

# Learning how to plan a science lesson: An exploration of pre-service science teacher reflection in online microteaching

*by* Zeni Haryanto

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## Learning how to plan a science lesson: An exploration of pre-service science teacher reflection in online microteaching

Z Haryanto<sup>1</sup>, N F Sulaeman<sup>1</sup>, A Nuryadin<sup>1,2</sup>, P D A Putra<sup>3</sup>, S A Putri<sup>1</sup>, A Z Rahmawati<sup>1</sup>

<sup>1</sup>Physics Education Study Program, Faculty of Teacher Training and Education, Mulawarman University, Indonesia

<sup>2</sup>Graduate School of Sciences and Technology for Innovation, Yamaguchi University, Japan

<sup>3</sup>Science Education Study Program, Faculty of Teacher Training and Education, University of Jember, Indonesia

zeni.haryanto@kip.unmul.ac.id

**Abstract.** As a compulsory approach in shaping pre-service teachers for Technological Pedagogical Content Knowledge (TPACK), microteaching is either essential and challenging. During the COVID-19 pandemic, the shift from offline to the online microteaching course had occurred. This major shift drives the change of planning science lessons. Our research examined how pre-service science teachers designed and reflected their planning on a 30-minute microteaching unit. The participants of our study were four groups of pre-service science teachers that consisted of five students. The participants were pre-service science teachers from two national universities in Indonesia that were chosen by purposive sampling. The data was collected through the lesson plan, self-reflection to the lesson plan, and group discussion. We conducted both qualitative and quantitative analysis on research data for content analysis. The qualitative analysis dealt with the themes and patterns of the theme, while quantitative analysis dealt with the duration and frequency of the theme. Based on the analysis, the single domains such as CK, PK, TK were shown in the lesson plan. However, the complex domain of TPACK was rarely seen. The group discussions revealed that teacher educators need to become specific and explicit about which technology is being infused to support learning. It is significant to enhance the TPACK during planning in online microteaching classes and conduct further study of the implementation of this planning in the lesson.

### 1. Introduction

During the 4-year program of pre-service science teachers, they learn how to develop the specific teacher's professional ability that builds their identity[1]. The discussion of science teacher preparation focuses on how to prepare science teachers connected to the vision of the national curriculum and the goals for science teacher education[2]. The teaching ability is a complex terminology that is well-known as Technological Pedagogical Content Knowledge (TPACK). This terminology could be traced from the terminology of Pedagogical Content Knowledge (PCK) in 1987[3], its implication also needs the new element of technology that strongly influence the ability of teaching [4]. Recently, the discussion of the definition of TPACK has been explored deeply and became a concern of researchers in teacher education. TPACK consists of seven components: Technology Knowledge (TK), Pedagogical Knowledge (PK), Content Knowledge (CK), Technological and Content Knowledge



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(TCK), Technological and Pedagogical Knowledge (TPK), Pedagogical and Content Knowledge (PCK), and Technological Pedagogical Content Knowledge (TPACK)[5]. These domains were interconnected [6].

On the other hand, pre-service science teachers are a unique group at the university level. They learn science subjects as well as learn how to teach the subjects. Even though the development of TPACK started from their first semester, the activities in the microteaching course are suitable to be the course that is blending all the knowledge into observable skills. However, the COVID-19 pandemic changes science teacher education in many ways [7,8]. Moreover, in the era of science and technology innovation, the role of a science teacher became crucial to bring an understanding of the integration of science, technology, mathematics, and engineering (STEM) concepts[9]. The need to fulfill the role of a science teacher in the future highlights the requirement to explore the development of TPACK during distance learning [10]. The planning phase of microteaching has been given considerably less attention in both practice and research[11]. A deeper exploration of this issue is needed to address such education shortcomings in preparing future teachers who can plan online science lessons. This paper reported the findings from a study designed to explore the development of TPACK from pre-service science teachers during their activities in planning the science lesson.

## 2. Method

### 2.1. Data collection

This study is part of a larger collaborative project between science education teacher preparation programs in Indonesia that mainly focused on designing and redesigning the microteaching course. This study presents results from the initial cycle of what took place during the planning phase of the microteaching unit. The authors had introduced the research project to the pre-service science teachers two weeks in advance and acquired permission to conduct the recordings. The participants were pre-service science teachers in two national universities in Indonesia who were in their 6<sup>th</sup> semester and taking the online microteaching course. All participants joined two online meetings (@ 60 minutes) where authors 2 and 3 described the microteaching class and planned the science lesson. Then they developed their lesson plan. Moreover, the last meeting was discussion time for reflecting on their lesson plan. The data was collected through the lesson plan and group discussion.

**Table 1.** Participants Demography

Institution	Participants	Gender	
A	10	Male	2
		Female	8
B	10	Male	3
		Female	7

### 2.2. Data analysis

Data were then carefully read and reread several times by two authors in line with our analytic approach [10]. We conducted both qualitative and quantitative analysis on research data for content analysis. The qualitative analysis dealt with the themes and antecedent consequent patterns of the theme, while quantitative analysis was related to the duration and frequency of the theme. The theme in qualitative analysis followed the seven elements in TPACK. The observation sheet used for observing the lesson plan could be seen in Table 2.

**Table 2.** TPACK Observation Sheet

No	Aspects	Classification		Description in the lesson plan
		Existed (1)	Cannot found (0)	
1	Technology Knowledge (TK)			
2	Pedagogical Knowledge (PK)			
3	Content Knowledge (CK)			
4	Technological and Content			

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	Knowledge (TCK)
5	Technological and Pedagogical Knowledge (TPK)
6	Pedagogical and Content Knowledge (PCK)
7	Technological Pedagogical Content Knowledge (TPACK)

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Authors 5 and 6 became the raters for the lesson plan, and inter-rater reliability is estimated with the following equation [12]:

$$\text{Inter - rater agreement} = \frac{\text{Number of cases with the same score from two raters}}{\text{Number of cases}} \times 100 \quad (1)$$

### 3. Result and Discussion

The analysis and estimation of the inter-rater reliability were conducted on the collected data with SPSS software. The result showed that our instrument had a coefficient of reliability of 0.7, which was categorized as sufficient [13]. From the lesson plan data analysis, the appearance of seven components of TPACK could be identified. Moreover, the identification of strength and vulnerable components were conducted. The confirmation of those findings was conducted through classroom discussions.

#### 3.1. The strength in basic components (CK, PK, TK)

The lesson plan analysis showed that Content Knowledge (CK), Pedagogical Knowledge (PK), and Technological Knowledge (TK) were the three components that were clearly stated. During the planning phase of microteaching sessions, either online or offline, it is commonly found that the pre-service teacher firstly decides the content part. Therefore, the kinds of science content to be delivered in the lesson plan always becomes a priority. The class discussions revealed that the CK domain was relatively easy to decide at the beginning of the debate.

*Student A: During the group meeting, my group discussed what content each student should have. Then every student made their lesson plan and put the content in it.*

Moreover, the PK domain was seen through the opening and closing part of the lesson plan. PK refers to the methods and processes of teaching and includes knowledge in classroom management [4]. This result is similar to the result in in-service physics teachers [14]. Specifically, during the online microteaching class, the students were urged to decide which technology or platform would be used during their lesson. This situation drives the TK domain to be strongly addressed in the lesson plan. For example, the platform for online meetings or supporting their presentation.

#### 3.2. The vulnerable in more integrated component (TPACK)

Although the participants could show their understanding of a single component in the lesson plan, the formation of the complex component remained a challenge for them. The result showed that the more complex domains such as TPACK became more vulnerable components. There was a tendency that the lesson plan for the online microteaching had more briefs than the offline lesson plan. Therefore, there was a lack of evidence of the TPACK domain found in the lesson plan. TPACK is a framework that introduces the relationships and the complexities between all three basic components of knowledge (technology, pedagogy, and content) [5]. These findings confirmed that teacher educators need to become very specific and explicit about which technology to be infused to support learning [15]. Understanding this domain is more complex than understanding the six single components.

*Student C: I was thinking of using a digital platform during my lesson; the content was about mechanical spring. I did not mention it clearly in the lesson plan. It was challenging to decide which technology that suitable for the topic. It would be great if there were more examples from the lectures.*

The formation of TPACK needs a constant bidirectional process among the single domains [16]. The method of TPACK includes an integrated understanding of how to represent science concepts with technologies, pedagogical techniques that use technologies in constructive ways to teach science, and knowledge of what makes concepts easy to learn. More examples of TPACK from the teacher educators during the microteaching course are required [17]. Digital literacy for teachers also became a significant concern for the online teaching process [18,19]. Our result highlights the need for teacher preparation programs to foster the development of complex domains on TPACK, bringing the ability to enhance the lesson plan.

#### 4. Conclusion

The results conclude that the single domains such as CK, PK, TK were shown in the lesson plan developed by the participants. However, the complex domain of TPACK was rarely seen. The group discussions revealed that teacher educators need to become very specific and explicit about which technology to be infused to support learning. It is significant to enhance the TPACK during planning in online microteaching classes. Although the planning phase is essential, the implementation of this lesson plan was unexplored by this research. Therefore, it is beneficial to conduct further study on pre-service science teachers' TPACK performance.

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