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PRE-SERVICE TEACHERS' EXPERIENCES AND CHALLENGES IN DEVELOPING DIGITAL LEARNING MEDIA THROUGH THE TPACK FRAMEWORK

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Abstract

Implementing Information and Communication Technology (ICT) in education transforms traditional learning into modern learning. Teachers must adapt to technology in this era, especially in creating digital learning media. Before becoming formal teachers, they join teacher training programs as pre-service teachers. They develop and implement digital learning media in real teaching. Based on the literature gap, it aims to describe the experiences and challenges overcome by pre-service teachers in developing digital learning media through the TPACK Framework. This study used qualitative descriptive research. The participant of this study was 32 English pre-service teachers were attending the teacher training program namely UNNES LANTIP 4 Program. The data were derived from the closed-ended questionnaire and semi-structured interview. Thematic analysis and method triangulation were employed to analyze the data. The results revealed that all the pre-service teachers perceived mastering content, pedagogical, and technological knowledge. They perceived great experiences in developing digital learning media concerning four aspects of TPACK framework: Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), Technological Knowledge (TK), and Technological Pedagogical Content Knowledge (TPACK). In addition, they also perceived several challenges in developing digital learning media through the TPACK framework. For instance, time constraints in teaching technology, insufficient training programs, time constraints in developing digital learning media, limited access and resources, technical problems, and technology misuse. By understanding this study, pre-service teachers could develop appropriate digital learning media concerning TPACK Framework.**Keywords:** digital learning media, pre-service teachers, TPACK framework

INTRODUCTION

Implementing information and Communication Technology (ICT) is crucial to transforming learning into modern practice by improving student engagement and learning outcomes (Curran et al., 2015; Rickard et al., 2008). To achieve this, teachers must adapt their instructional strategies and develop technological and pedagogical skills (Aldunate & Nussbaum, 2013; Watson & Szapkiw, 2021). Through teacher training programs, pre-service teachers gain theoretical knowledge and practical experience that help them enhance their teaching skills. Mufidah (2019) explains that programs allow them to apply educational concepts in real classroom settings.

Being compatible pre-service teachers means they have competency to develop

digital learning media for the educational process. Digital learning media ability aligns with the TPACK framework, which emphasizes integrating the knowledge of content pedagogical, and technological (Koehler & Mishra, 2009). This theoretical concept emphasizes that successful teaching with technology necessitates comprehension of how three areas of knowledge interrelate to improve student learning. Pre-service teachers skilled in developing digital learning materials can more effectively cater to various learning styles and requirements, fostering inclusivity in the classroom (Hofer & Harris, 2010). Furthermore, as educational settings increasingly incorporate technology, pre-service teachers must have design skills and implement digital media that support curriculum goals and engage students meaningfully (Ertmer & Leftwich, 2010). By mastering these competencies, pre-service teachers become more effective educators, prepared to navigate the complexities of modern teaching environments.

Based on an informal survey, some pre-service teachers did not have experience teaching in a real classroom. They did not join a job as a teacher to teach the students, so they did not have experience teaching in a real classroom, even developing and implementing digital learning media. They only taught the students in the Microteaching Course as a requirement for submitting the course task. In addition, many pre-service teachers faced several challenges in creating digital learning media. The lecturers did not explain how to develop appropriate digital learning media. They only explained the way to develop lesson plans rather than learning media. Moreover, there was no teacher training program before the UNNES LANTIP 4 Program deployment. In fact, teacher training programs are crucial to professional development, especially in creating digital learning media.

Furthermore, most previous studies focused on the perception of pre-service teachers in teaching process, including digital competence, digital teaching materials, assessment literacy using digital tools, teacher training programs, and creating a metaverse classroom (Çebi & Reisoglu, 2020; Demirkan, 2019). There were also several studies on the implementation and perception of developing digital learning media. These studies highlighted the implementation and perception using specific digital learning media, such as digital storytelling (Navila et al., 2023), digital game-based learning (Rüth et al., 2022), and e-portfolios (Kabilan & Khan, 2012).

Besides, several studies highlighted pre-service teachers' challenges in teaching practice. Several issues appear, including adjustment in educational systems, high demand for teaching materials (Ratih et al., 2021), insufficient resources, disruptive student behavior (Abdillah & Fithriani, 2023), and a lack of learning materials (Mudra, 2018). Limited material and students' factors act as a fundmental part in creating experiences for pre-service teachers.

Several studies also highlighted the challenges in creating specific digital learning media. Limbong and Wadham, (2024) focused on the challenges of creating interactive instructional materials using PACIFIC tools. Meanwhile, Nuroh et al. (2025) analyzed the challenges in developing digital storytelling content. These studies focused only on one kind of digital learning media to identify the challenges in specific information. Not only English pre-service teachers, several studies highlighted pre-service teachers participants from other subjects, such as ICT (Boonmoh & Sanmuang, 2024), Economics (Ring & Brahm, 2024), Science (Izgi-Onbasili et al., 2022), and Mathematics (Aiym et al., 2022). They highlighted of pre-service teachers' ability to develop digital learning media,

teaching practices, challenges, and perceptions

In other hand, these studies implemented several theooritical frameworks. Moreover, most of the studies implemented DigComp Framework (Çebi & Reisoglu, 2020), Tehnology Acceptance Model (TAM) (Hwang & Lee, 2024; Rüth et al., 2022), and Curriculum Development Action Research (CD-AR) (Erdem & Erişti, 2022) as theorticial frameworks.

Based on a preliminary study and several previous studies, the researcher found the gaps in this study. This study mainly highlights the experiences and challanges of English pre-service teachers in developing digital learning media through the TPACK framework. There is no specific digital learning media so that any digital learning media can be observed in this study. Moreover, research gaps appear in different participants, locations, and data sampling techniques. In addition, teachers must have knowledge and skills in developing digital learning media. Knowing their experience developing digital learning media, we can infer the teachers' knowledge and ability to design and implement it. Moreover, by understanding the challenges pre-service students face in creating digital teaching media, it can be evaluated for educational institutions to hold a teacher training program to build better quality teachers. This research describes the way pre-service teachers perceived their experiences and challenges in developing digital learning media concerning TPACK Framework. In this study, the researcher proposed two research questions.

1. How do pre-service teachers perceive their experiences in developing digital learning media concerning TPACK framework?
2. How do pre-service teachers perceive their challenges in developing digital learning media concerning TPACK framework?

METHODOLOGY

Research Design

The researcher implemented qualitative descriptive research. A qualitative approach is an approach to explore the individual meaning or groups who think comes from social or human problems (Creswell, 2009). It aims to examine further comprehension of the symptoms and facts of the issue being studied (Raco & Tanod, 2014). Moreover, descriptive research explains the characteristics and facts of spesific population (Dulock, 1993). It is beneficial in explaining rare phenomena or events and identifying new phenomena. Therefore, this method is suitable for investigating the experiences and challenges faced by individuals in depth.

Research Site

It is implemented in schools under the UNNES LANTIP 4 Program. UNNES LANTIP 4 Program is an educational training program for pre-service teachers. Moreover, UNNES LANTIP is a program to develop UNNES students' potential through learning activities in partner education units to develop teaching competencies. There are several schools, including vocational high school, junior high school, and high school. They spread across six cities and districts in Central Java, including Semarang, Demak, Kendal, Temanggung, Magelang, and Salatiga. In this study, the school's characteristics are where pre-service teachers teach English and develop digital learning media, which refers to the TPACK framework in the teaching process. Concerning the ethical standard of research, the researcher kept the information of participants anonymous.

Respondents

This study utilized a sampling of purposive to collect the participants.

Sampling of purposive is a sampling technique where respondents are selected based on the characteristics relevant to this study (Rai & Thapa, 2019). The respondents had several criterias: 1) English pre-service teachers in the UNNES LANTIP 4 Program and 2) teachers using digital learning media concerning the TPACK Framework. Based on these criteria, 32 English pre-service teachers participated in this research. In collecting the information from the participants, the researcher followed the ethical standars. At the beginning, the researcher explained the concept of this study and asked them whether they were willing to contribute as participants. Then, the researcher also keeps the participants' identities anonymous. The information from the participants was not distributed to the public. After gaining the data from the 32 particpant in the questionnaire, the researcher selected seven participants to continue to the interview. They mostly strongly agree with the statements that they have had better experiences and faced the most challenges in creating digital learning media concerning the TPACK Framework.

Instruments

Research Instruments

1. Questionnaire

A questionnaire consists of several questions to collect an individual's crucial information for quantitative marketing and social research (Roopa & Rani, 2012). In this study, the researcher implemented closed-ended questions. Closed-ended questions provide a specific series of response choices. They can be nominal to pick only one answer, whether "yes" or "no", or ordinal to select several answers. It also can be created to choose a single answer or multiple selections (Dillman et al., 2014). There were 11 questions, four with "Yes" or "No" options and seven using the Likert Scale with multiple choices of Agree, Neutral, Strongly Agree, Strongly Disagree, and Disagree. The questionnaire was about the experiences and challenges in developing digital learning media. It referred to the theory of the TPACK Framework by Koehler and Mishra (2009), containing TK, TCK, TPK, and TPACK. The questionnaires were posted to the respondents online via Google Forms.

2. Interview

An interview is a dialogue to collect specific issues, phenomena, and subjects that could be interpreted based on the meanings that the interviewees assigned to it (Schostak, 2006). This study employed semi-structured interviews to gather qualitative information regarding participants' perspectives on a subject and sensitive personal matters (DeJonckheere & Vaughn, 2019). The researcher asked eight questions related to the experiences and challenges in developing digital learning media concerning TPACK Framework. The interview was conducted online via Zoom.

Data Collection Procedures

In conducting research, the researchers asked permission from the English pre-service teachers to become the participants in this study. If they agreed, the researcher distributed the questionnaire to them. The data from the questionnaire is used to sort the respondents who are developing the digital media through the TPACK framework and gain information about pre-service teachers' experiences developing digital learning media concerning the TPACK framework. After compiling the information from the questionnaire, the researcher selected only seven participants to participate in the interview. Seven participants were chosen because they had great experiences developing digital learning media using the TPACK Framework and faced many challenges. The interview is used to gain in-depth information about pre-service teachers' experiences and challenges in producing

digital learning media concerning the TPACK framework.

Data Analysis

Thematic analysis and method triangulation were used to investigate the data in this study. Thematic analysis means a flexible and useful method that results in detailed and complex data (Braun & Clarke, 2006). Creswell and Poth (2018) pointed out that the researchers guaranteed the study's privacy and confidentiality because it involves the respondents' knowledge and willingness. There were six steps of this analysis: 1) adapting the data, 2) generating the code, 3) finding for theme, 4) evaluating theme, 5) labelling theme, and 6) explaining the report (Braun & Clarke, 2006).

Furthermore, Denzin and Lincoln (2018) stated that method triangulation is a technique for validating data from different data collection. The researcher implemented two data sources: a questionnaire and a semi-structured interview in this study. Therefore, it implemented method triangulation to check the validity of the data in this study.

RESULT AND DISCUSSION

Finding1

The Experiences in Creating Digital Learning Media Concerning TPACK Framework

The researchers provided a questionnaire to describe pre-service teachers' experiences creating digital learning media concerning TPACK Framework. The following diagram displays the research findings.

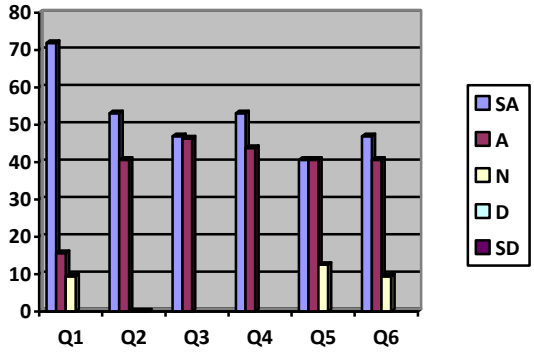

Figure 1. Diagram of Pre-Service Teachers' Experiences

1. Technological Knowledge (TK)

Based on the data, most participants strongly agreed (71.9%), and agreed (15.6%) that the pre-service teachers mastered various digital technologies that can be used in teaching. This total was higher than (9.4 %) of pre-service teachers who chose neutral. Additionally, (53.1%) was strongly agreed, and (40.6%) was agreed that they implement technology in creating digital learning media. Similarly, P3 indicated during the interview:

"I used some digital tools, such as Canva, Kahoot, Quizlet, Quizziz, and Wordwall." (P3)

All pre-service teachers positively perceived Technological Knowledge (TK). They perceived using and mastering several digital tools in developing digital learning media through the TPACK Framework. They used several digital tools, such as Canva, Google Classroom, Google Documents, Google Forms, Kahoot, Quizlet, Quizziz, Booklet, Padlet, and Wordwall. In addition, they mastered several digital tools to develop digital learning media, such as Canva to develop the presentation slides and Quizizz or Wordwall to develop quizzes or game activities.

2. Technological Pedagogical Knowledge (TPK)

Based on the data, most of the participants strongly agreed (46.9%) and agreed (43.8%) that the pre-service teachers implemented digital learning media suitable for lesson plan development, classroom management, assessment, student learning, and teaching methods. Similarly, P5 indicated during the interview:

"....Technology helped to improve students' active participation. For example, the implementation of Kahoot. The activity can be designed to fit the student's needs to be engaging enough for the students." (P5)

All pre-service teachers positively perceived Technological Pedagogical Knowledge (TPK). They perceived that technology influences the teaching strategies and supports their learning approach. Technology influences teaching strategies from traditional to modern ways using digital learning media. To deliver the material, they used Canva or Microsoft PowerPoint to make presentation slides. This way provides engaging and interactive learning materials and encourages students to pay attention.

Furthermore, implementing technology enables students to participate and become more active in the classroom. They usually implemented several digital tools, such as Wordwall, Kahoot, Quizizz, Quizlet, Mentimeter, or Padlet. These applications have several features that create fun and interactive learning. It encouraged participation and competition among students.

Additionally, technology changed the assessment procedure from fixed assessments to real-time feedback. Implementing Quizizz helped the teacher provide instant feedback on their answers. Traditionally, the teachers discuss the evaluation with the students, make remarks, and give feedback over several days. However, the implementation of Quizizz helps the teacher to provide instant feedback on their answers, so it helps them to identify and correct the mistakes immediately. Lastly, technology has increased student collaboration through Google Documents. The students shared their ideas about an issue or wrote a text together in this application.

Besides, the technology supported the teaching approach in the learning process based on several criteria. During the interview, P5 indicated:

"Actually, I used Canva, Kahoot, or Quizlet to modify the activity based on the students' needs." (P5)

The technology supported the teaching approach in the learning process. There were several key points to determine the technology that supports the teaching approach, such as learning outcomes, students' needs, the available facilities at school, the complexity of the platforms, time allocation, students' learning styles, learning environment, accessibility of the digital tools, and the primary focus of work. For instance, if the focus was to check the student's understanding of the material, they used Quizizz or Wordwall to assess students' progress in understanding the material.

Moreover, if the learning outcomes were focused on vocabulary acquisition, they used Quizlet to learn vocabulary from the flashcards. Then, if the focus was to check the student's understanding of the material, they used Quizizz or Wordwall to assess students' progress in understanding the material. These applications were also used to solve the problem when the students were getting bored or sleepy so that the students were excited to learn the material. Pre-

service teachers should understand that the students have different learning styles.

3. Technological Content Knowledge (TCK)

Based on the data, most respondents strongly agreed (53.1%) and agreed (43.8%) that the pre-service teachers taught the material using suitable digital learning media. Similarly, P2 indicated during the interview:

"I think vocabulary and grammar are suitable material using digital learning media. Interactive digital learning media enhanced students' motivation and flexibility, enabling it to be accessed anywhere and anytime." (P2)

All of the pre-service teachers positively perceived TCK. They perceived they could decide which materials are suitable for digital learning media. The types of material that are suitable for delivery through digital learning media were vocabulary and grammar. For instance, they used the flashcard feature in Quizlet to teach vocabulary. It made the learning more engaging and helped the students learn through practice. The students will easily understand vocabulary with help features like images, audio, and games. They used Quizziz or Kahoot to teach grammar, including verbs, tenses, and sentence structure. These digital tools make learning grammar more engaging and allow instant feedback, which helps the students learn through practice. Pre-service teachers also created a new concept of the material using digital learning media. During the interview, P6 indicated:

".....In group writing activity, I usually used paper to write the descriptive text. In a modern way; we can use Google Docs to write narrative text in the group." (P6)

They perceived that they created a new material concept, which became an engaging learning method. Instead of writing the adjective on the whiteboard, they used Blooket to teach the students about adjectives. This digital tool fostered the students to find the meaning of the adjectives in a fun way. Additionally, in the traditional way, pre-service teachers taught regular and irregular verbs by asking the students to remember those words and write the words and their meanings in Indonesian Language. In the new concept, they explained how to change the basic form to regular and irregular with the grammatical rules. Then, they used Wordwall to implement a new concept of the material. The students played the game to match the basic form and the regular or irregular verb. This new concept could foster the students' interest in learning the material.

Furthermore, they usually used paper in group writing activities to write the descriptive text. In the modern world, they use Google Docs to write narrative text in groups. It provided an online space for students to collaborate, share, and discuss ideas. Lastly, they usually asked the students to list vocabulary with definitions and write sentences using those words in their notebooks to teach vocabulary related to daily activities. In a new concept, they used Quizizz or Wordwall to match the vocabulary with pictures or definitions in fun and interactive quizzes.

4. Technological Pedagogical Content Knowledge (TPACK)

Based on the data, the respondents have the same percentage strongly agreed and agreed (40.6%) that pre-service teachers implemented technology in creating learning media for teaching the material using various teaching strategies, methods, and techniques. This total was higher than (12.5%) of pre-service teachers who chose neutral. Additionally, most respondents strongly

agreed (46.9%) and agreed (40.6%) that they implemented digital learning media aligned with the content, pedagogy, and technology in teaching. This total was higher than(9.4%) of pre-service teachers who chose neutral. Similarly, P1 indicated during the interview:

"In teaching, one of the language features of narrative text is the use of adjectives. First, I showed the pictures related to adjectives using Canva. After that, I explained the meaning and function of adjectives. Then, the students are divided into groups to play a game using Wordwall to arrange several adjectives on the list." (P1)

All pre-service teachers positively perceived TPACK to combine content, pedagogical, and technological in teaching. For instance, pre-service teachers explained the material about adjectives in the narrative text through PowerPoint created by Canva. Then, the students were divided into groups to play a game using Wordwall to arrange several adjectives on the list. The students worked in groups using Wordwall to play an adjective-matching game. In the end, pre-service teachers used Quizziz to review adjectives learned during the lesson in a fun quiz format.

Similarly, material about the narrative text, pre-service teachers introduce the material by watching a video animation. After that, every group was tasked to examine the elements and structure of narrative text and analyze the examples of narrative text through Google Forms. Every group was given a task to create a narrative text. After finishing creating the narrative text, every group presented the text displayed on the screen. They explained the structure and elements of the text. Lastly, they are asked to reflect on what they have learned.

Second, pre-service teachers showed a paragraph about daily activities in the form of PowerPoint presentations using Canva. Then, they explained daily activities and the simple present tense. The students were asked to work in pairs to do quizzes provided on Quizizz and Wordwall. Moreover, pre-service teachers used Mentimeter to check students' understanding of the material. The students identified a kind of daily routine in a text. They wrote the words or phrases and the meanings using Google Documents. Then, the students are asked to work individually to do the final assessment through Google Forms.

Third, pre-service teachers told me how to analyze poetry and explained key elements, such as rhyme. They led class discussions on poetry, encouraged the students to write poems, and used peer feedback to help students improve. They used Google Docs to collaborate on analyzing the meaning of poems and poetic devices. Then, they also used short videos to explain these tools visually and engagingly. Thus, all pre-service teachers mastered TPACK to combine content, pedagogical, and technological in teaching.

FINDING 2

The Challenges in Creating Digital Learning Media Concerning TPACK Framework

1. Time Constraints in Teaching Technology

There was a challenge in creating digital learning media concerning Technological Pedagogical Knowledge (TPK). Pre-service teachers perceived that they did not plan effectively to implement technology in teaching. During the interview, P7 indicated:

".... I had planned to use Quizizz to do the game quiz, but I did not know whether the students mastered to use Quizizz or not." (P7)

They planned to use digital learning media in teaching but did not know the student's ability to use digital tools. Initially, they implemented digital learning media to teach them how to use technology, but a challenge happened. Instead of creating fun learning with the digital learning media, pre-service teachers spent extra time teaching them how to operate the application. Thus, time constraints in teaching technology to the students become a challenge in creating digital learning media concerning the TPACK Framework.

2. A Lack of Professional Development

A lack of training programs became a pre-service teachers' challenge. During the interview, P4 indicated:

".... I think I just adapted to technology development and learned it by myself, without any specific guidance from the lecturers or institutions to provide a training program about creating digital learning media concerning the TPACK Framework." (P4)

Pre-service teachers perceived that they did not obtain the training program to develop an appropriate digital learning media for teaching English. The lecturers or educational institutions did not provide specific guidance before deploying the UNNES LANTIP 4 Program. Pre-service teachers might only learn from the teachers in school, but the explanation was not specific. Therefore, pre-service teachers learn the TPACK Framework in detail individually.

3. Time Constraints in Creating Digital Learning Media

Pre-service teachers spent extra time creating digital learning media concerning TPACK Frameworks. During the interview, P5 indicated:

".... The preparation of the learning media using technologies can also be challenging because it is time-consuming." (P5)

Pre-service teachers perceived that they spent extra time from planning until creating the digital learning media concerning TPACK Framework. They needed additional time to prepare the lesson concept using digital learning media. They thought about the digital tools and materials suitable for teaching strategies. They also allocated time to reminiscing about the implications of digital learning media in the classroom. Then, they needed to create or pick the appropriate digital learning media. This process could not happen quickly and immediately. It took a few hours, even a day, to prepare to develop a digital learning media concerning the TPACK framework. Thus, spending extra time becomes a challenge in creating digital learning media concerning the TPACK Framework.

4. Limited Access and Resources

Pre-service teachers perceived that many schools had limited access to technology and a lack of facilities, making it difficult for them to develop digital learning media concerning the TPACK framework. During the interview, P7 indicated:

".... Some schools lack facilities. For example, projector or Wi-Fi." (P7)

The school had two main limited facilities: a projector and an internet connection. Several schools did not provide a projector in every classroom. They only had two or three projectors for all of the students in the school. The problems occurred when all projectors were lent, so pre-service

teachers could not use them. The learning process did not run as expected due to the limited projector.

Furthermore, the internet connection could not reach every classroom. They could only be used in several rooms, such as the teachers' rooms or computer laboratories. When learning depended on internet access, pre-service teachers and students used personal internet connections to continue learning using digital learning media. However, every person had a different internet connection speed. Some had stable internet connections to use the digital tools, but some faced trouble because of the unstable internet connections. The next problem occurred when the students had no personal internet data connection. Hence, limited access and resources to internet connection and projects are becoming the challenges in creating digital learning media concerning the TPACK Framework.

5. Technical Problems

Sometimes, a problem occurrs when implementing digital learning media in the learning process. During the interview, P4 indicated:

"..... I also spent more time troubleshooting technical issues during lessons, like the screen which could not appear during the explanation of the material." (P4)

Pre-service teachers perceived several technical issues in implementing digital learning media in teaching. For instance, the presentation slide did not appear on the screen due to an issue with the projector or a connected cable. These issues caused pre-service teachers to spend extra time troubleshooting during the lesson. It also distracted the lesson and even put the students in a bad mood for studying. In the end, pre-service teachers had limited time to teach the material. Therefore, there was still a material that had not been explained yet.

Moreover, the students could not take the game quiz because their phones belonged to their parents, and they did not know the password. It became an issue during the implementation of game quizzes using digital tools. Hence, the issue of the projector, cable, and account became a challenge in implementing digital learning media concerning TPACK Framework.

6. Technology Misuse

Many schools allow students to use their smartphones at school, but the misuse of technology is a challenge in implementing digital learning media. During the interview, P4 indicated:

"The students also can be distracted by other things in technology rather than focusing on the materials." (P4)

Pre-service teachers perceived that several students did other activities instead of doing the learning activity using their smartphones. For instance, they chat with their friends, watch videos, or even play games together with their friends. They were typically the students who easily got distracted by other things. They were not focused on the material in the learning process, but they did another activity they wanted using their smartphone. Hence, technology misuse becomes a challenge in creating digital learning media concerning the TPACK Framework.

DISCUSSION

English pre-service teachers positively perceived content, pedagogical, and technological knowledge in teaching. They perceived great experiences in creating digital learning media concerning four aspects of TPACK Framework: TK, TCK, TPK, TPACK. First, pre-service teachers

positively perceived TK in teaching. They perceived utilizing and mastering several digital tools, such as Canva, Google Classroom, Google Documents, Kahoot, Quizlet, Quizziz, Mentimeter, Booklet, Padlet, Google Forms, and Wordwall. Not only utilize and master several digital tools, but they also have TK in learning the technology easily, keeping up with important new technologies, using the technology regularly, and solving technical problems (Chakim et al., 2023).

Second, pre-service teachers positively perceived TPK in teaching. Using digital learning media, technology has changed their teaching strategies from traditional to modern. For instance, the implementation of PowerPoint using Canva or Microsoft PowerPoint to deliver the material. Similarly, Hutasuhut and Harahap (2024) stated that technology has made blended learning, flipped classrooms, and personalized instruction possible and has revolutionized traditional educational environments. Furthermore, implementing technology encouraged students to participate and become more active in the classroom. They usually implemented several digital tools, such as Wordwall, Kahoot, Quizizz, Quizlet, Mentimeter, or Padlet. It also enhanced the student's collaboration to share their ideas through Google Documents. Lastly, technology changed the assessment procedure from fixed assessments to real-time feedback. Implementing Quizizz helped the teacher provide instant feedback on their answers, so it helped them identify and correct the mistakes immediately.

In addition, there are several key points to determine the technology which supports the teaching approach, such as learning outcomes, students needs, the available facilities at school, the complexity of the platforms, time allocation, students' learning styles, learning environment, accessible of the digital tools, and the main focus of work. For instance, we used Canva to present materials, images, and videos more engagingly.

Third, pre-service teachers positively TCK in teaching. Based on this research, pre-service teachers explained the materials using suitable digital learning media. Most pre-service teachers use Quizlet to teach vocabulary and Wordwall or Quizizz to teach grammar. In addition, they perceived creating a new concept for the material using digital learning media. For instance, instead of writing the adjective on the whiteboard, they use a Booklet to teach the students about adjectives.

In contrast with this study, the teachers may think they could use subject-specific technologies, but they felt unfamiliar with them (Omoso & Odindo, 2020). The challenge of TCK has been widely discussed by Bowers and Stephens (2011), who state that some subject domains may require more specialist technologies, which many teachers may not be conversant with. For instance, Biology teachers often focus more on technology than content, indicating better integration strategies are needed (Aumann et al., 2024).

Fourth, pre-service teachers positively perceived combining the knowledge of content, technological, and pedagogical in TPACK. For instance, pre-service teachers explained the material about adjectives in the narrative text through PowerPoint created by Canva. Then, the teachers divided the students into several groups to play a game using Wordwall to arrange several adjectives on the list. The students worked in groups using Wordwall to play an adjective-matching game. In the end, pre-service teachers used Quizziz to review adjectives learned during the lesson in a fun quiz format. Similarly, Wahab et al. (2024) highlighted that pre-service teachers showed high performance in TPACK, indicating

strong mastery of technology, pedagogy, and content knowledge.

In addition, there were several challenges in developing digital learning media concerning TPACK Framework. The first challenge is time constraints in teaching technology. Several pre-service teachers did not plan effectively about students' ability to operate the technology. They spent extra time to teach them how to manage the technology. Similarly, Tyarakanita et al. (2020) stated that teaching students how to use technology is necessary because incorporating multiple technologies into the lesson plans reduces the allocated time.

Second, pre-service teachers perceived a lack of professional development in the form of training programs from the lectures or educational institutions before deploying the UNNES LANTIP 4 Program. Most of pre-service teachers felt difficulty in developing the learning media, especially the digital learning media. They did not gain the knowledge about how to utilize several applications or website that used for teaching. They needes to learn individually without any guidance from the institutions or the lecturers. In fact, continuous training and professional development are crucial for the teachers to implement technology into their pedagogical practices, ensuring successful technology adoption in educational environments (Caldeira et al., 2025). In enhancing the quality of education, a modification in the teacher training program is needed through the following steps: planning, execution, evaluation, trainers, trainees, infrastructure, and nature of training (Siddaraju & Dange, n.d.)

Third, pre-service teachers perceived spending extra time preparing and creating digital learning media. It took a few hours or even a day. According to Marpanaji et al. (2018), the teachers should implement three main components of the learning process: planning and preparation process, implementation process, and evaluation process. Planning and preparation process takes a long time because it will develop learning tools for the learning process. For instance, a study highlighted that pre-service teachers required additional time to prepare and develop digital learning media after joining digital events (Kabaran & Altan, 2022). That is why the time in preparing digital learning media becomes a challenge in developing digital learning media.

Fourth, pre-service teachers perceived that several schools had limited access and resources for preparing projectors and internet connections. Not every classroom had a projector; there were only a limited projectors, around two or three in the school. Moreover, the internet connection could not reach the classroom. It could be accessed in several rooms, such as the computer laboratory and the teachers' room. In line with these findings, a study by Swandi et al. (2024) revealed that many schools lack digital facilities, such as projectors and internet connections.

The inadequate facilities, such as projectors and internet, affect the students' learning outcomes. Projectors are among the most appropriate facilities to enhance the students' learning outcomes. Utilizing a projector enhances the students' activity, focus, and understanding level in an outstanding category (Sari et al., 2024). On the other hand, the internet becomes a crucial part of the learning activity. Implementing the internet as a learning resource enhances the students' learning outcomes (Prasetyo & Nurhidayah, 2021). The students could easily access the learning resources, collaborative learning with other students worldwide, expand the information, and develop professional skills (Akpan & Akpan, 2017). By understanding the benefit of adequate facilities, the schools must provide complete facilities to enhance the students' learning outcomes.

Fifth, pre-service teachers perceived that many unexpected technical problems appeared in the teaching process. For instance, the presentation slide did not appear on the screen, and the students did not know the password to join the online quiz. Similarly, Aran et al. (2016) faced the same challenge. They had prepared the presentation slide, but the screen did not display due to the broken cable. The next problem was that the students could not take the game quiz because their phones belonged to their parents, and they did not know the password. To overcome these challenges, the teachers should construct a backup plan. They could switch to the traditional method with the available facilities in the classroom, such as the whiteboard. They could explain the material orally or use a whiteboard as a medium to write several important notes.

Sixth, pre-service teachers perceived that technology misuse appears during the teaching process. The students did not focus on the material but did other activities. For instance, they can chat with friends, watch videos, or play games together. Similarly, Griffin (2014) stated that the students often engage in activities like texting, chatting on Facebook, or playing games during class, leading to a lack of focus on the material being taught.

The integration of smartphones into the educational process brings both advantages and disadvantages. On the positive side, students can access a wealth of information, prepare for their classes, record lectures, and read textbooks related to their subjects. On the negative side, students may engage with social media during class and become distracted by educational content (Bayanova et al., 2019). Besides the positive sides, the teachers should monitor the students' activity while utilizing their gadgets in the lesson. It is implemented to avoid the negative side effects of using smartphones in the lesson.

In a nutshell, English pre-service teachers perceived great experiences in developing digital learning media through the TPACK Framework: TK, TCK, TPK, and TPACK. Besides the experiences, they also perceive several challenges in developing digital learning media. For instance, time constraints in teaching technology, insufficient training programs, time constraints in creating digital learning media, limited access and resources, technical problems, and technology misuse.

CONCLUSION

All pre-service teachers positively perceived content, pedagogical, and technological knowledge in creating digital learning media. Besides, the researcher found several challenges in creating digital learning media: time constraints in teaching technology, a lack of professional development, time constraints in creating digital learning media, limited access and resources, technical problems, and technology misuse. This study contributes to the theoretical development and practical implementation of the TPACK Framework. English pre-service teachers' experiences in developing media related to the TCK, TPK, TK, and TPACK highlight the usefulness of the TPACK Framework in integrating technology. Thus, this study strengthens the theoretical value of the TPACK Framework.

There is a limitation of this study. It only focused on limited participants, two common types of instruments, and only used qualitative research. Then, there are several implications for future research. The researcher could implement a mixed-method approach to gain deep findings through quantitative and qualitative data. They could conduct research with a high number of participants. They could implement classroom observation and documents for the instruments, so it is not only a questionnaire

and an interview. Then, they could observe the advantages of using digital learning media in teaching and solutions to overcome the challenges of creating digital learning media.

It also provides several practical implications for the policymaker. Educational institutions should provide a teacher training program in creating digital learning media before deploying the UNNES LANTIP 4 Program. Then, the lecturers also explain the TPACK Framework Theory as a guide to develop digital learning media. Lastly, there is an implication for classroom practice. English pre-service teachers should implement technology in their lessons. They could develop digital learning media that align with the TPACK Framework appropriately.

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