed by Hennessy-Hicks. This model is employed to ascertain training needs at various levels, including the individual, group, or organizational levels (Markaki et al., 2021). The application of TNA in training program design has been exhibited to enhance the relevance and appropriateness of these programs to the conditions and challenges faced by early childhood education in the field (Ngema, 2024).

The TNA is further expected to evaluate the extent to which teachers have mastered educational technology, as well as the aspects that still require skills improvement. These include the utilization of interactive media in learning and the use of digital applications for classroom administration. Furthermore, the TNA results are anticipated to inform the most effective training models, such as practice-based workshops, hands-on training with

expert assistance, or online learning that is flexible and accessible according to teachers' needs.

In the context of technology training for early childhood education teachers, the Technological Pedagogical Content Knowledge (TPACK) model is an appropriate conceptual framework for designing technology, pedagogy, and learning content training. This model enables teachers to develop a comprehensive understanding of technology utilization, as well as the capacity to adapt it effectively in the learning process (Rahayu et al., 2024). This approach enables educators to select and implement technologies that align with children's developmental needs and learning objectives (Sierra et al., 2024).

The present study is predicated on the constructivist learning theory, as proposed by Piaget and Vygotsky (Wibowo et al., 2025). This theory posits that children learn actively through interaction with their environment, including technology that can enrich the learning experience (Jumaah, 2024). Piaget (1954) underscores the significance of independent exploration in early childhood education, while Vygotsky (1978) highlights the pivotal role of adults or teachers in providing scaffolding to guide children in their learning (Özkan, 2022). Consequently, the integration of technology in early childhood education should be meticulously designed to foster children's exploration, interaction, and active involvement in the learning process, thereby facilitating meaningful interactions between teachers and children.

The results of a preliminary study in three early childhood education schools in Karangpawitan Subdistrict, Garut Regency, revealed that although the majority of teachers recognized the importance of using technology in learning, they faced several barriers, such as limited access to technology, lack of understanding of digital literacy, and lack of relevant training. Teachers felt less confident about using technology in the classroom due to limited technical and pedagogical skills. This problem was experienced not only by young teachers but also by the majority of older early childhood teachers who are used to more traditional approaches to learning. In addition, most schools did not have adequate technology

facilities, and government support for improving teachers' skills in using information and communication technology remains limited. Although teachers were eager to learn, they wanted more structured training that balances theory and practice and focused on using technology to create creative and innovative learning, not just the new curriculum.

Research in this area has demonstrated the necessity of training for early childhood teachers in the use of technology. A study conducted by Saptani et al. (2024) found that training based on the TPACK framework can enhance teachers' competence in effectively utilizing technology. Additionally, research by Huang (2025) demonstrated that teachers who received technology training exhibited significant enhancement in their capacity to incorporate technology into their teaching methods. Concurrently, research by Chang (2023) underscores the capacity of TPACK-based training to facilitate the comprehension of technology's potential to enhance contextualized and active learning in the early childhood education sector.

In addition to pedagogical benefits, the use of technology in early childhood education also increases the efficiency and flexibility of the teaching process (Anggraeni & Listiana, 2023). Technology can be used to provide more diverse learning resources, differentiate instruction, and provide more interesting and meaningful learning experiences for children (Eden et al., 2024). With adequate training, educators can leverage technology, including interactive learning applications, educational software, and other digital resources, to support the achievement of learning objectives (Artacho et al., 2020).

Nevertheless, it should be noted that technology training for early childhood education teachers should not only focus on technical aspects but should also consider pedagogical factors and relevant socio-cultural contexts. The technology employed should be meticulously customized to align with the unique needs and characteristics of early childhood children and their learning environment. In designing TPACK-based training, it is imperative to engage a diverse range of stakeholders, including teachers, curriculum developers, and education

policymakers, to ensure that the resulting training program aligns with the needs of the field.

This research makes a novel contribution by linking micro-level insights from the Karangpawitan Subdistrict with broader early childhood education policy considerations. In contrast to previous research that has segregated local case studies from policy analysis, this research integrates the two to examine how technology is utilized in rural early childhood education and its ramifications at the national level. The research introduces a contextualized and scalable intervention model designed specifically for underrepresented rural institutions, which aims to inform technology integration in similar socio-cultural contexts.

Additionally, the present study is predicated on this extant background and pursues two primary objectives: first, to analyze the training needs of early childhood education teachers in utilizing technology, and second, to develop a TPACK-based training program aimed at enhancing the quality of teaching and learning in the Karangpawitan Subdistrict, Garut Regency. To achieve these objectives, the study adopted a mixed-methods approach, combining qualitative case study techniques for in-depth contextual understanding with a developmental research framework to guide the design and iterative refinement of the training program. This methodological integration ensures that the resulting model is both empirically grounded and practically applicable. It is anticipated that the findings will inform more effective and sustainable teacher training policies and contribute to improving the overall quality of early childhood education through the optimized use of educational technology.

METHODS

This study employed a mixed methods approach (Vazirani & Bhattacharjee, 2024) to investigate the TPACK model utilized in early childhood teacher competency improvement training, emphasizing the necessity for technology training in learning (Fitriyah et al., 2024). This approach facilitates a comprehensive understanding of how technology integration can enhance teaching

practices and improve learning outcomes in early childhood education settings.

The participants in this study were 50 teachers who were recruited using purposive sampling to determine the sample (Fernandes & Solimun, 2022; Suwardi et al., 2020). The participants were recruited to ensure diversity in their educational backgrounds, experiences, and access to educational technology, as well as to improve their pedagogical and technological competencies (Ismawati et al., 2023). Data were collected through the application of survey techniques, with the Training Needs Survey (TNS) serving as the primary instrument. The TNS was meticulously designed to assess the seven key indicators in the TPACK model, as illustrated in Figure 1.

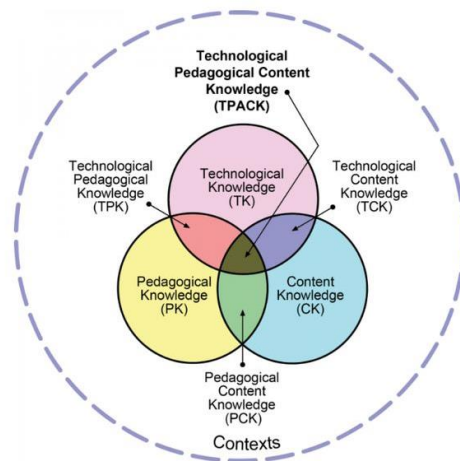


Figure 1. TPACK Model (Rahayu et al., 2024)

TNS is a comprehensive evaluation framework that assesses teachers' competencies in Technological Knowledge (TK), Pedagogical Knowledge (PK), and Content Knowledge (CK), as well as the integration of these three domains, such as TPK, TCK, and PCK. Utilizing TNS, educators in the field of early childhood education were evaluated on their understanding of educational technology (TK), teaching strategies (PK), proficiency in teaching materials (CK), and their capacity to integrate these competencies holistically. The TNS results mapped teacher competencies, identified skill gaps, and informed the development of training models, such as

practice-based training to improve CK or strengthen understanding of technology-based content (TCK). A professional community-based approach can also be applied to enhance reflection and collaboration on technology utilization in early childhood education.

The survey was administered in educational institutions through a self-assessment method (Kittelman et al., 2024), wherein teachers completed the TNS under the supervision of researchers to ensure data accuracy. The collected data were then analyzed quantitatively using descriptive techniques, with the average score of the TNS results being utilized to identify discrepancies between teachers' actual competencies and established standards. These competency standards were determined based on specific reference values. For a more thorough examination of the survey's findings, refer to the Training Needs Assessment Tool in Table 1.

Table 1. Training Needs Assessment Tool Adapted from Dikdik et al. (2025)

TNS Score	Gap Category	Level of Competence	Interpretations
21-31	Very High	Level 1 – Develop	The competency gap is huge, and urgent training is needed.
32-42	High	Level 2 – Worthy	The competency gap is significant, and training is highly recommended.
43-52	Medium	Level 3 – Competent	Competency gaps exist but are within reasonable limits; training is still required.
53-63	Conforms to Standard	Level 4 – Proficient	There are no competency gaps which are in line with expected standards.

The results of this competency mapping initiative lay the foundation for the development of a sustainable professional training model based on TPACK and teacher professional communities. This model has

demonstrated efficacy in enhancing technology-based teaching skills through a reflective, collaborative, and sustainable approach. The research findings offer a comprehensive overview of teachers' pedagogical, professional, social, and technological competence achievement and the necessity for more structured training interventions. The study's findings further offer insights into the competencies of early childhood education teachers and provide a concrete training model based on identified needs. This model aims to enhance teachers' readiness to adopt technology-based learning, encourage innovation in teaching practices, and foster a more interactive and effective learning environment for early childhood. Additionally, the findings of this study offer valuable insights for policymakers as they endeavour to develop training programs that align more closely with the demands of education in the digital era.

RESULTS AND DISCUSSION

Result

The results of the TNS analysis completed by early childhood education teachers in Karangpawitan Subdistrict, Garut Regency, indicate variations in competency levels based on the mapping in the Training Needs Assessment Tool. The mean score obtained was 39.12, suggesting a discrepancy between teachers' actual competencies and the expected standards. The findings reveal a substantial discrepancy between teachers' actual competencies and the anticipated standards, as indicated by the Level 2 (Worthy) category.

This observation underscores the necessity for more systematic and authentic training interventions that are aligned with teachers' pedagogical, professional, social, and technological needs. Such interventions are crucial for enhancing their competencies in supporting digital-based early childhood education in the contemporary educational era. For a more comprehensive overview of the TNS results, please refer to Table 2.

Table 2. TNS Statistical Data of Early Childhood Education Teachers

Training Need Survey Statistics		
N	Valid	50
	Missing	0
Mean		39.12
Std. Error of Mean		1.600
Median		41.00
Mode		42
Std. Deviation		11.315
Variance		128.026
Range		42
Minimum		21
Maximum		63
Sum		1956
Percentiles	25	29.75
	50	41.00

A survey of 50 early childhood education teachers in Karangpawitan Subdistrict, Garut Regency, revealed several factors that underscore the pressing need for technology utilization training in early childhood education. Regarding teacher age, the majority fell within the 38-44 (32%) and 45-51 (16%) age brackets, suggesting a need for technology integration into teaching methods. Regarding the teachers' educational attainment, 52% held elementary/junior high/middle school diplomas, 44% possessed a bachelor's degree, and only 4% obtained a diploma or higher qualification, suggesting a digital skills deficit. Moreover, 46% of the teachers have accumulated more than 10 years of teaching experience, which might imply that they have not been exposed to recent technological advancements. Consequently, there is an urgent need for technology training for early childhood education teachers to enhance the quality of learning by contemporary standards.

In addition to the tabular presentation, the TNS results were also visualized using chart diagrams to show the overall TPACK profile of teachers. This approach facilitates the identification of areas of strength and areas

requiring development, particularly with regard to the dimensions of TK, PK, CK, TPK, TCK, PCK, and TPACK, which serve as the fundamental framework for developing the TNS model design.

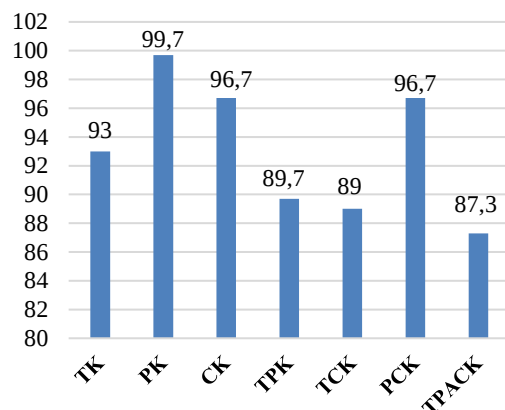


Figure 2. Average of TPACK Score Results

The mean TPACK score results indicate that teachers possessed exemplary competencies in Pedagogical Knowledge (PK), Content Knowledge (CK), and Pedagogical Content Knowledge (PCK) domains, with scores exceeding 96 in each category. These findings suggest a high level of proficiency in teaching strategies, subject matter expertise, and the integration of these elements into learning environments. In comparison, technological knowledge (TK) demonstrated a satisfactory level of proficiency with a score of 93; the predominant challenge resides in integrative competencies, particularly in Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and notably, TPACK, which exhibited the lowest score of 87.3. This finding suggests that educators continue to encounter challenges in effectively integrating technology, pedagogy, and content in learning practices. Consequently, there is a necessity for more applicable and integrated training, ensuring that educators are not only proficient in the utilization of technology but also adept at optimizing it to enhance the quality of learning in its entirety.

The analysis further indicates a need for significant enhancement in the domains of Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and, notably, TPACK. This finding

implies a necessity for educators to enhance their proficiency in the integration of educational technology and the mastery of teaching materials. Consequently, the subsequent development model will prioritize these three domains while still considering the integration of the seven (TPACK) as the ultimate objective. Figure 3 below illustrates the teacher needs model based on TPACK theory.

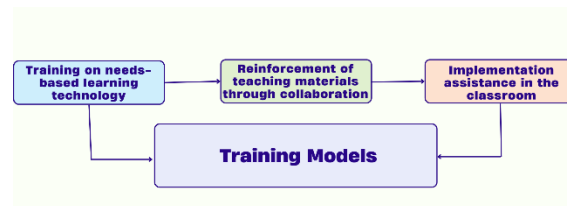


Figure 3. Teachers Need Training Models

The proposed training development model is organized into three integrated stages to address the identified needs based on the TPACK framework. Initially, technology-based instructional training was administered to fortify teachers' Technological Knowledge (TK), which was identified as the most critical domain for enhancement. Second, the model emphasized collaborative improvement of teaching content, aiming to improve Content Knowledge (CK) through discussions with peers, adaptation of materials, and co-creation of learning resources. The subsequent phase involved an ongoing mentoring program in the classroom setting, ensuring the practical application of the knowledge gained. This was supported by a reflective supervision and feedback process aimed at facilitating ongoing professional growth.

Discussion

Analysis of Teachers' Technological Competency and Training Needs

The TNS results obtained from the completion by early childhood education teachers demonstrated that the mean score from the TNS distribution was 39.12, falling short of the predetermined ideal score of 53. The survey results of 50 early childhood education teachers in Garut Regency regarding the utilization of technology in early childhood learning exhibited substantial variations in competency levels. The data were then

analyzed using a scale of four competency levels: develop, worthy, competent, and proficient. This analysis was conducted to identify the most pressing training needs. The data collected reflect the level of technology mastery in various aspects of learning, ranging from hardware and software utilization to technology integration in learning methods.

The survey results indicate that the majority of teachers have attained the worthy level (Level 2) in fundamental technology skills, including the utilization of hardware such as laptops, computers, and smartphones, as well as basic software such as Microsoft Word and PowerPoint. This suggests that while teachers possessed an initial understanding of technology, they lacked the proficiency necessary to incorporate it into the learning process effectively. Research by Dinçer (2024) denotes that technology mastery confined to the operational level, without integration into pedagogical practices, will not significantly impact learning quality. Consequently, there is a need for training that emphasizes not only the technical aspects but also strategies for incorporating technology into the early childhood learning process.

A similar trend was observed in teachers' proficiency in locating teaching resources online, with the majority falling within Level 2 of the specified scale. However, a proportion of respondents demonstrated Level 3 proficiency, indicating "competent" status. These findings imply that while many teachers were already employing the Internet as a learning resource, further training is necessary to enhance their capacity to select and evaluate the quality of the materials they utilize. As asserted by Wahyuddin et al. (2024), the possession of digital literacy skills in education is imperative to guarantee that the information utilized is pertinent, valid, and congruent with the requirements of learners. Consequently, specialized training in digital literacy is requisite for early childhood education teachers, thereby enabling them to exercise greater discernment in their utilization of internet-based teaching resources.

The integration of technology in learning, including the use of learning videos and digital platforms, exhibited significant variation among educators. While some teachers have attained Level 3 and even Level

4 (proficient) in their technological proficiency, the majority remained at Level 2. This discrepancy suggests a gap in the utilization of technology to enhance interaction with students and to present teaching materials creatively and interactively. According to Sabila et al. (2024), the integration of multimedia in learning can enhance children's comprehension by amalgamating visual and auditory components. However, the efficacy of this approach hinges on how educators manage and present materials interactively. As a result, there is a necessity for training that will empower educators to utilize multimedia effectively, aligning it more closely with the distinctive features of early childhood learning.

The capacity to employ technology-based learning methods remains limited, with many educators still at the initial levels of proficiency, specifically Level 1 (develop) and Level 2. This underscores the necessity for additional training to facilitate the understanding of how technology can enhance student engagement and adapt digital-based learning methods according to the developmental needs of early childhood. According to Teichert and Salman (2023), early childhood learning is characterized by direct experience and active exploration. Accordingly, technology applied in learning should be designed to encourage children's active participation in the learning process. Therefore, technology-based approaches need to be introduced in teacher training to ensure technology is used optimally according to the child's developmental stage.

In terms of comprehension of early childhood learning concepts, the majority of teachers demonstrated a satisfactory level of understanding, with numerous respondents attaining Level 3. This suggests that teachers have attained a relatively advanced understanding of children's cognitive, social, emotional, and physical development. Nevertheless, the application of these concepts to technology-based learning remains a challenge that necessitates further training. As demonstrated by Oliveira et al. (2024), the efficacy of technology integration in early childhood education is contingent upon its adaptation to foster play and exploration rather

than merely presenting information passively. Hence, the training provided should emphasize technology-based learning strategies that prioritize engagement as the fundamental aspect of early childhood education.

The survey results indicate that a limited proportion of teachers have attained Level 4 in terms of their proficiency in integrating technology into lesson plans and selecting suitable technology platforms. This finding underscores the necessity for enhancing skills in digital-based lesson planning, encompassing the development of effective lesson plans that seamlessly incorporate technology. As posited by Fatimah et al. (2025), the efficacy of technology integration within the curriculum is contingent upon the extent to which educators comprehend the interplay between technology, pedagogy, and the subject matter being instructed. Thus, the training curriculum ought to encompass components of strategic planning, the selection of digital platforms that align with the distinctive needs of early childhood education, and the assessment of the effectiveness of technology-based learning.

Additionally, the survey results indicated a clear necessity for enhancing the competencies of early childhood education teachers in adapting and integrating technology into learning. While some teachers exhibited commendable proficiency, the majority are still in a developmental phase and necessitate assistance to refine their skills further. Consequently, the training curriculum should encompass the utilization of more interactive software and digital platforms, strategies for selecting suitable technologies for early childhood, and the implementation of effective technology-based learning methods. According to Diederich et al. (2024), the integration of technology in early childhood education should be designed to support social interaction, creativity, and physical object engagement rather than replacing direct learning experiences. It is anticipated that, through comprehensive training, teachers' competence in utilizing technology will be enhanced, thereby positively impacting the quality of early childhood learning in the Garut Regency.

Recommendation for the Early Childhood Education Teacher Competency Development Model in Karangpawitan, Garut Regency

The TPACK approach-based for early childhood education teacher competency development model, which is the focus of this study, offers recommendations that are intended for stakeholders in the field of education. These stakeholders include the Garut Regency Education Office, early childhood education institution managers, and teacher training institutions. These stakeholders play a role in improving the quality of early childhood education in Karangpawitan Subdistrict. The active involvement of the local government is imperative to provide adequate policy support, budget, and training facilities.

The development of competencies among early childhood education teachers is typically supported by training that utilizes the TPACK approach model. The TPACK approach is a training model that aims to enhance teachers' proficiency in leveraging technology to facilitate learning activities. Through this training, early childhood education teachers are expected to acquire the skills necessary to effectively integrate technology into learning, thereby creating more engaging and meaningful learning experiences for children.

The TPACK framework is a theoretical model that integrates three components of learning: Technological Knowledge (TK), Pedagogical Knowledge (PK), and Content Knowledge (CK) (Mgeladze et al., 2024). This framework was developed to assist educators in comprehending the effective utilization of technology in a learning environment (Vijayatheepan, 2023). In the field of early childhood education, the necessity for a balanced integration of digital tools in childhood learning is emphasized, advocating for structured digital engagement that supports cognitive and social development while mitigating potential harms, such as reduced attention and impaired social skills (Clemente-Suárez et al., 2024).

The TPACK model posits that the effective integration of technology in education is contingent not only on the adeptness in the utilization of digital tools (Zou et al., 2024) but also on the educator's capacity

to seamlessly amalgamate technology with pedagogical methodologies and a comprehensive grasp of instructional materials (Zhao & Wang, 2024). As asserted by Phan (2024), the efficacy of technology integration in learning is determined by the equilibrium between these three TPACK components. Consequently, an early childhood education teacher must possess not only a fundamental understanding of technological functionality but also the capacity to utilize technology in a manner that is both pedagogically sound and content-appropriate, thereby enriching children's learning experiences.

Further, the TPACK framework underpinning this approach encompasses seven distinct components: Content Knowledge (CK), Pedagogical Knowledge (PK), Technological Knowledge (TK), Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and Technological Pedagogical Content Knowledge (TPACK) (Ning et al., 2024). These seven aspects are interconnected, forming a more comprehensive understanding for teachers in designing technology-based learning (Phan et al., 2024). For early childhood education teachers, this understanding is important so that the use of technology is not only instructional but also supports children's creativity and exploration in learning.

In light of the significance of technology integration in early childhood education, a training approach based on the TPACK framework has been advocated as a means to enhance pedagogues' competencies. This training endeavours to assist educators in comprehending the harmonious integration of technology, pedagogy, and teaching materials, thereby facilitating the creation of a learning environment that is both engaging and interactive, aligning with the developmental stages of early childhood. Furthermore, this training offers educators a comprehensive understanding of not only the technical facets of utilizing digital devices but also the pedagogical strategies that facilitate enhancing learning outcomes.

To enhance the efficacy of technology integration in early childhood education in Karangpawitan Subdistrict, Garut, a

meticulously designed training program is imperative. This program must encompass explicit objectives, clearly defined outcomes, and a curriculum that aligns with the needs of both teachers and learners at the early childhood education level. A meticulously designed training program, underpinned by the TPACK framework, is poised to yield substantial benefits, namely the enhancement of teacher competencies and the improvement in the quality of learning in the early childhood education sector. The subsequent section delineates the proposed training activities.

1. Name of Activity:

Early Childhood Education Teacher Training in Technology Utilization to Improve the Quality of Early Childhood Learning in Garut Regency, West Java.

2. Activity Objectives:

- a) Improve early childhood education teachers' understanding of the TPACK (Technological, Pedagogical, and Content Knowledge) model.
- b) Train teachers in selecting and using appropriate technology for early childhood learning.
- c) Develop teachers' skills in designing technology-based learning media.
- d) Enhance teachers' creativity in integrating technology with appropriate teaching methods for early childhood education.
- e) Provide hands-on experience in the use of various technology media.

3. Expected Outcomes:

- a) Improved digital literacy of teachers
- b) Ability to use educational applications and create digital learning media
- c) Improved creativity and teaching
- d) Improving teacher readiness for future education

4. Content/Curriculum Structure:

- a) Introduction to technology in early childhood education
- b) Utilization of digital applications and devices for early childhood education
- c) Media creation for early childhood education teaching and learning
- d) Implementation of technology in the curriculum of early childhood education
- e) Evaluation and reflection of training results

5. Activity Implementation Stages

The stages of activity implementation are outlined in the following activity matrix table.

Table 3. Early Childhood Teacher TPACK-Based Training Models Implementation Matrix

Days	Activity Stage	Activities	Material	Delivery Media	Result
Day 1: Introduction and Basics of Technology Utilization in Early Childhood Education	Opening	Remarks from the committee and related leaders	Training objectives, benefits, and agenda overview	PowerPoint presentation and opening speech	Participants understand the objectives and benefits of the training.
	Pre-Test	Baseline test to measure participants' understanding before training	Multiple choice and short answer questions on technology use in learning	Paper test/digital form (e.g., Google Forms)	Baseline data on participants' level of understanding
	Introduction to Technology in Learning Early Childhood Education	Exposure to the importance of technology in early childhood learning	Basic concepts of technology in early childhood learning	PowerPoint presentation and short inspirational video	Participants understand the basic concepts of technology utilization.
	Types and Benefits of Digital Media for Early Childhood Education	Interactive workshop on various digital media and its application in learning	Types of digital media (images, videos, audio, apps) and their benefits in early childhood education	Live demonstration, visual media, and interactive video	Participants recognize and understand the various digital media that can be used.
	Basic Practices of Using Technology Devices	Hands-on training on the use of laptops, tablets, and projectors in learning	Basic usage of laptops, tablets, and projectors; device safety and maintenance	Hands-on practice with devices and printed module	Participants can operate basic technology devices.
	Reflection and Q&A	Discussion and sharing of participants' initial experiences in using technology	Participants share experiences, challenges, and opportunities.	Group discussion, Brainstorming session	Participants better understand the constraints and opportunities of technology utilization.
Day 2: Implementation of Technology in Early Childhood Education Learning	Day 1 Review	Material summary and discussion on participants' understanding	Summary of Day 1 material	Q&A session and light quiz (Kahoot / Wordwall)	Reinforce participants' understanding of the previous material
	Use of Educational Apps for	Training on the use of educational	Introduction and use of apps like Canva,	Live demos, tutorial videos, and	Participants can use the

	Early Childhood Education	applications such as Canva, Wordwall, Kahoot, and YouTube Kids	Wordwall, Kahoot, and YouTube Kids	individual practice	application in learning.
	Digital Learning Media Creation	Workshop on creating simple learning videos and digital teaching materials	Creating simple educational videos and digital materials	Workshop, design templates, and basic editing apps	Participants produce digital content for learning.
	Technology Integration with Early Childhood Education Learning Methods	Simulation of the application of technology in thematic learning and play methods	Integrating technology in thematic learning and play-based approaches	Simulation, roleplay, case studies	Participants understand how to integrate technology with learning methods.
	Reflection and Q&A	Evaluation and discussion of participants' learning experience	Evaluation of learning experiences and participant feedback	Panel discussion and written/oral reflection	Participants are more confident in using technology.
Day 3: Evaluation and Strengthening Early Childhood Education Teacher Competencies in Technology	Day 2 Review	Re-discussion and reinforcement of material	Review of Day 2 content	Q&A sessions and interactive educational games	Solidify participants' understanding and practice
	Simulated Teaching with Technology	Participants practice learning using technology in front of the class.	Teaching practice using technology and peer feedback	Classroom simulation and digital teaching tools	Participants can apply technology directly in learning.
	Learning Outcome Evaluation	Post-test to measure the improvement of participants' understanding	Post-test to assess knowledge and skill improvements	Digital or manual test form and practical observation	Data on Participant Competency Results
	Follow-up Plan	Development of a technology implementation plan in each participant's classroom	Drafting a classroom technology implementation plan	Technology-based lesson plan templates and group discussion	Participants have concrete plans to implement at school.
	Closing and Certificate Delivery	Certificate presentation and closing ceremony	Final reflection, closing remarks, and certificate awarding	Group photo session, activity recap video, and closing speech	Participants receive a training certificate.

The Training Needs Analysis (TNA) table above offers a comprehensive overview of the implementation stages of the early childhood education teacher training program activities in technology utilization in Garut Regency, West Java. The table details the activity stages, responsible parties, and expected outcomes to ensure effective training planning, implementation, and evaluation. The program's objective is to enhance teachers' pedagogical competence in the utilization of technology through systematic identification of training needs, development of pertinent materials, and facilitation by qualified professionals. This approach is expected to lead to enhanced quality of early childhood learning experiences and support teachers' professional growth over time.

6. Target Participants

- a) Early childhood education teachers in Karangpawitan Subdistrict, Garut Regency
- b) Early childhood education teachers who are members of the Indonesian Early Childhood Educators and Education Personnel Association who have never participated in digital training and have limitations in accessing technology resources
- c) Number of participants: 50 early childhood education teachers

7. Speakers/Instructors/Mentors/Trainers

- a) Academics and education practitioners in the field of early childhood education
- b) Experts in technology-based learning media development
- c) Digital content creation practitioners, namely creators who are experienced in creating educational content

The financial underpinnings of training programs for early childhood education teachers can be integrated into regional development strategies through the allocation of the local budget (Dougherty & Morabito, 2023). Such financial support must prioritize principles of effectiveness, efficiency, and accountability to ensure the optimal use of resources in enhancing human resource capacity. A strategic emphasis on the professional development of early childhood education teachers is paramount in enhancing the quality of early learning environments

(Phillips & Boyd, 2023). This model, while offering a practical framework for budget-based training initiatives, may be subject to limitations due to variations in regional budget capacities, policy implementation, and institutional readiness. These limitations underscore the necessity for further research to explore contextual factors influencing the sustainability and scalability of such financing models. Understanding these contextual factors will not only inform policymakers but also guide educational institutions in developing tailored strategies that align with local needs and resources, ultimately fostering a more robust early childhood education system.

CONCLUSION

The findings of the research indicate that there is an urgent necessity to enhance the technological proficiency of preschool teachers to elevate the quality of early childhood education. The study's findings also denote a persistent disparity in the adeptness of educators in the utilization of technological devices, the development of digital teaching materials, and the incorporation of technology into the learning process. In addressing this critical gap, the Technological Pedagogical Content Knowledge (TPACK) training model emerges as a strategic framework. The model is implemented through three integrated stages: the initial stage is the strengthening of teachers' fundamental technology skills; the subsequent stage is the enhancement of collaborative content development; and the final stage is the application of the learned knowledge through mentoring and simulation in the classroom. This model aims to enhance teachers' technological, pedagogical, and contextual competencies, thereby optimizing their use of technology in the learning process. This approach enables teachers to not only understand the use of technology but also adapt it according to children's developmental needs and learning objectives. The implementation of structured, needs-based training is expected to increase teachers' confidence and readiness to face the challenges of digital-era education while supporting the creation of a more interactive, innovative, and meaningful learning environment for early childhood.

ACKNOWLEDGEMENT

The authors would like to express their gratitude to the Association of Early Childhood Educators and Education Personnel and early childhood education schools in Karangpawitan Subdistrict, Garut Regency. These entities have made a significant contribution to the preparation of this article by offering facilities and resources.

REFERENCES

- Adiyono, A., Hayat, E. W., Oktavia, E. D., & Prasetyo, N. T. (2024). Learning interaction in the digital era: Technological innovations and education management strategies to enhance student engagement. *Journal of Research in Instructional*, 4(1), 205–221.
- Anggraeni, N., & Listiana, A. (2023). The role of contemporary pedagogical technology in ECE: A systematic literature review. *Indonesian Journal of Educational Research and Review*, 6(1), 99–110.
- Artacho, E. G., Martínez, T. S., Martín, J. L. O., Marín, J. A. M., & García, G. G. (2020). Teacher training in lifelong learning—the importance of digital competence in the encouragement of teaching innovation. *Sustainability*, 12(7), 2852.
- Ashraf, H., Ata, G., & Rizwan, A. (2023). Training need analysis model for teachers and managers: A case of trainings at Quaid e Azam Academy for Educational Development, Punjab. *Global Educational Studies Review*, 8(1), 445–461.
- Chang, H. (2023). Technology learning in early childhood education, Case study in Taiwan. *Journal of Education, Humanities and Social Sciences*, 8, 2293–2306.
- Clemente-Suárez, V. J., Beltrán-Velasco, A. I., Herrero-Roldán, S., Rodríguez-Besteiro, S., Martínez-Guardado, I., Martín-Rodríguez, A., & Tornero-Aguilera, J. F. (2024). Digital device usage and childhood cognitive development: Exploring effects on cognitive abilities. *Children*, 11(11), 1299.
- Diederich, K., Currin, F. H., Blasi, K., Schmidt, A. D., David, H., Peterman, K., & Hourcade, J. P. (2024). Changing the dynamics of preschool children's social play with technology: Evaluation of technology-based supports for tools of the mind style play. *Behaviour & Information Technology*, 43(8), 1554–1579.
- Dikdik, A., Suryana, A., Triatna, C., Rahyasih, Y., & Oktaviani, F. F. (2025). Improving teacher's numeracy skills at Cisarua State Elementary School, West Java, Indonesia. *Jurnal Prima Edukasia*, 13(1), 111–127.
- Dinçer, S. (2024). Bridging the gap in technology integration in education: An examination of science teachers' competencies and needs. *Journal of Turkish Science Education*, 21(4), 620–634.
- Dougherty, S., & Morabito, C. (2023). Financing and delivering early childhood education and childcare across levels of government. *OECD Journal on Budgeting*, 2023(2), 1–24.
- Eden, C. A., Chisom, O. N., & Adeniyi, I. S. (2024). Harnessing technology integration in education: Strategies for enhancing learning outcomes and equity. *World Journal of Advanced Engineering Technology and Sciences*, 11(2), 1–8.
- Fatimah, S., Shafie, Z., & Jamaluddin, R. (2025). Relationship between teacher's knowledge and digital technology integration in design and technology teaching practices. *International Journal of Academic Research in Business and Social Sciences*, 15(1), 694–706.

- Fernandes, A. A. R., & Solimun, S. (2022). Comparison of the use of linkage in cluster integration with path analysis approach. *Frontiers in Applied Mathematics and Statistics*, 8, 790010.
- Fitriyah, S. N., Sutadji, E., Dewi, R. S. I., & Kusumaningrum, S. R. (2024). A mixed methods study to address the integration of TPACK in elementary school students' learning process. *Jurnal Penelitian Pendidikan IPA*, 10(8), 5825–5836.
- Gcabashe, N. B. (2024). Empowering teachers: Enhancing business studies teachers' technology integration skills through technology peer mentoring. *Interdisciplinary Journal of Education Research*, 6, 1–12.
- Hai, P. T. T., Giang, N. T. H., Huyen, N. T., Hanh, P. H., & Duong, T. N. (2024). Technology integration in teaching: Applying TPACK model for Vietnamese universities. *VNU Journal of Science: Education Research*, 40(3), 12–22.
- Huang, H. (2025). Development and evaluation of a teacher training program in artificial intelligence technology. *Journal of Advanced Research in Education*, 4(1), 23–31.
- Ismawati, E., Hersulastuti, H., Amertawengrum, I. P., & Anindita, K. A. (2023). Portrait of education in Indonesia: Learning from PISA results 2015 to present. *International Journal of Learning, Teaching and Educational Research*, 22(1), 321–340.
- Jumaah, F. M. (2024). Exploring constructivist learning theory and its applications in teaching English. *The American Journal of Social Science and Education Innovations*, 6(8), 7–19.
- Kittelman, A., Izzard, S., McIntosh, K., Morris, K. R., & Lewis, T. J. (2024). Self-assessment survey: Evaluation of a revised measure assessing positive behavioral interventions and supports. *Assessment for Effective Intervention*, 49(4), 225–232.
- Markaki, A., Malhotra, S., Billings, R., & Theus, L. (2021). Training needs assessment: Tool utilization and global impact. *BMC Medical Education*, 21(1), 310.
- Mgeladze, A., Kapanadze, M., & Chakhaia, L. (2024). From measuring to action: The next steps in physics teachers' technological pedagogical content knowledge. *Science Education International*, 35(4), 429–438.
- Ngema, M. (2024). Enhancing professional development of foundation phase teachers through training needs analysis at primary schools in King Cetshwayo District, KwaZulu-Natal. *UnisaRxiv*, 1(November), 1–21.
- Ning, Y., Zhang, C., Xu, B., Zhou, Y., & Wijaya, T. T. (2024). Teachers' AI-TPACK: Exploring the relationship between knowledge elements. *Sustainability*, 16(3), 978.
- Nurhayati, S., & Novianti, D. (2024). Enhancing digital competence: A comprehensive digital educational games training needs analysis for PAUD teachers. *Jurnal Smart Paud*, 7(2), 169–181.
- Oliveira, S. R., Rocha, H. C. P., França, M. N., Silva, L. G., Rosa, J. P. R., & Veloso, R. G. F. P. (2024). Interdisciplinarity in the use of playful technologies in early childhood education: Impacts on teaching and learning. *Revista de Gestao Social e Ambiental*, 18(11), e09648.
- Özkan, E. Ç. (2022). Scaffolding as teachers' guidance role in the context of constructivist learning approach. *Journal of Educational Issues*, 8(1), 399–419.
- Phan, T. C., Tran, H. Van, Truong, T. D., Le, H. T., & Phan, D. M. (2024). Developing information technology competence in

- online education with the TPACK approach. *Vietnam Journal of Education*, 8(2), 166–176.
- Phillips, A., & Boyd, W. (2023). Characteristics of high-quality early childhood education and care: A study from Australia. *Frontiers in Education*, 8, 1155095.
- Rahayu, A., Widodo, A., Saud, U., & Muslim, M. (2024). Improving technological pedagogical content knowledge (TPACK) of elementary school teachers through training with a collaborative, practical and reflective approach. *Mimbar Sekolah Dasar*, 11(4), 642–658.
- Sabila, A. Z., Nana, N., & Mahmudah, I. R. (2024). Development of interactive learning multimedia based on Somatic, Auditory, Visual, Intellectual (SAVI) approach assisted by Articulate Storyline 3 on circular motion material. *Jurnal Riset dan Kajian Pendidikan Fisika*, 11(1), 11–20.
- Saptani, E., Rukmana, A., & Supriyadi, T. (2024). Analysis of TPACK competence of elementary school physical education teachers: A cross-sectional study. *Mimbar Sekolah Dasar*, 11(4), 702–721.
- Sierra, Á. J., Iglesias, J. O., & Palacios-Rodríguez, A. (2024). Diagnosis of TPACK in elementary school teachers: A case study in the Colombian Caribbean. *Education Sciences*, 14(9), 1013.
- Subasman, I. (2024). Improving the practice of teacher learning reflection through digital technology-based lesson study. *Al-Ishlah: Jurnal Pendidikan*, 16(2), 2621–2634.
- Suwardi, S., Suyatno, S., & Arikunto, S. (2020). The effectiveness of a collaborative academic supervision model of principal and senior teachers in improving junior teachers' academic supervision competence. *Universal Journal of Educational Research*, 8(12A), 7218–7226.
- Teichert, L., & Salman, M. (2023). Digital technology in the early years: A reflection of the literature. *McGill Journal of Education*, 56(2), 292–313.
- Vazirani, A., & Bhattacharjee, T. (2024). What motivates new venture investors? A mixed-method study approach. *IEEE Transactions on Engineering Management*, 71, 10896–10911.
- Vijayatheepan, M. R. (2023). The application of TPACK model in teachers' teaching practices: A study on integration and effectiveness. *The International Journal of Research and Innovation in Social Science*, 8(12), 3955–3969.
- Wahyuddin, N. R., Yanti, N. E., Arnas, R., & Hermansyah, S. (2024). Digital literacy integrated with blended learning in improving EFL students' English language skills: A lesson learned from the Independent Campus Program. *Journal of Language and Literature Studies*, 4(4), 744–757.
- Wibowo, S., Wangid, M. N., & Firdaus, F. M. (2025). The relevance of Vygotsky's constructivism learning theory with the differentiated learning primary schools. *Journal of Education and Learning*, 19(1), 431–440.
- Zhao, X., & Wang, F. (2024). A quantitative model of technological pedagogical content knowledge (TPACK) based on graphical calculation. *Discover Education*, 3(1), 265.
- Zou, R., Jiang, L., Cao, Y., Muthukrishnan, P., Fauzi, M. A., Abdullah, P. A., & Zhang, H. (2024). Mapping fifteen years of technological pedagogical and content knowledge (TPACK) model applications in higher education. *Research Square*, 3, 1–28.