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Pre-service Teachers' Perceptions after Designing TPACK-based Media for 21st Century Learning in Practice Teaching Experience

Farikhathulislakhah^{1*}, Sukma Nur Ardini², Sugiyanta³

¹Pendidikan Profesi Guru Study Program, Universitas PGRI Semarang, Semarang, Indonesia.

²English Education Study Program, Universitas PGRI Semarang, Semarang, Indonesia.

³MAN 1 Kota Semarang, Semarang, Indonesia.

farikhathulislakhah@gmail.com^{1*}, sukmanurardini@upgris.ac.id², sugiyanta@gmail.com³

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ABSTRACT

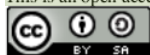
There are three research objectives in this research. First, to find out the pre-service teachers' perception of using Technological Pedagogical Content Knowledge (TPACK)-based media in their teaching practice. Second, to explore technological content knowledge TCK-based media which pre-service teachers used in their teaching and learning. Third, to describe the challenges that the pre-service teachers face in practice teaching experience. This research uses descriptive qualitative method. The subject of this research consists of 25 pre-service teachers. The data of this research were collected by using questionnaires and interviews. The questionnaire consisted of closed-ended questions using a Likert scale to measure participants' perceptions related to TPACK implementation. The responses from the questionnaire were analyzed using pie charts to visually represent the distribution of responses. Additionally, interviews were conducted to validate the questionnaire responses and gain further insights into the use of TPACK-based media. The findings of the study indicated that pre-service teachers held positive perceptions of TPACK-based media. They reported implementing TPACK-based learning approaches, successfully overcoming design challenges, and observing improved student engagement and comprehension. The study underscores the importance of technological content knowledge (TCK) utilized by pre-service teachers during their teaching experience. By examining the development and practical application of TPACK, the research aims to contribute to the design of professional development programs that enhance pre-service teachers' technical pedagogical knowledge.

Keywords: perceptions; pre-service teacher; teaching practice; TPACK; 21st century

INTRODUCTION

Current demands for teachers' knowledge include not only knowledge of the discipline of science they teach and pedagogical knowledge related to classroom principles and strategies, but also the ability to manage effective teaching through the use of technology (Asad et al., 2020; Nur Aenida, Herdiawan, & Rofi'i, 2022) need for pre-service teachers to feel prepared and comfortable using technology in the classroom is perhaps the most important factor in attaining effective technology integration among pre-service teachers. According to Valtonen et al., (2017), pre-service teacher education is the ideal setting for addressing the challenges that national and international educational systems confront.

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A teachers' perceptions and thoughts about the interaction between technology, content, and pedagogy are influenced by their use of technology in the classroom and their technological competencies; therefore, it is crucial that they receive professional development in this area (Çırak & Demir, 2014; Widyanita et al, 2023). To analyze and describe pre-service teachers' perceptions of technology integration in education, it is necessary to develop a framework. This framework should be grounded in theory and empirical evidence in order of evaluating and tracking the educational paths of pre-service teachers.

According to Mishra & Koehler (2006), the Technological, Pedagogical, and Content Knowledge (TPACK) framework is an example of a technology integration paradigm that can become one of the most successful ways to adapt teacher knowledge. TPACK is an established theoretical structure between researchers who study the use of information and communication technologies (ICT) by pre-service teachers (Voogt et al., 2013). In accordance with (Mishra & Koehler, 2006), the TPACK framework includes seven constructs: Content Knowledge (CK), Technological Knowledge (TK), Pedagogical Knowledge (PK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), Pedagogical Content Knowledge (PCK), and Technological Pedagogical Content Knowledge (TPACK).

In accordance Raudyatuzzahra (2020), teachers should be capable to establish an enjoyable classroom environment so that students will pay greater focus to their instructions. As remarked by Voogt et al. (2013), teachers must be familiar with a variety of pedagogical approaches in order to take advantage of ICT and facilitate learning's acquisition of 21st-century abilities. The emphasis of twenty-first century skills is on pedagogy, including collaborative learning and problem-solving as pedagogical practices. We hypothesize that the TPACK model, when linked with the educational aspects of 21st-century skills, will offer an extensive framework for researching and assisting pre-service teachers' development of TPACK that is aligned with 21st-century skills. Voogt et al. (2013) state that in order for teachers to make effective use of information and communication technologies (ICT) and contribute to the growth of students' twenty-first-century skills, they need to be familiar with a variety of pedagogical techniques. The implications of this point to the necessity of incorporating abilities relevant to the twenty-first century into the curriculum of future teachers.

It is common knowledge among those who work in education that the act of teaching is a challenging profession that calls for an intricate blending of a wide variety of fields of expertise. Teaching is a representation of an ill-structured subject since it requires teachers to employ complicated conceptual structures in a variety of situations and contexts (Mishra & Koehler, 2006). Thus, teaching is an instance of a field that does not fit neatly into one area. Kong et al. (2013) says that teaching has changed in the 21st century and that teachers must be able to use technology in their lessons to meet the current day's standards. So, it is important for new teachers to start using technology in their lessons as soon as they get to the field. Thus, this study aims to find out pre-service teachers' perceptions after designing TPACK for 21st century learning in practical teaching experience.

Unfortunately, not all educators are capable of managing and integrating technology into the teaching-learning process. In light of this fact, it would be advantageous to require teachers to take technology courses as part of their education curriculum. Therefore, the objective of this research was to determine the perceptions of pre-service teachers focusing on how TPACK-based media knowledge related to the use of various technologies in their teaching practice experiences. Given the current limitations in TPACK research, the aim of this study is to investigate how classroom educators construct TPACK and utilize it as an approach to assist in the design of learning innovations during lesson preparation and

39 practice. The researchers will focus on the technological content knowledge (TCK) used by pre-service teachers in their teaching experience. This can help shape the design of professional development initiatives targeted at strengthening pre-service teachers' technical pedagogical knowledge by examining the evolution of TPACK and its practical use. It can also offer insightful information for teacher education programs. In the end, our research aims to close the knowledge gap between theory and practice, enabling successful and significant technology integration in educational settings.

The understanding of perception comes from several definitions of perception. Qiong (2017) remarks that perception comes from the Latin terms *perceptio* and *percipio*, that mean obtaining, gathering, and comprehending with the thoughts or the senses. According to Walgito (2010), perception is a process that begins with collecting a stimulus through the senses, then continuing with the stimulus, and the following process is referred to as a perception process. Perception is the process through that a person or a group look at a circumstance. It involves the gathering of inputs and the usage of thoughts and emotions in understanding (McDonald, 2011). Perception is completing information and giving meaning to sensory stimuli via objects, relationships obtained, and experiences (Rahmat, 2018). The perception process does not take place despite the sensing process. Interpreting the meaning of sensory information requires sensation, attention, expectancy, motivation, and memory. According to Wilcox (2018), perception is the brain's interpretation of all information given by all senses, including what we have seen, everything we want, expect, assume, and need, as well as our experienced. As said by Morissan (2013), psychological factors influence perception. Everything observed will always give meaning, and that meaning is significant to what is seen. Experience, understanding, and contextual circumstances all have a substantial impact on perception. According to Mahmud (2018), perception refers to the process through which our brain interprets stimuli. Perception can also be defined as a perspective about the happenings to us. Not only is the stimulus itself a factor in perception, but also the stimulus background, sensations, emotions, attitudes, and intentions at the time.

TPACK is a framework that explains the links and complications of technology, pedagogy, and content (Mishra & Koehler, 2006). The junction of these three knowledge kinds is an intuitive understanding of teaching subject with appropriate pedagogical approaches and technologies. The TPACK framework has seven parts. First, Technology knowledge (TK) expertise encompasses pencil and paper, the Internet, digital video, interactive whiteboards, and software applications. Second, Content knowledge (CK): Mishra & Koehler (2006) define content knowledge as "knowledge about actual subject matter that is to be learned or taught." Teachers must understand their curriculum and how knowledge varies by subject. Third, Pedagogical knowledge (PK) is evaluation, lesson planning, classroom administration, and student learning all form part of PK. Fourth, Pedagogical content knowledge (PCK) is content knowledge that is relevant to teaching. Fifth, Technological content knowledge (TCK) refers to the awareness of how certain content might be presented through innovative uses of technology. It suggests that educators are aware of the potential for some technological tools to revolutionize the ways in which students learn and apply knowledge in a given subject area. Sixth, Technological pedagogical knowledge (TPK) refers to the process of gaining an understanding of how various technologies might be utilized in the classroom as well as how these technologies may influence the approaches used by educators. Seventh, Pedagogical content knowledge (TPACK) is the knowledge teachers need to integrate technology into any topic area.

6 By employing suitable pedagogical approaches and technologies to teach material, teachers intuitively understand the intricate interplay between the three basic components of knowledge (CK, PK, TK). In line with this, a study from Batane & Ngwako (2017)

illuminates the importance of equipping pre-service teachers with technology skills and knowledge to satisfy the educational demands of the twenty-first century. They emphasize the need for a systematic and comprehensive strategy involving all stakeholders to ensure a smooth transition from training to practice for pre-service teachers, reinforcing the use of technology at all educational levels.

Research by Nordin et al. (2013) emphasizes the importance of pre-service teachers learning about technology, content, pedagogy, and their interaction, known as Technological Pedagogical Content Knowledge (TPACK). The perceptions of pre-service teachers' TPACK mastery levels before and after field experience in schools were evaluated to see if there were any significant differences in TPACK after field experience. The TPACK survey was completed by 107 pre-service teachers enrolled in a research-intensive university program in New Zealand. Three student teachers were interviewed both before and after the fieldwork. Pre-service teachers performed best in the TPACK domains of Content Knowledge (CK) and Technology Knowledge (TK) before and after field experience. Following field experience, TK, PK, PCK, TCK, and TPACK all increased dramatically. Taking into account pre-service teachers' perceived knowledge prior to field experience, the study highlights the importance of field experience in developing TPACK and warns against misinterpreting TPACK survey results.

Koh, Chai, Wong, and Hong's theoretical paper explores the challenges teachers encounter while building ICT lessons for 21st-century learning and the need of TPACK and design thinking. The authors use the literature on design thinking to explain a conceptual framework that views teachers' The design procedure as non-sequential and episodic, and relying on how they experiment with ideas, develop design structures, alongside as they create and carry out teachings. TPACK structures are viewed as cognitive tools used by instructors in the planning process. The framework shows how guiding questions might trigger different types of teachers' TPACK throughout the design process.

A study conducted by Jannah et al. (2020) aimed to identify elementary school teachers' perceptions of digital technology-based learning in the 21st century. Using qualitative research and phenomenology, ten teachers were interviewed for this study to acquire data. Teachers believed that digital integration in elementary schools would have a positive impact on both the instructional process and student learning outcomes. However, the presence of digital technology in learning caused students to experience social and cultural issues. It was discovered that the effectiveness of digital-based learning depends on the competencies of teachers, such as digital skills, creative thinking, and communication skills. The research suggests promoting these competencies via collaboration between educators, stakeholders, parents, and education environment parties. The study's findings are consistent with those of previous studies that emphasize the significance of integrating technology in learning and the need for adequate technological devices, facilities, and infrastructure, as well as qualified teachers, in order to integrate technology in learning.

A study from Batane & Ngwako (2017) investigates the use of technology by pre-service teachers during their teaching practicum and the factors that influence their technology adoption. The majority of pre-service teachers did not use technology in their classrooms, despite having high levels of technology competency, according to the study. Fewer than 10% of the participants utilized technology in their classrooms, and the vast majority of instructors who did so taught in private institutions. A lack of training, support, and access to technology, as well as a perception that technology was not required for passing teaching practice, were among the factors identified in the study as impeding technology use. Additionally, the availability and accessibility of technology resources in institutions were analyzed. The results revealed that the majority of pre-service instructors lacked access to technology resources, and those with access had limited access. The study suggests that

schools provide adequate technology resources to pre-service teachers to facilitate the integration of technology into their teaching practice.

METHODOLOGY

In conducting research, the researchers used a qualitative method and a descriptive approach. According to Jackson & Mazzei (2011), qualitative research uses circumstances as the main data source, with the researchers serving as the primary instrument. According to Creswell (2012), qualitative research is a method for studying and understanding how important it is of people or groups attributed to a society human issue. Designing objectives and methods, collecting data from participants' circumstances, implicitly analyzing data, evolving from specific to general themes, and data analysis are all components of the research process. The arrangement of the final report was inconsistent. This assertion asserts that the application of qualitative methodologies allowed the writer to accurately describe the facts.

In this research, instruments used to collect the data were questionnaire and interview. The primary data source for this research was their reflective perception of using TPACK-based media in the past. According to Kumar (2011), a questionnaire is a handwritten survey form where respondents agree to give a response and submit their responses. In a questionnaire, respondents learned the questions, comprehended what was necessary, and then answered with their responses. The researchers used closed-ended questions in this research. This closed-ended question used the Likert scale type, also known as a summated rating scale, as the type of attitudinal scale. The researchers supplied five possible responses using Likert Scale: strongly disagree, disagree, neutral, agree, and strongly agree. The questionnaires included numerous items representing twenty questions related to technological content knowledge (TCK). The TPACK-21 questionnaire provides a useful tool for evaluating pre-service teachers' knowledge and skills related to 21st-century skills, including creative thinking, critical thinking, and information and communications technology (ICT) (Valtonen et al., 2017).

The data from the questionnaire was analyzed by determining the percentage of each student's response to each question. Each of the questions is described in the percentage through the diagram. Firstly, the researchers grouped the data and created a pie chart by grouping comparable responses together. This helped visualize the percentage distribution. Second, researchers interpreted the diagram to determine the response categories with the highest frequency. This provided with a sense of the prevalent perspectives among the respondents. Then the researchers described in the form of paragraph text. The researchers also used interview to collect data. Interviews are a standard technique for gathering information from participants (Kumar, 2011). Interviews are one of the most used methods of gathering information by asking questions to receive answers from participants (Jemna, 2016). In this study, the researcher used a semi-structured interview type. The semi-structured interviews are a type of data collection approach appropriate for qualitative research. In semi-structured interviews, researchers must provide a question guide to be easily understood by respondents, after which they will answer in their own words (Adhabi & Anozie, 2017). This interview method was used to validate questionnaire responses and learn more about TPACK-based media. According to Matthew et al (2014), the researchers used data analysis techniques to analyze interview transcripts. The data analysis of the Miles & Huberman model is a continuous process between data collection, data reduction, data presentation, and conclusion. The researchers derived conclusions based on the questionnaire and interview. These questionnaire and interview demonstrated pre-service teachers' engagement in technology competences in teaching based TPACK. The pre-service teachers' at MAN 1 Kota

Semarang during the school year 2022/2023 served as the focus of this particular case study which had a total of 25 pre-service teachers of Universitas PGRI Semarang and Universitas Negeri Semarang. A Google form was used by the researchers to distribute the questionnaire and interview.

RESULT AND DISCUSSION

To explore the pre-service teachers' perceptions after designing TPACK-based media for 21st-century learning in practice teaching experience, the researchers provided a questionnaire to figure out the objectives of this study. The questionnaire contained of 20 questions, including 15 closed questions and 5 open questions. The following diagram displayed the research findings.

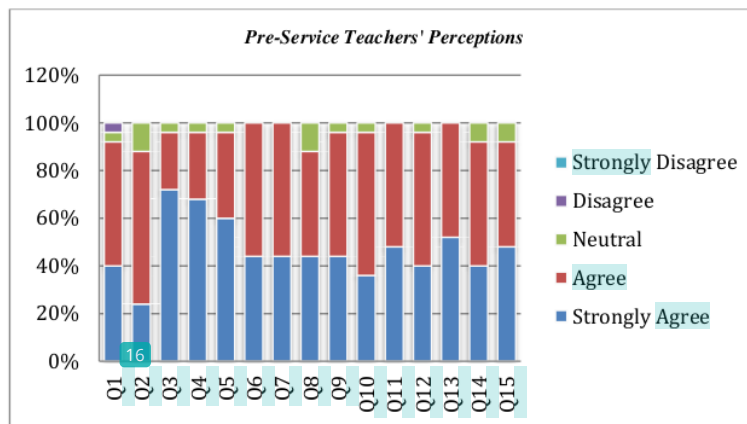


FIGURE 1. Pre-service teachers' perceptions

Based on the Figure 1, the researchers discovered that the majority of pre-service teachers hold positive perceptions about TPACK-based media. The result of question number one was 52% of the pre-service teachers strongly agreed that they have implemented TPACK-based learning approaches in their teaching practice. Based on question number two, 64% of the pre-service agreed that they overcome hurdles in designing TPACK-based media. Question number three was the pre-service teachers find it easier when teaching with technology. The result showed that 72% of the students were strongly agree, it could be conclude that they find using technology to teach simpler. This was supported by questions number four and five with presentation results of 68% strongly agree that technology enhances student participation and engagement and 60% strongly agree that the TPACK-based media can improve 21st-century learning comprehension. Question number six and seven showed pre-service teachers all agreed that TPACK improves their teaching quality. They utilize learning media integrating content, technology, and effective teaching strategies, including multimedia presentations, interactive tools, and online resources. According to the results of question number nine, 52% of the pre-service teachers strongly agreed that the use of technology in learning has improved the efficiency and effectiveness of the learning process. Pre-service teachers use various technologies such as interactive projectors, PCs, learning software, and mobile devices. According to the results of question number twelve, 56% of the pre-service teachers strongly agreed that understanding TPACK can enhance their creativity in designing engaging learning experiences, indicating their belief that TPACK-literate individuals can

offer more engaging learning experiences. This was supported by the result of question number 13,14,15 showed most of pre-service teachers agreed that TPACK could helps them adapt to 21st-century technologies and student needs, fosters creativity and innovation in learning design, and promotes interactive learning. ³⁰

From collected research data, it was found that the results of interviews are presented in the following table.

TABLE 1. The result of the interviews

Category	Perceptions
Media	Quizizz, ppt, video animation, YouTube , liveworksheet, kahoot, powtoon, mentimeter, wordwall, jamboard, canva.
Facilitating 21st-century learning	<ul style="list-style-type: none"> a. Make it easy for teachers to show engaging and innovative learning media b. Improve students' enthusiasm in learning c. TPACK can help students develop critical thinking skills d. Technology is crucial to 21st-century learning.
Advantages of TPACK implementation	<ul style="list-style-type: none"> a. Increase student learning motivation; b. Enhance student comprehension; c. Simplify complex learning content; and d. Aid pre-service teachers in achieving competency development objectives. e. Enhance pre-service teachers' abilities to use technology collaboratively in the classroom. f. Simplify the distribution of instructional materials, evaluation, and assessment.
Challenges	<ul style="list-style-type: none"> a. school facilities are less applicable b. adjusting technology and subject to be taught c. limited ability to explore technology d. lack of internet network availability e. creative teaching materials
Solution	<ul style="list-style-type: none"> a. research online and ask peers. b. paying attention to the topic to be taught, need to examine the characteristics, modalities, and needs of students in learning to adapt what technology supports this subject. c. Self-improvement through training d. using technology that optimizes classroom accommodation e. checking again some of the things to do before learning

From Table 1, it can be assumed that pre-service teachers utilize a variety of media based on the TPACK framework to enhance their teaching practice. These media include Quizizz, a platform for creating interactive quizzes; PowerPoint presentations to deliver content in a visually engaging manner; video animations to illustrate complex concepts; YouTube for accessing educational videos and tutorials; liveworksheet for creating interactive worksheets;

Kahoot, a game-based learning platform for formative assessments; Powtoon for creating animated presentations; Mentimeter, an interactive presentation tool for real-time audience engagement; Wordwall for creating interactive games and activities; Jamboard for collaborative brainstorming and visual organization; and Canva for designing visually appealing learning materials. These media tools enable pre-service teachers to leverage technology effectively in their classrooms, making learning more interactive, engaging, and tailored to the needs and preferences of their students.

The TPACK framework, according to pre-service teachers' perceptions, facilitates 21st-century learning by providing several benefits. It makes it easy for teachers to incorporate engaging and innovative learning media, improving students' enthusiasm in learning. TPACK also helps students develop critical thinking skills through the effective integration of technology in the classroom. Furthermore, it recognizes the crucial role of technology in 21st-century learning, preparing students for the digital age by fostering digital literacy, communication skills, collaboration abilities, and adaptability. Overall, the TPACK framework empowers pre-service teachers to create dynamic learning environments that enhance students' engagement, critical thinking, and technological competencies, aligning with the needs of 21st-century learning.

According to the perceptions of pre-service teachers, implementing TPACK in their teaching practice requires overcoming numerous challenges. Firstly, limitations in school facilities hinder the effective integration of technology. To address this, educators can conduct online research and consult peers for insights. Secondly, aligning technology with specific subjects requires careful consideration. A thorough analysis of the topic, student characteristics, and needs can help determine the best technology support. Thirdly, constraints in exploring and utilizing technology due to limited resources or training opportunities can be resolved through self-improvement via training programs. Additionally, employing technology that optimizes classroom accommodations and efficient resource utilization proves beneficial. Lastly, the creation of creative teaching materials can be demanding, but reviewing and preparing materials in advance ensures alignment with learning objectives and technology integration. By implementing these solutions, pre-service teachers can improve their TPACK skills, integrate technology effectively, and design engaging learning environments.

CONCLUSION AND RECOMMENDATION

Pre-service teachers have favorable perceptions of TPACK-based media in teaching. They have successfully adopted TPACK-based learning methodologies, overcome design challenges, and think that technology improves student engagement, comprehension of 21st-century content, and teaching quality. They use numerous media resources, such as interactive projectors, PCs, learning software, and mobile devices, to create interactive and unique learning experiences. Despite barriers, pre-service teachers are determined to use research, peer consultation, training programs, and preparation to overcome obstacles and create dynamic learning environments. Embracing the TPACK framework and successfully utilizing technology prepares students for the 21st century and builds critical abilities.

The outcomes of the research align with those of previous studies that emphasize the significance of integrating technology in learning and the need for adequate technological devices, facilities, and infrastructure, as well as qualified teachers, in order to effectively employ technology in teaching. Consequently, it is essential to offer pre-service teachers their training in order and support for successfully integrating technology into the classroom in order to establish a successful learning setting.

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