AN INTEGRATION OF TRADITIONAL ECOLOGICAL KNOWLEDGE AND CASE-BASED LEARNING IN STEM COURSE: ITS CORRELATION TO TEACHER STUDENTS' ABILITY IN DESIGNING WORKSHEET

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Abstract. The integration of science and local knowledge is still rarely found in the learning media used in lectures. This has an impact on the lack of meaningful learning and students' ability to create student worksheets. This study applied a case-based learning strategy integrated with traditional ecological knowledge to evaluate the ability of prospective teacher students to design student worksheets, so this study aimed to determine the correlation between the two variables. The sample for this study was 73 prospective science teacher students who programmed the STEM course. The study used a one-shoot case design and the results showed that (1) students' ability to design TEK-based worksheets increased from meeting 1 to meeting 3 after the implementation of the CBL strategy, and (2) there was a positive and strong relationship between the implementation of the CBL strategy and the ability of students to design TEK-based worksheets. So, the CBL strategy is appropriate to use in STEM lectures to improve students' ability to design worksheets.

Keywords: case-based learning, traditional ecological knowledge, STEM

INTRODUCTION

The ability to design learning and activities in the classroom is a skill that must be possessed by students who take pre-service teacher education, as a provision to become an effective and competent teacher (Anisimova et al., 2020). The ability to design learning consists of the ability to design models, media, methods, strategies, and other elements of learning to adapt to the development of learning theories and concepts so that learning objectives are achieved (Cennamo & Kalk, 2019).

Frerejean et al. (2019) stated that designing learning resources (media, student worksheets, and teaching materials) that can help students connect the concepts they learn with everyday life in their environment is an important thing for every prospective teacher to have. It is supported by Van Merriënboer and Kirschner (2018), who stated that one of the tasks of a teacher is to present an authentic and thorough experience based on real-life through learning resources. However, the developed learning resource should not only be related to the environment and real life but must also contain local and traditional elements so that students can more easily understand the concepts taught because it feels more familiar and close to their culture (Effendi, 2019). Learning that integrates traditional local elements is called by Klara et al., (2015) ethno-pedagogy which is learning that is associated with biocultural, ethnobotany, ethnographic, or folklore diversity.

The use of learning resources and real problems will increase the attractiveness and meaningfulness of learning. Engaged learners actively connect knowledge and ideas in their cognitive structures with new information learned, thus encouraging students to engage among deep learning (Hofstein & Lunetta, 2013; Sholahuddin,

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2015). The integration of ethnoscience in the learning process will bridge students' preconceptions with scientific concepts. This can avoid misconceptions in students (Østergaard, 2017; Rahmawati & Ridwan, 2017; Sudarmin, 2015).

Designing student worksheets is one of the many learning design activities that need to be when preparing a lesson. However, several previous studies have shown the importance of integrating local environmental knowledge into the development of worksheets to be able to train students with various necessary competencies such as science literacy. Wilujeng et al., (2019) developed worksheets to improve students' literacy towards the environment as a solution to the problem of students' lack of environmental literacy; they need to be given views and knowledge about their local environment in science learning so that their understanding of science concepts is more profound. Moreover, Suryawati et al., (2020) found that the relevance of elements of local environmental knowledge in science learning is still low because existing learning is still not relevant to the environment and phenomena around students, so it is necessary to have contextual and authentic issue-based worksheets related to the surrounding environment so that students have good science literacy.

Several researchers have conducted investigations related to Traditional Ecological Knowledge, hereinafter abbreviated as TEK, in learning. Susanti and Chankook (2020) found that ethno-pedagogy integration makes prospective teachers able to design good learning. While Greene (2019) showed that TEK integration can facilitate students understanding science better. Both studies used TEK in different cultural backgrounds, where Susanti and Chankook (2020) used a Javanese cultural background, especially the Ponorogo area, East Java, while Greene (2019) used American culture. Different cultures produce different pedagogic impacts for students, just as wetland environmental cultures would produce different results.

Reflecting on these findings, researchers assume that the insertion of environmental elements and local knowledge in worksheets needs to be developed. It is supported by Kopnina (2020) who states that the science learning resources used by participants today (also called Western science) tend to lose elements of local environmental knowledge, where this element is the foundation of the knowledge system that shapes students' perceptions of science concepts that are adaptive to the surrounding environment. The solution that can be done to overcome this problem is to integrate science learning with students' local knowledge (this study is called TEK). The integration of science learning with local knowledge aims to increase the meaningfulness of students' learning and science literacy. Teachers must be able to relate the concept of science to local knowledge or their daily environment. Therefore, prospective teachers need to be trained in their ability to design learning through the design of worksheets containing TEK. Worksheets are important because they are a guide for students to carry out the learning process independently to achieve planned learning goals.

The learning strategy that can be applied is to use case-based learning (hereinafter abbreviated as CBL) in science, technology, engineering, and mathematics (STEM) lectures. This strategy follows the characteristics of adult students who can face real problems and solve problems in teams. This strategy is under *Permendikbud No. 3 Tahun 2020*, that learning at the university or lecture level must be interactive, holistic, integrative, scientific, contextual, thematic, effective, collaborative, and student-centered. In addition, learning must also be able to achieve not only mastery of knowledge but also various soft skills needed in the era of information technology society.

This research has a fairly high urgency considering that there has been no research that examines the insertion of TEK in science learning and its instruments,

and then how case-based learning strategies can train the ability of prospective teachers to design worksheets containing TEK. So, the formulation of the problem used in this study is "(1) how is the ability of prospective science teacher students to design worksheets containing TEK? and (2) how is the relationship between the implementation of CBL strategies and students' ability to design worksheets containing TEK?"

METHOD

This research is a pre-experimental research with a one-shot case design with parallel group treatment. This design implies a treatment applied to one sample with no control group; thus, the effect of the treatment is observed indicating the power of the measurement and the scientific value of a research design (Nashan, Anisa, Ummah, Margaretha, & Amaliyah, 2023). The sampling method was total population sampling as the number of subjects in the population is small and homogenous. The subjects of the study were 73 students who participated in STEM courses in the even semester of 2022/2023 with three parallel classes. The object of research is to determine the effectiveness of case-based learning strategies to train the ability of prospective science teacher students to design TEK-based worksheets.

Research data collection was done by using questionnaires of student responses to learning with case-based learning and portfolio assessment rubrics for the worksheets developed by students. The student response questionnaire used was adapted from the CBL conceptual framework developed by Raza et al., (2020), however, there is a slight modification to integrate TEK elements into this CBL implementation. The conceptual framework of CBL in this study can be seen in Figure 1.

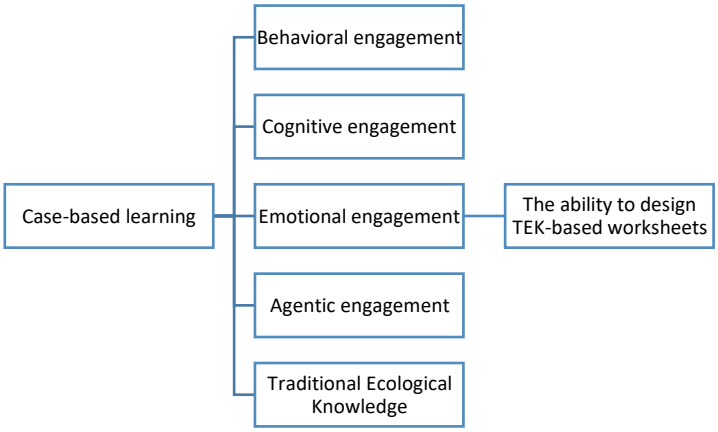

Figure 1. Case-based learning framework

Figure 1 shows the insertion of TEK elements in the CBL strategy framework. Then, TEK is also integrated into the stages of CBL implementation with the following steps: (1) In class, students choose cases that have been identified related to the wetland environment and analyze them in groups, (2) Students determine the approach to be used in solving cases, (3) In groups, students determine the target of the problem solution to be given, (4) Students combine the initial knowledge they form from the results of exploration (TEK) with what they learn to design problem solution projects, (5) Students present the results of discussions in the form of problem

solutions, and (6) Students reflect on the results and processes of the solutions provided.

RESULTS AND DISCUSSION

The main findings of this research are that the ability of students to design worksheets containing TEK is increasing after the implementation of the CBL strategy and there is a positive and strong relationship between the application of the CBL strategy and the ability of students to design TEK-based worksheets.

The implementation of CBL strategies in learning is measured using questionnaires containing statements based on 5 (five) aspects of TEK integrated CBL as mentioned in Figure 1 and resulted in the following scores.

Table 1. Results of TEK integrated case-based learning questionnaire

No	Aspect	Score	Percentage
1	Behavioural engagement (BE)	3,47	86,75%
2	Cognitive engagement (CE)	3,13	78,25%
3	Emotional engagement (EE)	3,39	84,75%
4	Agentic engagement (AE)	3,33	83,25%
5	Traditional Ecological Knowledge (TEK)	3,44	86,00%
			83,80%

In Table 1, it can be seen that from the five aspects, aspects of behavioral engagement and traditional ecological knowledge received the highest positive perception score. The behavioral engagement aspect itself is an aspect that refers to whether this strategy trains positive habits, self-efficacy, and meaningful activities in learning. The traditional ecological knowledge aspect refers to whether exploration of the environment and the surrounding community can help students understand the concept of science. Overall, students' perceptions of the implementation of the TEK-integrated CBL strategy are very good (83.80%) and positive.

Of the total 24 statements in the questionnaire, six statements received negative responses. However, the lowest average score is indicated by the statement "My ability to express my opinions and views is getting better" (cognitive engagement). This shows that the average student does not agree that the implementation of this CBL strategy can improve their ability to argue. It is due to the basis of their opinion in solving cases, which is the local knowledge of the people who live where the case takes place. As students interviewed the people, they internalized the local knowledge and integrated it with what they learned. It is a good sign of meaningful learning, but then they were in doubt about whether the argumentation came from their mind or the local people. Diaz (2019) argues that TEK is hardly integrated in a modern context, which might be the reason why it leads to confusion when it comes to solving modern issues. The lack of confidence in giving opinions is also because the allocation of time to conduct discussions as one of the stages in CBL is short, so only a few students have the opportunity to express their views regarding the case being discussed. This then becomes the evaluation of researchers to optimize discussion sessions when learning with CBL strategies takes place.

After the CBL strategy was applied to three parallel groups, students' ability to compile worksheets was then evaluated, and the results can be seen in figure 2 below.

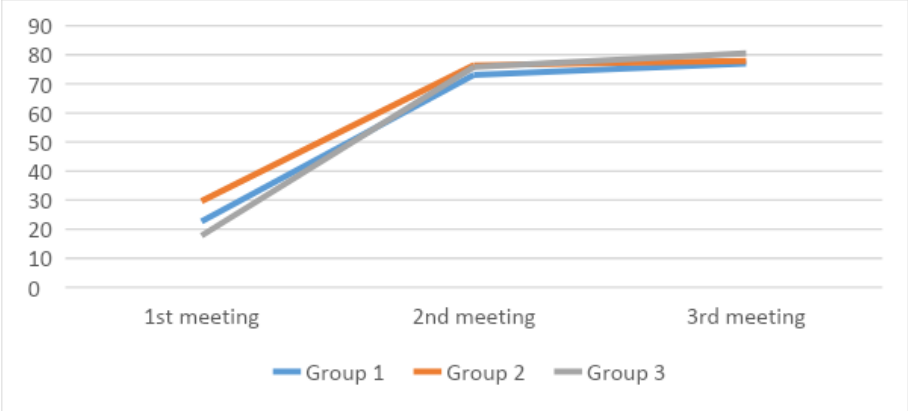

Figure 2. Graph of student ability to compile worksheets containing TEK

Figure 2 shows that all three groups experienced a significant increase in the ability to compile TEK-contained worksheets, especially from the first meeting to the second meeting. At the third meeting, students' abilities improved, but not significantly. This is because at the first meeting, students are still in the early stages of learning how to design worksheets containing TEK, so the progress made is quite slow. At the second meeting, students had begun to understand how to adapt the format and elements of worksheets given by the lecturer to be used as a basis for the preparation of their worksheets, so the changes were significant in the second meeting. Meanwhile, the 3rd meeting was the continuation of the 2nd meeting, so the increase is not so notable. Overall, students' ability to design worksheets containing TEK increased from the first meeting to the third meeting, with the average scores in each sequential group being 77.03, 77.88, and 80.59. This increase is due to the implementation of CBL as it is analyzed by the correlation test explained in Table 2 below. It is also supported by the questionnaires (Table 1) filled in by the students showing that the implementation of CBL involves TEK; thus, it makes it easier for students inserting TEK in the worksheets they developed. It is also supported by Merritt et al., (2022) that CBL helps students understand more about the materials they are taught as they apply real-life experiences. The implementation of CBL helps prospective teacher students understand the cases and provide solutions, which then makes it easier for them to design the activities in the worksheets.

After an analysis was carried out on improving students' ability to compile worksheets containing TEK, researchers analyzed the relationship between the application of CBL strategies and students' ability to design worksheets containing TEK. This analysis used the Spearman correlation and generated data as shown in Table 2.

Table 2. Correlation of CBL strategy implementation and ability to compile worksheets

			CBL	**worksheets**
Spearman's rho	CBL	Correlation Coefficient	1.000	.005
		Sig. (2-tailed)	.	.967
		N	73	73
	worksheets	Correlation Coefficient	.005	1.000
		Sig. (2-tailed)	.967	.
		N	73	73

Based on Table 2, it can be concluded that there is a correlation between the two variables, where the correlation value between the application of case-based learning and the ability of students to design student worksheets is positive and strong, characterized by a significance value of 0.967, which is greater than 0.5. This suggests that the CBL strategy can be used to improve the ability to design worksheets containing TEK due to the positive and strong relationship between the two variables. However, these results are not accompanied by supportive expert opinions because there has been no research on TEK associated with the ability to design worksheets. Thus, this research has a novelty in terms of the use of Traditional Ecological Knowledge elements in science learning which is not common in Indonesia, to support future science education and STEM learning.

CONCLUSION

The conclusion produced by this study is that the ability of students to design worksheets containing TEK is increasing from meeting 1 to meeting 3 after the implementation of the CBL strategy, and there is a positive and strong relationship between the application of the CBL strategy and the ability of students to design TEK-based worksheets. However, for this TEK-related research to provide more optimal results, it is better to allocate more meeting time to implement this CBL strategy so that students have more time to discuss. Then, the time given for students to explore TEK in their local environment should be made longer so that the results of exploration and observation become more in-depth.

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