
Preservice Biology Teacher's TPACK Integration into Lesson Planning

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ABSTRACT

KEYWORDS:

*TPACK,
Lesson planning,
Integration,
Preservice teacher*

This research was aimed to investigate preservice Biology teacher's performance in integration TPACK into lesson plans. The subjects in this study were preservice biology teacher taking Biology lesson planning and microteaching course. The object of this research was all of lesson plan developing by preservice biology teacher. The aspects of TPACK that were examined for integration of TPACK in the lesson plans included content knowledge (CK), pedagogical knowledge (PK), technological knowledge (TK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), pedagogical content knowledge (PCK), and technological pedagogical and content knowledge (TPACK). TPACK integration data on the lesson plan was obtained through documentation techniques and analyzed using an identification sheet. The result of identification were analyzed descriptively using percentage techniques. The results of the identification show that the integration of TPACK aspects into lesson planning at the microteaching course is: learning objectives of 66.67%, opening activities of 30.77%, core activities of 89.74%, closing activities of 7.69%, student worksheet of 38.46%, and assessment instruments of 12.82%. While the integration at the biology lesson planning course is: learning objectives of 78%, opening activities of 33%, core activities of 89%, closing activities of 22%, student worksheet of 51%, and assessment instruments of 13%.

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1. INTRODUCTION

Currently we live in the era of technology. The Industrial Revolution 5.0 refers to technological developments which include artificial intelligence, robotics, Internet of Things (IoT), big data, virtual reality, and other technologies. In this era, learning demands underwent significant changes. The rapid development of technology has had a major impact on the development of life, one of which is education. Aydın Günbatar et al. (2017) said that technology has been integrated in the curriculum and instruction. Teachers have a crucial role in the implementation of technology in classrooms so that they need to be teachers are one of the keys to the successful integration of technology in learning so that teachers should have the essential skills and knowledge needed to carry out effective integration of technology in the teaching and learning process. One of the essential types of knowledge that teachers must have in integrating technology in learning is TPACK.

TPACK is a specialized, highly applied type of knowledge that supports content-based technology integration. It has been characterized as the multiple intersections of teachers' knowledge of curriculum content, general pedagogies, technologies, and contextual influences upon learning. Nurhidayah and Suyanto (2021) TPACK level component that integrates with technology is TPACK which is a combination of technological knowledge, pedagogy, and content. TPACK is an understanding, knowledge, and communication of concept representations using

technology, pedagogical techniques, knowledge of concepts whether difficult or easy to learn and knowledge of how to help and develop students.

The TPACK framework indicates that teachers need to have a deep understanding of technology, pedagogy, and content in learning and be able to manage them. TPACK helps teachers to integrate technology effectively in learning. They learn how to use technology as a tool to support teaching and learning, thereby enhancing the quality of student learning experiences. Teachers with a good understanding of TPACK can choose and use technological tools that are appropriate to learning content and learning objectives (Akhwani 2020).

TPACK integration can increase student involvement in learning. By using the right technology, teachers can create interesting, interactive, and relevant learning experiences for students. Teachers can incorporate technology into their teaching strategies to facilitate student collaboration, exploration, and problem solving, which in turn increases student engagement in the learning process. Through TPACK, teachers can understand and respond to students' needs in using technology. They can identify students' technological preferences and abilities and adapt technology methods and tools to suit students' needs. This helps create relevant and personalized learning for each students (Bwalya and Rutegwa 2023).

TPACK was very important knowledge in preservice teacher education. TPACK helps preservice teacher to develop an understanding of how technology can be used effectively in learning contexts. They learn about technology tools and resources relevant to their teaching materials, and how to use them to facilitate active, student-centered, and engaging learning. Through TPACK, preservice teacher learns to combine pedagogical knowledge with content knowledge and knowledge about how to use technology to meet students' needs. They learn student-centered teaching strategies and leverage technology as a tool to facilitate better understanding, student engagement, and learning differentiation. TPACK encourages student teacher candidates to develop creativity and innovation in their learning designs. With knowledge of technology, they can design learning experiences that are interesting, diverse, and relevant to students' needs. Student teacher candidates can use technology to create interactive learning resources, collaborative projects, or creative activities that encourage students' critical and creative thinking (Sari and Mega 2022).

Aspects of TPACK can be developed in the teaching and learning process if integrated explicitly in the lesson plan. Learning devices occupy an important role in order to achieve success in the learning process. Therefore, all preservice teachers are equipped with the ability to develop learning tools. One of them is by compiling learning tools in the form of lesson plans. The TPACK aspect can be seen from the preparation of the lesson plan, because the lesson plan contains elements of pedagogy, content and technology.

This research was aimed to investigate preservice Biology teacher's performance in integration TPACK into lesson plans

2. MATERIALS AND METHODS

This research is a descriptive study that aims to describe TPACK integration in lesson planning by preservice biology teacher at the course of biology lesson planning and microteaching in Biology Education Department Faculty of Teacher Training and Education Universitas Muhammadiyah Surakarta. The aspects of TPACK studied in this research were aspects of PCK, TCK, TPK, and TPACK. Subjects of this research were 342 lesson plans developed by preservice biology teacher in the biology lesson planning and microteaching course. Technique of data collection in this research was the documentation namely collecting all lesson plans documents developed by preservice Biology teacher students. This documents then analyzed using an identification sheet to determine the integration of TPACK. Data analysis was performed by qualitative descriptive analysis using percentage techniques.

3. RESULTS AND DISCUSSION

Teaching and learning planning has an important role in determining the success of learning. Learning devices occupy an important role in order to achieve success in the learning process. One of the learning tools is the lesson plan. The integration of TPACK aspects was obtained from the identification results of lesson plan for preservice Biology teacher taking microteaching and Biology lesson planning courses presented in Table 1.

Table 1. TPACK Integration in Lesson Planning by Preservice Biology Teacher

Course	Aspect	Learning outcomes	Percentage of integration in... (%)				Assessment
			Learning Activity			Student Worksheet	
			Opening	Main Activity	Closing		
Microteaching	PCK	97.44	87.18	100	100	92.31	94.87
	TCK	66.67	30.77	89.74	7.69	38.46	12.82
	TPK	66.67	30.77	89.74	7.69	38.46	12.82
	TPACK	66.67	30.77	89.74	7.69	38.46	12.82
Biology Lesson Planning				100.0	71.00		82.00
	PCK	83.00	72.00			62.00	
	TCK	78.00	33.00	89.00	22.00	51.00	13.00
	TPK	78.00	33.00	89.00	22.00	51.00	13.00
	TPACK	78.00	33.00	89.00	22.00	51.00	13.00

3.1. Preservice Biology Teacher's PCK Integration in Lesson Planning

Pedagogical Content Knowledge (PCK) is a concept used in education to describe a teacher's knowledge and understanding of how to teach a particular subject matter effectively. PCK combines two important aspects, namely knowledge about subject matter (content knowledge) and knowledge about effective teaching strategies (pedagogical knowledge).

Based on Table 1, it is known that the integration of PCK aspects into lesson planning at the microteaching course is: learning objectives of 97.44%, opening activities of 87.18%, core activities of 100%, closing activities of 100%, student worksheet of 92.31%, and assessment instruments of 94.87%. While the integration at the biology lesson planning course is: learning objectives of 83%, opening activities of 72%, core activities of 100%, closing activities of 71%, student worksheet of 62%, and assessment instruments of 82% (**Fig 1**).

In order to improve the quality of learning, it is important to integrate PCK into learning tools. This assists teachers in conveying learning materials effectively, improves student understanding, and facilitates a better overall learning process. By integrating PCK into learning tools, teachers can develop appropriate teaching strategies to deliver material effectively. This helps improve students' understanding and facilitates a better learning process (Sukaesih et al. 2017).

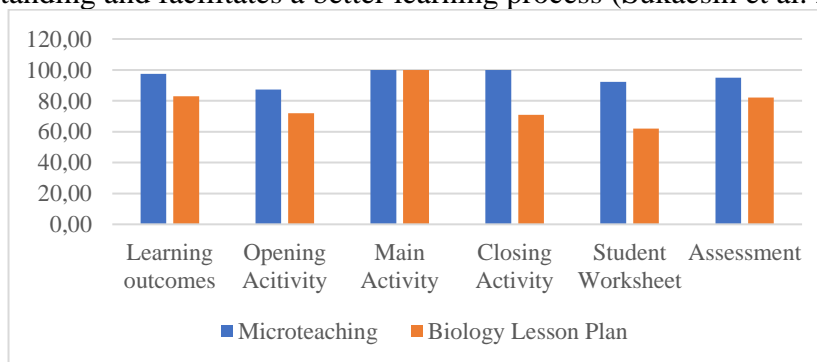


Fig. 1. PCK Integration by Preservice Biology Teacher in Lesson Planning

Every student has a different learning style and needs. With PCK integrated into learning tools, teachers can better identify and respond to individual student needs. They can provide clearer explanations, relevant examples, and adapted learning strategies to help students overcome their learning difficulties. The application of PCK in learning tools requires a deep understanding of learning materials and effective teaching strategies. By paying attention to PCK, teachers are expected to continue to develop themselves in the field of pedagogy and content. This encourages the professional development of teachers and ensures that they continuously improve the quality of their teaching (Shopie Azizah et al. 2021).

3.2. TCK integration in lesson planning

Technological content knowledge (TCK) refers to the knowledge of how technology can create new representations for specific content. It involves the intersection of technological knowledge and content knowledge. It suggests that teachers understand that, by using a specific technology, they can change the way learners practice and understand concepts in a specific content area (Schmidt et al. 2009).

Based on Table 1, it is known that the integration of TCK aspects into lesson planning at the microteaching course is: learning objectives of 66.67%, opening activities of 30.77%, core activities of 89.74%, closing activities of 7.69%, student worksheet of 38.46%, and assessment instruments of 12.82%. While the integration at the biology lesson planning course is: learning objectives of 78%, opening activities of 33%, core activities of 89%, closing activities of 22%, student worksheet of 51%, and assessment instruments of 13% (**Fig 2**).

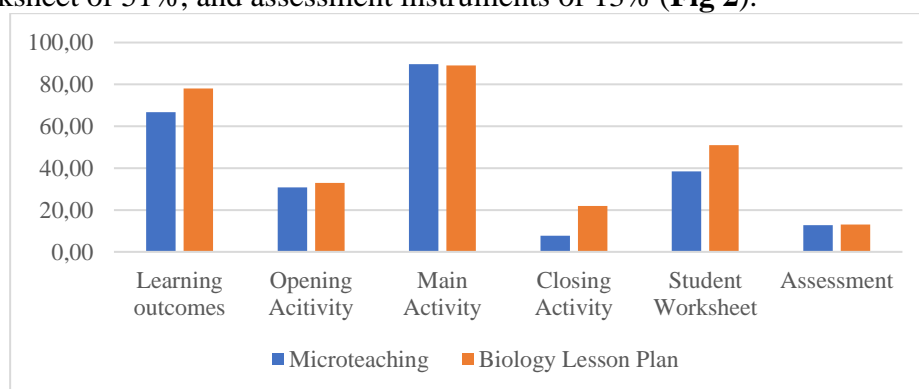


Fig. 2. TCK Integration by Preservice Biology Teacher in Lesson Planning

3.3. TPK integration in lesson planning

According to Schmidt et al (2009) TPK refers to the knowledge of how various technologies can be used in teaching, and to understand that using technology may change the way teachers teach. TPK refers to understanding technology's benefits and limitations as an enhancer of various teaching styles. It pertains to the knowledge of how various technologies can be used in the classroom and the potential for technology to alter how teachers teach (Bwalya and Rutegwa 2023). Based on Table 1, it is known that the integration of TPK aspects into lesson planning at the microteaching course is: learning objectives of 66.67%, opening activities of 30.77%, core activities of 89.74%, closing activities of 7.69%, student worksheet of 38.46%, and assessment instruments of 12.82%. While the integration at the biology lesson planning course is: learning objectives of 78%, opening activities of 33%, core activities of 89%, closing activities of 22%, student worksheet of 51%, and assessment instruments of 13% (**Fig 3**).

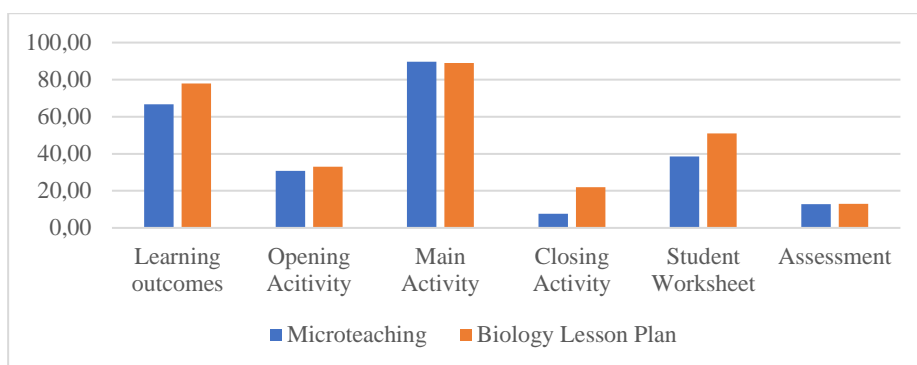


Fig. 3. TPK Integration by Preservice Biology Teacher in Lesson Planning

3.4. TPACK integration in lesson planning

TPACK defined by knowledge of the interaction between content, pedagogy, interrelated technology in the learning process (Akhwani 2020). Based on Table 1, it is known that the integration of TPACK aspects into lesson planning at the microteaching course is: learning objectives of 66.67%, opening activities of 30.77%, core activities of 89.74%, closing activities of 7.69%, student worksheet of 38.46%, and assessment instruments of 12.82%. While the integration at the biology lesson planning course is: learning objectives of 78%, opening activities of 33%, core activities of 89%, closing activities of 22%, student worksheet of 51%, and assessment instruments of 13% (**Fig 4**).

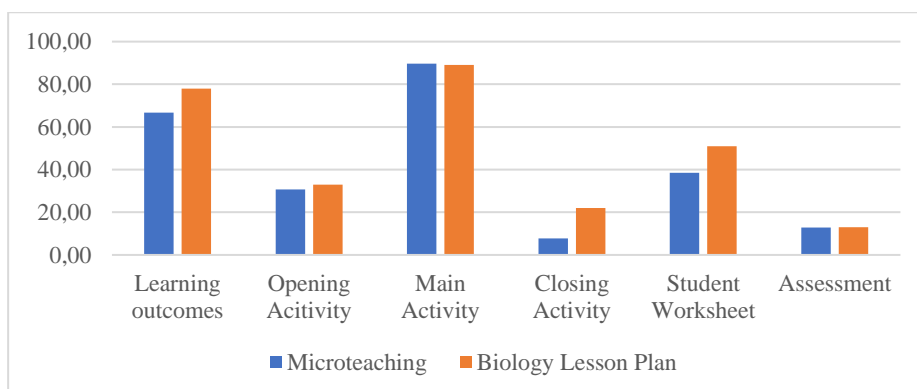


Fig. 4. TPACK Integration by Preservice Biology Teacher in Lesson Planning

TPACK helps teachers to integrate technology effectively in learning. They learn how to use technology as a tool to support teaching and learning, thereby enhancing the quality of student learning experiences. Teachers with a good understanding of TPACK can choose and use technological tools that are appropriate to learning content and learning objectives. Through TPACK, teachers can understand and respond to students' needs in using technology. They can identify students' technological preferences and abilities and adapt technology methods and tools to suit students' needs. This helps create relevant and personalized learning for each student. Overall, TPACK is important for teachers because it helps enhance their ability to integrate technology effectively in learning, increases student engagement, and prepares students for success in an evolving digital world (Chapoo et al. 2014).

It is important for student teacher candidates to integrate TPACK in learning for the following reasons: (1) TPACK integration helps student teacher candidates to design and implement more effective and meaningful learning experiences. They can use technology appropriately in delivering learning content, encouraging student interaction, and creating a relevant and interesting learning environment (Tafli and Atici 2016); (2) The current generation of students grew up in the

digital age and often have access to and familiarity with technology. By integrating TPACK, student teacher candidates can confront this digital trend and connect learning to students' real lives. This helps create greater connectedness and relevance in learning; (3) The use of appropriate technology in learning can increase student engagement and participation. Through TPACK, student teacher candidates can combine interesting and interactive technological tools and resources to activate students in the learning process. Technology can facilitate collaboration, exploration, and experimentation that encourages active student engagement (Güneş and Bahçivan 2016); (4) TPACK integration helps prospective teacher students to equip students with relevant skills to succeed in the digital world. They can teach students about digital literacy, digital ethics, and the ability to use technology as a tool for solving problems, communicating ideas, and working collaboratively. This helps students to be ready to face the demands of an increasingly digital world of work.; and (5) TPACK encourages student teacher candidates to be innovative in their learning approaches. They can use technology as a tool to create learning experiences that are creative, interesting, and in accordance with the needs of students. By utilizing technology effectively, prospective teacher students can present innovative and interesting learning for students.

4. CONCLUSIONS

The integration of PCK aspects into lesson planning at the microteaching course is: learning objectives of 97.44%, opening activities of 87.18%, core activities of 100%, closing activities of 100%, student worksheet of 92.31%, and assessment instruments of 94.87%. While the integration at the biology lesson planning course is: learning objectives of 83%, opening activities of 72%, core activities of 100%, closing activities of 71%, student worksheet of 62%, and assessment instruments of 82%. While the integration of TPK, TCK, and TPACK aspects into lesson planning at the microteaching course is: learning objectives of 66.67%, opening activities of 30.77%, core activities of 89.74%, closing activities of 7.69%, student worksheet of 38.46%, and assessment instruments of 12.82%. While the integration at the biology lesson planning course is: learning objectives of 78%, opening activities of 33%, core activities of 89%, closing activities of 22%, student worksheet of 51%, and assessment instruments of 13%

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