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Understanding Pre-Service Teachers' Perception in Applying Teaching Media: A TPACK-Based Study

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A B S T R A C T

This study explores how English pre-service teachers at Semarang State University develop and apply digital teaching media using the Technological Pedagogical and Content Knowledge (TPACK) framework. In today's digital learning environment, teachers are expected not only to master subject content but also to skillfully combine it with suitable teaching methods and digital tools. Based on the findings, the participants showed strong ability in using digital platforms such as Canva, Quizizz, Wordwall, and Google Classroom. They integrated these tools with their lesson plans to make learning more interactive, engaging, and student-centered. Although they faced challenges such as limited teaching time, unstable internet access, and a lack of school facilities they managed to adapt by modifying their teaching strategies and media use. These results confirm what suggested: that effective technology use in education requires a deep understanding of how content, pedagogy, and technology work together. This study highlights the importance of preparing future teachers with real-world experiences and practical digital skills to meet the demands of modern classrooms.

Keyword: *Pre-Service Teacher, Teaching Media, TPACK*
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INTRODUCTION

In the 21st century, learning has shifted from a teacher-cantered approach to one that emphasizes technology's role in student engagement and understanding, highlighting the critical function of teaching media to bridge content and comprehension for students (Zuhir et al., 2021). Technological advancements have significantly transformed how students learn and engage with educational content (Zahynei-zabolotenko et al., 2023). In this context, teaching media plays an important role as a bridge between learning content and student understanding. Educational media—whether visual aids, audio tools, or interactive digital content—serve to capture students' attention, facilitate abstract concept understanding, and enhance learning motivation (Gunahariati et al., 2022). The Indonesian Ministry of Education and Culture emphasizes the importance of digital literacy for teachers to adapt to current learning needs (Tinmaz et al., 2022). Therefore, effective and context-appropriate use of teaching media is an essential skill for teachers in the digital age.

The role of teachers in choosing and applying appropriate teaching media is integral to their professional capacity and directly impacts educational quality (Ridwan et al., 2024). Teachers need to understand not only the content of the material being taught (Content Knowledge), but also appropriate teaching strategies (Pedagogical Knowledge), as well as the ability to integrate relevant technology (Technological Knowledge). These three aspects are reflected in the Technological Pedagogical and Content Knowledge (TPACK) framework, which is an important guide in developing teacher competencies in the digital era. Many teachers face significant challenges in harmonizing these aspects of knowledge due to the

complexities present in the current teacher education policy (A. Kennedy, 2024). Some teachers report low confidence in using digital media due to limited digital self-efficacy, while others feel undermined by the institution's lack of adequate training programs, content support, and infrastructure, hindering effective technology integration. This sentiment aligns with research identifying major obstacles such as insufficient in-service training, inadequate content and technical support, and deficient infrastructure, all of which significantly impede teachers' ability to integrate technology in their teaching (Oğuzhan Atabek, 2019).

Teachers' perceptions regarding their pedagogical-technological knowledge significantly influence their implementation of educational media (Meirovitz et al., 2022). The integration of content, pedagogy, and technology knowledge is essential for effective teaching with technology. Perceptions of teachers regarding the use of teaching media significantly influence its implementation in classrooms, reflecting their subjective assessment of its usefulness and relevance to the learning process (Huang et al., 2022). Previous studies have shown that teachers who hold a positive perception of digital media are more motivated to use it in their instructional practice (Gil-Flores et al., 2024). Conversely, educators with limited ICT training often develop negative attitudes toward integrating technology into the classroom, particularly in schools lacking adequate infrastructure. However, most research continues to emphasize technical or media-effectiveness aspects rather than exploring teachers' perceptions of integrating technological, pedagogical, and content knowledge as articulated in the TPACK framework (Merjovaara et al., 2024).

In Indonesia, various studies have shown that teachers have mixed perceptions of the use of technology-based learning media. Understanding these perceptions is crucial for designing targeted training programs and interventions that effectively integrate technology, pedagogy, and content knowledge (Stergou et al., 2020). Few studies have delved deeply into how teachers interpret the use of instructional media within the TPACK framework, especially in the context of Indonesian junior high schools (Simanjuntak, 2022). For example, research by (Hartati et al., 2025) at SDIT Ridhotullah in West Sumatra showed that some teachers considered digital media to be very helpful in increasing student enthusiasm and material diversity. Similarly, ATEŞ & TEKİN (2024) showed that pre-service teachers using Web 2.0 tools for assessment had positive attitudes but generally low assessment literacy, particularly in understanding and applying alternative assessment methods. This is supported (Nor Pazilah et al., 2021)by highlighting the perception of teacher training programs. They reported that hands-on experience improved interaction with students. Then, service learning enhanced the understanding of pedagogy and student differences. Another systematic literature review on social science technology-based learning identified significant impediments—including high procurement costs, scarce teacher training, and a lack of technical staff—which collectively discouraged teachers from incorporating digital tools into their teaching (Bahtiar et al., 2024). Further, research mapping the perception and actual practice of technology integration among Indonesian senior high school teachers demonstrated that while positive perceptions were common, teachers' implementation often aligned only with basic levels of SAMR (Substitution and Augmentation), indicating a gap between intent and meaningful integration (Setyaningsih et al., 2020).

There is still limited research that comprehensively explores teachers' perceptions in direct relation to TPACK dimensions—specifically, how their technological knowledge aligns with their pedagogical strategies and content delivery. In Indonesia, many teachers have expressed varied opinions about the use of technology-based learning media in the classroom. Some see it as a helpful tool to boost student engagement and add variety to the learning materials, while others feel limited by challenges such as a lack of training, poor infrastructure, and minimal institutional support. Teacher training programs have made efforts to introduce hands-on experiences and service learning, which have helped improve teaching strategies and awareness of student differences. However, despite the growing availability of digital tools, some teachers still struggle to use them effectively, often applying

them only at a basic level rather than integrating them into deeper, more meaningful teaching practices.

Even with all this growing interest in technology integration, there is still a noticeable gap in research, especially when it comes to understanding how pre-service teachers, those still in training, experience and interpret the use of instructional media. Most previous studies have focused on practicing teachers or have only looked at the technical functions of media tools. What's missing is a deeper look into how future teachers connect technology with the way they teach and the content they deliver, especially during their early teaching experiences in junior high school settings. This study aims to fill that gap by exploring the real challenges and practical experiences of pre-service teachers through the TPACK framework. The goal is to provide insights that can help create more relevant and effective teacher training programs, grounded in the actual needs and classroom realities of those preparing to enter the profession.

The urgency of conducting this study becomes even more evident when viewed in the context of the growing demand to improve teacher competencies in response to the rapid evolution of educational technology. As classrooms increasingly integrate digital tools, it is essential to ensure that teachers are not only equipped with technological skills but also confident and purposeful in their use of instructional media. However, if we fail to understand how teachers perceive these tools, professional development initiatives risk being irrelevant, ineffective, or misaligned with the realities of classroom practice (Morina et al., 2025). This study, therefore, plays a pivotal role in generating empirical evidence that can support the development of more responsive and contextually grounded training models. Specifically, it aims to inform educational institutions, policymakers, and curriculum developers in crafting professional learning strategies rooted in the TPACK framework strategies that genuinely reflect teachers' experiences, perceptions, and on-the-ground needs. Based on this background, this study aims to explore in depth the challenges and experiences that teachers face in using teaching media within the classroom, particularly to the core components of the TPACK (Technological Pedagogical and Content Knowledge) framework.

Rather than merely identifying teachers' general perceptions, this research focuses on uncovering the real-world obstacles they encounter, such as limited technological infrastructure, a lack of institutional support, time constraints, and pedagogical uncertainty, alongside the strategies they employ to navigate these challenges. According to Oğuzhan Atabek (2019) A qualitative study on technology integration challenges reports insufficient infrastructure, inadequate training, and lack of support as the main barriers to effective use of digital tools in education. It also investigates how teachers lived experiences, including their previous exposure to technology and their levels of professional readiness, influence their ability to integrate media into their teaching meaningfully. The same systematic review highlights both internal (experience, confidence) and external factors (institutional support, infrastructure) as interconnected influences on teacher practice under TPACK (Kholid et al., 2023). The findings are expected to offer an empirical foundation for developing more responsive and realistic teacher training models programs that not only provide technical skills but also empower educators to critically adapt technology to fit their instructional goals, student needs, and school environments. Such a model is vital for ensuring that technology integration is not superficial but genuinely supports meaningful, context-sensitive learning.

METHOD

This study used a qualitative research approach to explore teachers' perceptions of learning media within the Technological Pedagogical and Content Knowledge (TPACK) framework. Exploring teachers' initial TPACK perceptions and instructional technology use through qualitative interview methods. Relevant for exploring foundational perspectives on media integration (Oktasari & Hediansah, 2020). A qualitative design was chosen as it allows for in-depth exploration of participants' experiences, beliefs, and attitudes, which are

important in understanding how teachers interpret and implement media use in actual classroom contexts. The flexibility and depth advantages of semi-structured interviews in qualitative inquiry highlight the ability to probe deeply while maintaining research focus (Sarib & Rasak, 2022).

The study involved ten purposively selected respondents who met specific criteria: The participants were drawn from Semarang State University English Language Education Students or pre-service teachers (PPL) who had experience using learning media and were familiar with educational technology. The data collection process consisted of four structured steps. First, the researcher developed an interview guide containing asked the participants probing questions designed to elicit rich information about teachers' experiences, challenges, and attitudes toward the integration of media in their teaching practice, especially about the TPACK domains. Second, ten suitable participants were contacted and recruited based on their willingness and relevance to the topic, and informed consent was obtained to ensure ethical participation. Third, the interviews were conducted individually using WhatsApp voice calls, offering convenience and flexibility for both the researcher and participants. Each interview lasted approximately 30 to 40 minutes and was recorded (with the participants' permission) to ensure accuracy during transcription. The use of WhatsApp was not only practical during time and location constraints but also created a more relaxed environment that encouraged participants to speak freely and reflectively. Finally, the recorded interviews were transcribed verbatim and analyzed using thematic analysis with an inductive approach. This involved reading the transcripts multiple times to identify recurring patterns, themes, and significant statements that reflected the core aspects of technological, pedagogical, and content knowledge.

The main instrument in this qualitative research was the researcher, as qualitative studies rely heavily on the researcher's role in determining the focus, selecting participants, collecting data, and interpreting results. In this study, the researcher was actively involved throughout the process to ensure accurate and meaningful findings. To support data collection, a semi-structured interview guide was also used, developed based on the research objectives. The interview questions aimed to explore pre-service teachers' perceptions of teaching media in the classroom, focusing on the advantages and disadvantages, whether the media was engaging and easy to use for students, students' responses during its use, the impact of teaching media on student participation, and its appropriateness for learners of various ability levels. The flexible format of the interviews allowed participants to express their experiences in depth while still keeping the discussion aligned with the research focus.
This use of thematic coding aligned to TPACK domains found that coding data according to technological, pedagogical, and content knowledge provides insight into teachers' interplay of these components (Fimansyah et al., 2021). Attention was also paid to the broader contextual factors that influenced participants' views, including access to infrastructure, availability of training, and institutional support. Strong alignment with ethical norms in qualitative interview research is described by (Diah & Hidayati, 2025), who emphasize confidentiality, informed consent, anonymity, and participant voluntariness. By combining a flexible semi-structured interview design with purposive sampling and remote data collection, this study was able to capture nuanced insights into how Indonesian teachers perceive and apply instructional media in their classrooms. The results are expected to contribute to the development of more responsive, contextually grounded training models that align with real teaching needs and are informed by the lived experiences of educators. Overall, the methodological approach chosen in this study ensures depth, credibility, and relevance in addressing the research objectives, while highlighting the voices of teachers as key stakeholders in the integration of educational technology.

FINDINGS AND DISCUSSION

The findings of this study reveal that most pre-service teachers had positive experiences in applying digital learning media aligned with the TPACK framework. They were generally able to integrate technological, pedagogical, and content knowledge effectively, even if some were not fully familiar with the theoretical details of TPACK. Many developed their skills through teaching simulations and classroom assignments, allowing them to use platforms like Word Wall, Quizizz, and Canva creatively. However, they also faced challenges, bad connections, inadequate facilities (projector and LCD), and time constraints. Despite these obstacles, all participants showed the ability to apply core aspects of TPACK particularly TK, TPK, TCK, and TPACK, when applying digital learning media.

Experiences in Applying Digital Learning Media Concerning TPACK

Technology Knowledge (TK)

According to (Lee et al., 2022) Technological Knowledge (TK) refers to understanding how to use digital technologies to enhance student learning, including awareness of what technologies are available, how they function, and why they are useful in educational settings. According to the data, the researcher collected that all pre-service teachers mastered several applications in teaching. Table 1 presents the results of the questionnaire related to pre-service experiences related to Technological Knowledge (TK).

Table 1: Pre-Service Teachers' Experiences on Technological Knowledge (TK)

No.	Questions	Sub-Themes	Sample Respondent Quotes
1.	Have you applied digital learning media through the effective use of technology?	Classroom Adaptation of Digital Tools	"I used digital tools like Canva, Quizizz, Google Classroom, and Wordwall to help my students understand the lesson better. I chose the right media based on what I was teaching, so the technology supported the learning." (P9) "I used several digital tools, like Kahoot, Mentimeter, and Wordwall." (P3)
2.	I am proficient in using a wide range of digital tools for teaching	Mastery of using digital media	"Yes, I use digital teaching media in addition to attracting students' attention, I feel encouraged to think more creatively in designing character-appropriate learning content. So, for example, I changed the practice questions in the form of interactive quizzes and digital puzzles." (P4)

The pre-service teachers reported using a variety of digital tools to support their teaching practices, including Canva, Google Classroom, Kahoot, Quizizz, Mentimeter, and Wordwall. These tools were not used randomly but were selected carefully based on the lesson content and the students' learning needs. For example, one respondent explained how Canva and Wordwall helped make abstract topics easier to understand and more engaging through visually appealing presentations and game-based activities. Others mentioned how they designed interactive quizzes and puzzles tailored to students' characteristics, learning styles, and levels. Among the tools, Wordwall stood out as the most frequently used for creating interactive games and learning materials, while Quizizz was commonly employed for quizzes that blended assessment with fun competition.

This purposeful integration of technology indicates that the pre-service teachers demonstrated a strong grasp of Technological Knowledge (TK) as described in the TPACK framework. They not only knew how to operate digital tools but also understood how to use them strategically to enhance teaching and learning outcomes. One participant reflected that digital tools not only captured students' attention but also inspired the teacher to think more creatively when designing lessons. This ability to align technology with pedagogy and content reveals that the respondents were not just consumers of educational technology—they

actively utilized it to create more meaningful, student-centered, and effective learning experiences.

Technological Pedagogical Knowledge (TPK)

According to (G. M. Kennedy, 2024) refers to how teachers understand and leverage technology to transform and enhance pedagogical strategies in classroom settings. It involves knowing not just how to use a digital tool, but also how teaching methods can change when specific technologies are integrated effectively. The data showed that most pre-service teachers felt technology helped shape their way of teaching, so they used it to make their lessons more effective. Table 2 presents the results of the questionnaire related to pre-service experiences related to Technological Pedagogical Knowledge (TPK).

Table 2: Pre-Service Teachers' Experiences on Technological Pedagogical Knowledge (TPK)

No.	Questions	Sub-Themes	Sample Respondent Quotes
1.	How do your students respond when you use the Teaching Media you use in class?	Student Engagement and Motivation	"For the students themselves, they are very enthusiastic and enjoy the quiz sessions. Because they also feel more enthusiastic about learning, they feel challenged too, because the quiz is like playing a game." (P2) "It greatly affects student engagement, they are not only silent in the classroom listening to the teacher and only referring to the book, but they also actively answer, pay attention to the statements, and they also evaluate each other's answers." (P5)

All of the pre-service teachers agreed that the use of digital teaching media had a significant positive impact on student engagement and motivation during classroom activities. Unlike traditional methods that primarily relied on textbooks and teacher explanations often resulting in passive learning—the integration of platforms such as Quizizz, Kahoot, and Wordwall transformed the classroom atmosphere into a more interactive and enjoyable space. One pre-service teacher shared that students were highly enthusiastic during quiz sessions because they perceived them as games rather than formal assessments. This game-like experience not only reduced students' anxiety but also fostered a more relaxed and responsive environment where learners eagerly participated in the lesson.

Moreover, these digital tools did not only entertain but also stimulated deeper learning. The interactive nature of the quizzes encouraged students to pay close attention to questions, formulate quick responses, and engage in reflective discussions with peers. Another participant noted how students evaluated each other's answers, showing signs of critical thinking and peer-to-peer learning. Through such engagement, students were no longer passive listeners but became active contributors in the learning process. This shift supported the development of a more dynamic, collaborative, and student-centered classroom environment, where motivation grew organically from interaction, curiosity, and friendly competition.

Technological Content Knowledge (TCK)

According to (Harris et al., 2009) refers to teachers' understanding of how technology and subject matter interact—with each shaping and constraining the other. Effective TCK involves recognizing which technologies best represent or transform content in specific domains, thereby enhancing students' comprehension and application of subject concepts. Table 3 presents the results of the questionnaire on pre-service experiences related to Technological Content Knowledge (TCK).

Table 3: Pre-Service Teachers' Experiences on Technological Content Knowledge (TCK)

No.	Questions	Sub-Themes	Sample Respondent Quotes
1.	Did you teach the material in a way that was suitable for using digital learning media?	Content-Digital Media Alignment	"Yes, I did, vocabulary is a suitable material to use digital learning media such as Wordwall. Interactive digital learning media can increase students' motivation and

			flexibility, so they can be accessed anywhere and anytime." (P10) "I used Quizizz and Kahoot to teach Grammar because these tools provided engaging quiz formats and instant feedback, which allowed students to learn grammar through repeated, game-like practice." (P6)

Pre-service teachers stated that several types of material were suitable for teaching using digital learning media. Among them, Vocabulary and Grammar were considered the most effective to be delivered digitally. For vocabulary, they often used tools like Wordwall that provide flashcard features with images, audio, and games, making it easier for students to remember new words. These interactive elements helped increase students' motivation and flexibility, allowing them to learn anytime and anywhere. To teach grammar topics such as tenses, verbs, and sentence structure, pre-service teachers used platforms like Quizizz and Kahoot. These tools provided engaging quiz formats and instant feedback, which allowed students to learn grammar through repeated, game-like practice. This approach not only made the lessons more enjoyable but also supported a deeper understanding of the material.

Technological Pedagogical Content Knowledge (TPACK)

According to (Harris et al., 2009) Technological Pedagogical Content Knowledge (TPACK) refers to teachers' integrated understanding of content knowledge (CK), pedagogical knowledge (PK), and technological knowledge (TK) and how to combine them effectively when teaching subject matter through technology in pedagogically appropriate ways. Table 4 presents the results of the questionnaire on pre-service experiences related to Technological Pedagogical Content Knowledge (TPACK).

Table 4: Pre-Service Teachers' Experiences on Technological Pedagogical Content Knowledge (TPACK)

No.	Questions	Sub-Themes	Sample Respondent Quotes
1.	Did you implement technology in using learning media to teach the material through various teaching strategies, methods, and techniques?	Technology Supported Lesson Planning	"Yes, I implemented technology using Quizziz as my teaching media. I applied it with different strategies, like starting a lesson with quizzes to attract attention, using group discussions after the quiz to reflect answers, and assigning rewards to boost motivation. I also adjusted the media to match the students' levels. For example, I used images and simple questions for younger students, and more analytical ones for higher levels. This helped make learning more interactive, creative, and effective." (P7) "Yes, I implemented technology during my PPL by using various digital teaching media such as PowerPoint, educational videos, Quizizz, and Wordwall. I applied different strategies to make learning more interactive and engaging. For example, I used PowerPoint to explain the material, then continued with quizzes or games using platforms like Wordwall and Quizizz. These tools allowed me to apply active learning techniques, such as pair work, competition-based games, and interactive reviews. I also adjusted the content to suit different student levels by modifying the types of questions and games used. This integration of technology with varied methods not only increased student motivation but also helped me manage the class more effectively. Overall, technology enhanced my creativity in lesson planning and made the learning process more fun, effective, and student-centered." (P8)

Pre-service teachers integrated technological, pedagogical, and content knowledge in their teaching by utilizing interactive digital tools tailored to student needs. One

implementation of TPACK was through the use of Quizziz as a digital learning medium. The pre-service teacher began the lesson with an engaging quiz activity to capture students' attention and stimulate their prior knowledge. Following the quiz, students participated in group discussions to reflect on their answers and deepen their understanding of the material. To enhance motivation, the teacher provided rewards for high scores, fostering a healthy competitive environment. Furthermore, the teacher differentiated the content by adjusting quiz questions based on students' proficiency levels—using visual prompts and simpler questions for lower levels, and more analytical, concept-based items for advanced learners. This approach not only promoted active and collaborative learning but also supported creativity and effectiveness in delivering the lesson.

Pre-service teachers combined their technological, pedagogical, and content knowledge (TPACK) to create student-centered and engaging lessons. One example of this integration was the use of various digital media tools such as PowerPoint, educational videos, Quizizz, and Wordwall. To begin the lesson, pre-service teachers explained the material using PowerPoint slides, then continued with interactive learning activities using platforms like Wordwall and Quizizz. These platforms allowed for the implementation of active learning strategies, including pair work, competitive games, and interactive reviews. The content was carefully adjusted to match different student proficiency levels by modifying the types of questions and tasks presented. This thoughtful use of technology enhanced student motivation and classroom engagement. Moreover, it helped pre-service teachers manage the class more effectively while also fostering their creativity in designing lessons. The integration of these tools and methods resulted in a more fun, meaningful, and effective learning experience.

The Challenges in Applying Digital Learning Media Concerning TPACK Framework

The researcher identified a challenge encountered by pre-service teachers in developing digital media within the context of the TPACK Framework, namely the limited time available to teach and integrate technology effectively.

Time Constraint in Teaching Technology

One of the significant challenges pre-service teachers encountered during their PPL (Teaching Practice Program) was the limited time available to effectively incorporate digital media into their lessons. While most of them were eager and capable of integrating various digital tools such as Quizizz, Canva, and Wordwall, the time allocated for teaching in schools often restricted their ability to plan and execute lessons that fully utilized the TPACK (Technological Pedagogical Content Knowledge) framework. For many, combining technological, pedagogical, and content knowledge in a short teaching duration was a tough balancing act.

One respondent admitted, "*Creating the digital media took quite a long time. I had to make sure the media matched the material and was also suitable for the students. But sometimes, the time in class was just not enough, so I couldn't use all the media I had prepared.*" (P6). This sentiment was echoed by another respondent who said, "*We want to explore and maximize the use of digital tools, but the time to teach is limited. Sometimes the school's schedule is already packed, and we only get a short slot to teach.*" (P8).

Moreover, pre-service teachers shared that while tools like Wordwall and Quizizz helped make the lessons more interactive and fun, they also required additional preparation time, especially when customizing activities to align with the lesson goals. For example, designing a quiz that suits students' levels and abilities, uploading the content, and testing the tools before class could be time-consuming. When the actual teaching time was too short, the teachers had to cut or rush through some of the planned digital activities, reducing their intended impact on student learning.

Additionally, some pre-service teachers faced technical limitations that made it even more difficult to make use of the digital tools efficiently. "*Sometimes I had already prepared everything, but the internet was slow or the projector wasn't working. So, I had to change the plan*

quickly," said another participant (P2). These unanticipated problems required them to think fast and adapt their lesson delivery, which added more pressure within the already limited teaching time.

Despite these constraints, many pre-service teachers still viewed the use of digital media as a powerful aid in the classroom. They emphasized that proper time management, flexibility, and creative problem-solving were essential in overcoming such challenges. Their experiences highlighted the need for better support systems and training in lesson planning that incorporates technology effectively within real-world classroom time limits.

Technical Problems

One of the most frequently mentioned challenges faced by pre-service teachers during their PPL (Teaching Practicum) was related to technical problems. These technical issues often hindered the effective implementation of digital teaching media, despite the teachers' creativity and preparation. A major problem raised by several participants was the limitation of school facilities. For example, one participant noted that some schools lacked projectors, making it difficult to use interactive media such as Wordwall: *"In some schools, the facilities are still limited. For example, there's no projector, so I couldn't apply Wordwall"* (P2). This limitation directly affected how pre-service teachers could apply their lesson plans, especially those involving media that require visual presentations and internet connectivity.

Another technical challenge was the issue of unstable or limited internet access, both for the teachers and students. Since most digital tools like Wordwall, Quizizz, and Kahoot require a stable internet connection, several participants found it difficult to carry out the planned activities. One participant stated: *"Sometimes students don't have internet data, or maybe the school Wi-Fi is also slow"* (P2). This kind of problem reduced the effectiveness of the media, especially in group or game-based activities where speed and interactivity are key components. The participant added that sometimes she had to rely on tethering from her phone or ask students to share internet access with peers as a temporary solution: *"The solution is usually to tether from a friend's phone or use the school Wi-Fi, although it's often slow"* (P2).

Additionally, another respondent mentioned a technical limitation within the Wordwall platform itself. She explained that when creating a quiz link, the system does not separate the results by class, making it more difficult to evaluate students individually across multiple groups: *"When you create a link once, it cannot be separated by class, so all the students' results are mixed together. It's a bit tricky when it comes to assessment"* (P1). This problem not only complicated assessment but also affected classroom management and feedback.

Despite these technical problems, the pre-service teachers remained optimistic and sought alternative solutions to continue using teaching media effectively. They emphasized the importance of being flexible and adaptive, particularly by conducting trial and error to discover what works best for different classroom conditions. In summary, while the integration of digital media offered clear benefits in enhancing student engagement and learning, technical issues such as limited infrastructure, poor internet connectivity, and platform limitations were real obstacles that pre-service teachers needed to overcome during their practicum experience.

Time Constraints in Applying Digital Learning Media

One of the significant challenges faced by pre-service teachers in implementing digital learning media during their teaching practicum was the limitation of time, both in lesson planning and classroom execution. From the interviews conducted, many participants shared that integrating digital media required additional preparation time, especially when adapting games or quizzes to match students' proficiency levels. One respondent explained, *"When I created a quiz link, it couldn't be separated by class, so all classes had to use the same one, which made the assessment part a bit tricky."* This indicates that even after preparing materials like Wordwall quizzes, the pre-service teachers had to spend more time managing class-specific adjustments, which became time-consuming.

Moreover, several respondents mentioned that using digital tools like Wordwall, Quizizz, or Canva was not only limited by time but also by technological infrastructure. For example, one participant stated that the school's internet connection was unstable or some students did not have active data plans. *"Sometimes students didn't have data packages, or the school's Wi-Fi was too slow,"* she explained, showing how limited internet access could delay or disrupt the learning process. Without a stable connection or supporting facilities like projectors, teachers found it difficult to run digital tools smoothly, affecting the flow of their lessons. Another pre-service teacher noted that preparing interactive materials took more time compared to traditional methods: *"If I used traditional methods, I wouldn't have to go through the hassle of arranging materials and making the games in advance."*

Despite these time limitations, most pre-service teachers acknowledged that digital media had a positive impact on student engagement. However, due to time constraints, they often had to simplify their plans or revert to conventional methods when the digital approach became impractical. They also shared that adapting content for each lesson, dealing with technical issues, and adjusting materials for different classes all required significant effort and planning. One participant even mentioned having to rely on a friend's mobile hotspot or wait for a better signal in order to carry out her lesson.

These findings underline the importance of having adequate infrastructure and institutional support if the integration of digital technology in education is to be successful. It also highlights the need for pre-service teachers to receive training in time management and flexible lesson planning, especially within the framework of Technological Pedagogical Content Knowledge (TPACK).

Discussion

This section presents an interpretation of the research findings in relation to previous studies. The aim of this discussion is to analyze how the results align with or differ from earlier research. The data revealed that English pre-service teachers participating in the UNNES LANTIP 4 Program demonstrated strong mastery of Technological, Pedagogical, and Content Knowledge in their teaching practices. They gained valuable experience in developing digital learning media, particularly in applying four key components of the TPACK Framework: Technological Knowledge (TK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and the integrated Technological Pedagogical Content Knowledge (TPACK).

They also found several challenges in creating digital learning media. One of the challenges that refers to the TPACK Framework is the time constraints in teaching technology. This challenge refers to one aspect of the TPACK Framework, that is Technological Pedagogical Knowledge (TPK). Moreover, the researcher also found several additional challenges in creating digital learning media. There were time constraint in teaching technology, technical problems, and time constraints in applying digital learning media.

The Experiences in Applying Digital Learning Media Concerning TPACK Framework

The findings from this study reveal that pre-service teachers demonstrated a solid understanding of Technological Knowledge (TK), as defined by (Ait et al., 2023) which emphasizes knowing how to use digital technologies effectively to support student learning. All respondents had experience using a variety of digital platforms, including Canva, Quizizz, Google Classroom, Kahoot, Mentimeter, and Wordwall. These tools were carefully selected based on the learning objectives and student needs rather than being used arbitrarily. For instance, one respondent shared how Canva and Wordwall made abstract topics more accessible through visual presentations and game-based activities. Others highlighted how they transformed traditional exercises into interactive quizzes and puzzles to suit the characteristics and levels of their learners. Among the tools used, Wordwall was especially favored for creating games, while Quizizz was commonly employed for formative assessments. These findings suggest that pre-service teachers had not only technical proficiency but also strategic awareness in selecting and applying digital tools.

In relation to Technological Pedagogical Knowledge (TPK), pre-service teachers reported that technology integration significantly transformed their teaching strategies and increased student engagement. According to (Zhang, 2022), TPK involves knowing how technology can enhance and reshape teaching methods. The respondents observed that digital platforms like Quizizz and Kahoot created a lively, game-like environment where students felt more enthusiastic and motivated. One pre-service teacher described how quiz activities became a source of excitement and healthy competition, making students feel more challenged and actively involved. Moreover, instead of being passive recipients of knowledge, students were observed discussing and evaluating each other's responses, which led to deeper cognitive engagement and peer-to-peer learning. These practices clearly demonstrate how technology, when used purposefully, can support interactive pedagogy that promotes collaboration, reflection, and critical thinking among students.

The findings also show a strong alignment with Technological Content Knowledge (TCK), which, according to (Harris et al., 2009), emphasizes the interplay between subject matter and technology. Respondents stated that certain topics, particularly vocabulary and grammar, were effectively delivered using digital tools. Wordwall, for example, was frequently used to teach vocabulary through games, flashcards, and matching activities, supported by visuals and audio to aid memory retention. For grammar lessons, Quizizz and Kahoot enabled students to practice rules through repeated, interactive quizzes that offered immediate feedback. This approach not only made lessons more engaging but also helped students to internalize content through practical application. The pre-service teachers demonstrated a clear understanding of how to choose technology that best aligned with the learning objectives of specific subject areas, thus enhancing content delivery and comprehension.

Finally, in terms of Technological Pedagogical Content Knowledge (TPACK), the respondents showed their ability to integrate all three domains, technology, pedagogy, and content, into cohesive and effective teaching practices. Pre-service teachers used PowerPoint and educational videos to present content, followed by activities using Quizizz and Wordwall to reinforce learning through interactive strategies like games, pair work, and group discussions. They also differentiated instruction by adjusting content difficulty according to student levels. For example, visual aids and simple quizzes were used for beginners, while more analytical tasks were assigned to advanced learners. This strategic blending of content, pedagogy, and technology not only improved lesson delivery but also enhanced classroom management, student motivation, and teacher creativity. As such, these findings reflect a strong mastery of TPACK principles, equipping pre-service teachers with the tools and mindset necessary for effective and innovative digital-age teaching.

The Challenges in Applying Digital Learning Media Concerning TPACK Framework

The findings of this study revealed that while pre-service teachers demonstrated a solid understanding and application of digital learning media, they also encountered specific challenges, particularly in relation to the TPACK framework. In terms of Technological Knowledge (TK), all participants reported using a wide variety of digital tools such as Canva, Google Classroom, Wordwall, Quizizz, Mentimeter, and Kahoot. These tools were not chosen arbitrarily but were purposefully selected based on the lesson content and learners' needs. For example, visual design tools like Canva were used to create visually appealing content, while platforms like Quizizz and Wordwall provided game-based and interactive activities that aligned well with the subject matter. This demonstrates that the pre-service teachers had good mastery of TK, showing not only how to operate digital tools, but also how to use them effectively to support student engagement and content delivery. However, despite this strong foundation, several pre-service teachers expressed challenges such as limited time to fully explore the potential of technology, technical constraints, and the need to constantly adapt to new digital tools.

In terms of Technological Pedagogical Knowledge (TPK), the data shows that digital tools had a transformative effect on how pre-service teachers designed and delivered their lessons. The integration of tools like Quizizz, Wordwall, and Kahoot enhanced the learning atmosphere, making the classroom more interactive and student-centered. The quizzes were perceived by students as fun games, which increased their enthusiasm and reduced anxiety. Pre-service teachers noticed a clear shift in student behavior—learners became more active, paid closer attention, and even engaged in evaluating each other's answers. This interactive and reflective environment promoted both collaboration and critical thinking. However, a key challenge reported was the difficulty in balancing the use of technology with appropriate pedagogy. Some teachers struggled with selecting the right strategy for different learning styles, especially when classroom time was limited or when students had varied access to technology at home.

When considering Technological Content Knowledge (TCK), the pre-service teachers displayed awareness of how digital media can best represent specific content areas. Vocabulary and grammar were highlighted as two content areas that benefited most from digital tools. Tools like Wordwall, with its interactive flashcards and games, were used to teach vocabulary, while platforms like Quizizz and Kahoot helped deliver grammar lessons through repetitive, game-like practice. This shows that pre-service teachers recognized how technology can transform abstract linguistic content into more concrete and engaging experiences. However, one of the main challenges was identifying which digital tools best fit more complex language content, such as literary analysis or writing skills, which required deeper cognitive engagement.

Lastly, the integration of Technological Pedagogical Content Knowledge (TPACK) was evident in how pre-service teachers combined their knowledge of content, pedagogy, and technology to design creative and effective lessons. They used technology not only as a tool for instruction but as a core component of their teaching strategy. Lessons were carefully structured—beginning with a visual or interactive introduction, followed by engaging group tasks, and ending with reflective or competitive review activities. Yet, even with these successful integrations, time constraints, and the pressure to meet curriculum demands sometimes limited their ability to implement all elements of TPACK fully. Overall, while the pre-service teachers showed promising capabilities in using digital learning media, the findings suggest the need for continued support and training in navigating the complexities of TPACK in real classroom contexts.

CONCLUSION

In the discussion section, the researcher interprets the findings of this study in relation to existing literature. The main purpose of this discussion is to analyze and connect the current results with previous research. Based on the data collected, it was found that English pre-service teachers participating in the UNNES LANTIP 4 Program had a solid understanding of Technological, Pedagogical, and Content Knowledge (TPACK) in their teaching practices. These pre-service teachers demonstrated strong experiences in developing digital learning media, which aligned with the four key components of the TPACK framework: Technological Knowledge (TK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and the integration of all three in Technological Pedagogical Content Knowledge (TPACK).

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