



Needs Analysis of TPACK Development for Pre-Service Early Childhood Education Teachers in Integrating Technology into Early Literacy Instruction

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Abstract. The advancement of digital technology demands that prospective Early Childhood Education (ECED) teachers develop skills to integrate technology effectively into their teaching. Mastery of Technological Pedagogical Content Knowledge (TPACK) is essential for supporting young children's learning through technology. This study analyzes the need for TPACK development among future ECED educators, particularly in fostering early literacy. It focuses on the skills, knowledge, and challenges these educators encounter in applying digital technology to design literacy activities for young children. A total of 110 ECED teacher candidates participated in the study, which employed a descriptive quantitative method using surveys to gather data on their understanding and needs regarding technology and literacy integration. Data were analyzed by calculating frequencies, percentages, and means. The findings revealed that while most prospective ECED teachers possess a fundamental understanding of technology's role in learning and media creation, integrating this technology with pedagogical approaches tailored to early literacy remains a challenge. Limited access to technological tools was another obstacle highlighted by respondents. The study underscores the importance of training programs that strengthen TPACK competencies for prospective ECED educators, focusing on literacy integration. Furthermore, enhancing access to technology facilities, such as well-equipped computer labs and diverse technological resources, is crucial for preparing these educators to address the challenges of digital learning, thus supporting quality education for early childhood.

Keywords: TPACK, Prospective Early Childhood Education Educators, Needs Analysis.

1 Introduction

The ability to utilize digital technology, which has grown rapidly in recent decades, has affected almost all aspects of life. In accordance with Under the Permendikbud, prospective teachers are expected to be able to utilize technology to improve the quality of learning, especially in Early Childhood Education [1]. Referring to this phenomenon, it is necessary to reform teacher education institutions in order to prepare prospective early childhood education teachers with skills relevant to technological developments

[2]. One important framework that supports this ability is Technological Pedagogical Content Knowledge (TPACK). The TPACK concept emphasizes a balanced integration of technology, pedagogy, and content in the learning process [3,4]. For prospective early childhood education teachers, mastering TPACK is very important to support early literacy learning in early childhood, which is the main foundation in the development of children's language and reading skills [5].

Although the urgency of mastering TPACK is increasingly recognized, many prospective early childhood education teachers still face challenges in effectively integrating technology into learning, including literacy. These challenges are caused by various factors, such as limited access to technological devices, lack of training related to the application of technology in literacy learning, and difficulties in choosing pedagogical strategies that are appropriate to early childhood development [6,7]. According to Luo (2021), teachers should understand the interaction between technology, pedagogy, and content to design effective learning. Without adequate mastery in these three aspects, the use of technology in learning tends to be ineffective and can reduce the quality of learning [7].

This study aims to identify the need for developing TPACK in prospective early childhood education teachers in the context of early literacy learning. Literacy in early childhood is an important stage in children's education, where basic skills in language development are the main focus. Therefore, prospective early childhood education teachers must have specific skills in designing and implementing learning that utilizes technology appropriately [9]. Schmidt et al. (2009) stated that teachers who master TPACK are able to create a more innovative and interactive learning environment, which can significantly increase the effectiveness of children's learning [5]. Therefore, this study aims to analyze the skills, knowledge and challenges faced by prospective ECE teachers in developing TPACK, as well as identify more specific training needs for the development of these competencies.

2 Methods

This study used a descriptive quantitative method with a survey approach to evaluate early childhood education teacher candidates' skills, knowledge and challenges in integrating digital technology into early childhood literacy learning. Data were collected from 110 pre-service teachers through a *Google Form-based* questionnaire, designed to measure their understanding and needs related to the use of technology in literacy learning. The questionnaire covered aspects of knowledge, skills, and challenges in the application of digital technology. Surveys were chosen because they are efficient in collecting quantitative data from a large number of respondents [10].

Data was analyzed descriptively by calculating frequencies, percentages, and averages to find common patterns in respondents' answers. This approach provides insights into prospective teachers' level of understanding and identifies areas that require further development. In line with Creswell's (2015) view, descriptive analysis helps make recommendations regarding education and training policies [11]. This method is also effective in identifying gaps in mastery of Technological Pedagogical

Content Knowledge (TPACK), which is critical for successful integration of technology in education [12].

3 Results and Discussion

3.1 An application used to design learning

Based on 110 participating Early Childhood Education teacher candidates, with diverse backgrounds in terms of teaching experience and technology use. Most (90%) reported having attended technology-related training, while 10% stated they had never attended such training. The majority of participants (91.8%) used apps such as Canva to design learning activities. Other widely used apps include YouTube (68.2%), Pinterest (54.4%), PowerPoint (53.3%), Capcut (46.4%), and Learning Apps (42.7%) to present educational materials and create multimedia content for classroom learning. This can be attributed to some educational theories and the use of technology in learning. According to Vygotsky (1978) effective learning occurs when learners interact with the environment and relevant tools [13]. The use of technology in early childhood education learning can reinforce this process, as tools such as Canva and other multimedia applications provide opportunities for prospective teachers to create learning environments that are interactive and support children's cognitive development. In addition, the use of text, images and sound together can enhance learning, especially for young learners such as those in early childhood education [14]. Applications such as PowerPoint, YouTube, and Learning Apps used by these pre-service teachers allow them to present information through various media formats, which can improve information retention and student engagement in the learning

What Technology applications have you learned to design learning activities? (You may choose more than 1 option)

110 answers

Aplikasi Teknologi apa yang pernah Anda pelajari untuk merancang kegiatan pembelajaran? (Boleh memilih lebih dari 1 pilihan)
110 jawaban

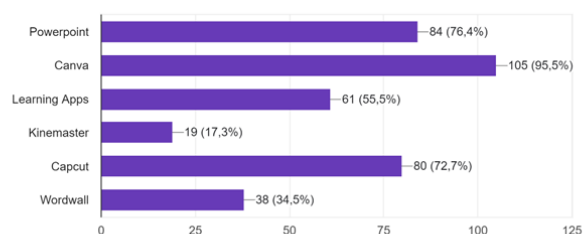


Fig. 1. Technology applications design learning activities

3.2 Basic understanding of technology utilization in learning and learning media development

How do you utilize technology in your lesson plans for PAUD?

Number of answers: 110 answers.



Fig. 2. Technology utilization chart

The chart above shows that 90% of prospective early childhood education teachers have used technology in lesson planning, such as a learning resource, to create worksheets, and for learning evaluation. This shows that the majority of prospective teachers already have a basic understanding and readiness to utilize technology to support the learning process. Based on the Technological Pedagogical Content Knowledge (TPACK) theory developed by Koehler and Mishra (2005), the integration between technology, pedagogy, and content is essential to create effective learning [12]. Although most prospective teachers have used technology, there are still challenges in optimizing its use, especially for deeper innovations, such as utilizing interactive applications to increase student engagement [7]. Dewi et al (2018) also emphasize that the maximum use of technology requires a further understanding of how technology can be matched with appropriate teaching strategies [15]. Therefore, although the level of technology use is already high, there is still a need for improvement in more creative and strategic use.

3.3 Challenges for future Educators in Using Technology for Early Childhood Literacy Learning

The chart shows that the integration of technology with appropriate pedagogical strategies in early childhood early literacy learning remains a significant challenge for prospective educators. Of the 110 respondent teachers, 47.2% reported limited knowledge and skills in utilizing technology effectively, while 25.9% cited limited internet access as a major barrier. While many pre-service teachers already understand

the basics of using technology, it is challenging to optimally apply technology to support appropriate pedagogical strategies in early childhood literacy learning.

What are the challenges in creating ICT media for teaching in Early Childhood Education?.

Apa tantangan dalam membuat media TIK untuk pembelajaran di PAUD?

108 jawaban

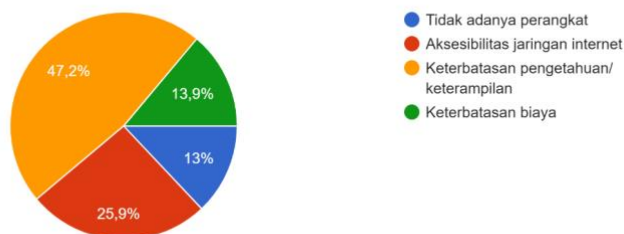


Fig. 3. The challenge of creating ICT

This limitation shows that even though technology is already used, further mastery of how to integrate technology with effective pedagogy is still needed so that the learning process can take place more optimally and innovatively [7]. As stated by Voogt and McKenney (2017), the development of TPACK skills is needed to increase the effectiveness of technology-based teaching [16]. In addition, limited internet access, as reported by 25.9% of respondents, is a significant inhibiting factor in utilizing technology thoroughly [17]. Hutchison and Reinking's (2011) study also highlighted the importance of adequate access to enable better use of technology in literacy teaching [18].

3.4 Challenges for future educators in using technology for early childhood literacy learning

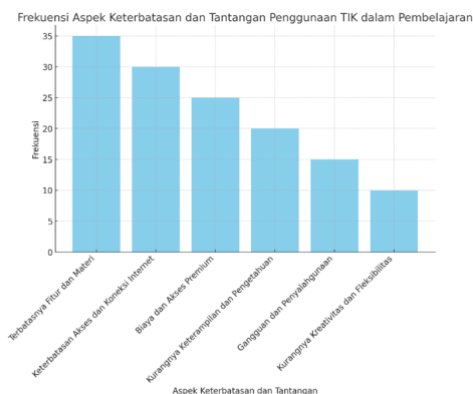


Fig. 4. Askes Frequency Limitations and Challenges

Training and workshops are considered more effective because teachers are actively involved in the learning process [19]. Through these activities, teachers not only passively receive materials, but also get the opportunity to practice new skills directly. In the context of ICT learning for early childhood, practice-based training allows teachers to develop digital learning media, educational applications and interactive strategies that can be directly applied in the classroom. Active engagement in workshops also helps teachers better understand how to integrate technology with appropriate pedagogical strategies and tailor materials to students' needs [20].

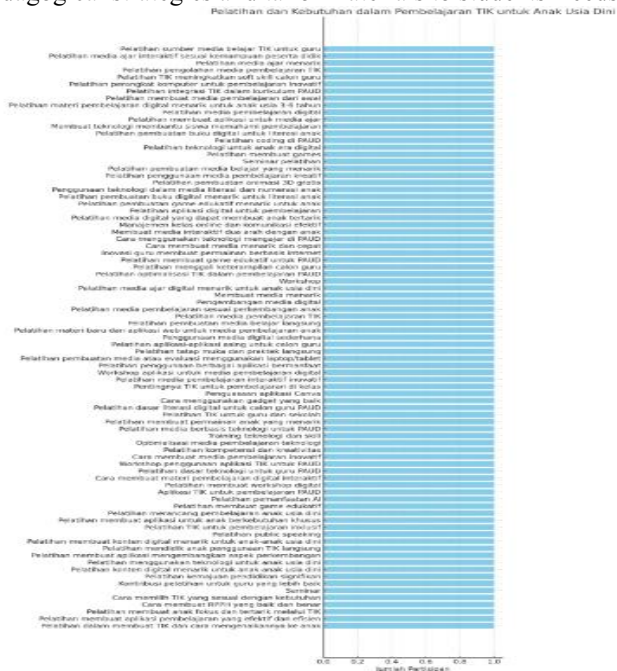


Fig. 5. Training Needs

The bar chart above illustrates the various training topics and needs in Information and Communication Technology (ICT) learning for prospective educators, with each category having an equal number of participants. This indicates that all training topics are considered important and relevant by the participants. Based on an analysis of 110 pre-service early childhood education (ECE) teachers, the majority expressed a need

for additional training in the use and integration of technology in their teaching. The findings revealed four key areas for training:

1. ICT Media Creation:

- Training on developing effective and efficient educational applications.
- Designing digital and interactive learning materials.
- Creating educational games and optimizing technology use in teaching.

2. Technology Use in Learning:

- Training to engage children using technology and maintaining their focus.
- Supporting inclusive education through digital applications and content.

3. Teacher Competency Development:

- Enhancing creativity and technical skills in using ICT.
- Addressing classroom management, public speaking, and digital safety.

4. Flexibility and Accessibility:

- Developing flexible digital content that adapts to curriculum updates and student progress.
- Improving access to technology, especially for rural areas.

The training aims to improve teachers' competencies, creativity, and the effective integration of technology in early childhood education.

4 Conclusion

In general, the result shows that prospective early childhood educators have a basic understanding of the use of technology in learning and the development of learning media. However, the main challenge faced is the limited knowledge and skills in integrating technology with appropriate pedagogical strategies, particularly in early childhood literacy learning. In addition, limited access to technological devices was also a significant barrier expressed by respondents. This finding confirms the need for training programs that focus more on developing Technological Pedagogical Content Knowledge (TPACK) competencies for prospective early childhood educators so that they can more effectively use technology in literacy teaching. Comprehensive and in-depth training is needed to equip prospective teachers with the ability to combine technology with innovative pedagogical strategies to create learning that is more interactive and relevant to early childhood development.

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