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The Effect of Students' Conceptual Error-Based Learning Tools on the TPACK Ability of Prospective Teachers

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Abstract.
This study aimed to determine the effect of learning tools based on the analysis of students' conceptual errors on TPACK abilities. This study uses an experimental method involving 105 samples in extracting the initial TPACK data owned by students studying to be teachers and their teachers. In the final data collection, 2 students carried out learning using a device that had been designed based on the possibility of student errors in the trial class, and 2 teachers taught conventionally in the control class. The data was taken by observing the TPACK indicator's achievement for students and teachers. The study results show that the content knowledge capabilities of prospective teachers have a better opportunity to present more actual problems and provide opportunities for students to develop higher-order thinking skills. In this case, the students introduced the concept of algebra (variables, coefficients, constants and real number operations) in the problem of managing pocket money, while the teacher gave the problem of the number of balls in a cardboard box. The implication is that the readiness of prospective teachers to teach will be better.

Keywords: *conceptual error-based learning,* TPACK ability

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1. Introduction

The results of the 2018 PISA evaluation stated that Indonesian students were in the bottom 10 of the 79 participating countries. The average reading ability of Indonesian students is 80 points below the OECD average (1)The ability of Indonesian students is also still below the achievement of students in ASEAN countries. Indonesian students' average reading, math and science abilities are 42 points, 52 points, and 37 points below the ASEAN average, respectively. Facts in the field related to the condition of education in Indonesia are not yet at a level that is said to be good to support external factors for the low ability of Indonesian students. All the classic problems, especially regarding the issue of the low capacity of human resources, have become annual issues that have yet to be resolved. In a study conducted by (2,3)she found surprising

facts that there was a legacy of misunderstandings committed by teachers, especially when teaching algebraic concepts(2). This has become a separate problem related to mastery of content and pedagogical competencies that a teacher should have. a framework that identifies knowledge, teachers need to teach effectively with a technological framework known as TPACK. TPACK is a framework for understanding and describing the type of knowledge needed by a teacher to streamline pedagogical practices and understanding concepts by integrating a technology in the learning environment (4)The basic concept of the presence of TPACK emphasizes the relationship between subject matter, technology and pedagogy. The interaction between the three components has the power and attraction to foster active learning focused on students. This can also be interpreted as a form of shifting learning that was originally centered on the teacher to shift to students. TPACK emphasizes the relationships between technology, curriculum content and pedagogical approaches that interact with each other. The TPACK scheme has a relationship between the constituent components, intersecting each other between materials (C). pedagogy (P) and technology (T) that influence in the context of learning. It takes a long time to overcome all of this, but it can save time if the right strategy is chosen. One of these strategies is to target LPTKs that produce prospective teachers. This study aims to determine the effect of learning tools based on the students' conceptual error analysis results on the TPACK abilities of prospective teacher students.

1.1. Method

This study uses an experimental method involving 105 samples in extracting the initial TPACK data owned by students and teachers. In the final data collection, 2 students learn using devices designed based on the possibility of student errors in the trial class, and 2 teachers teach conventionally in the control class. Each student learns 2 times using learning tools based on students' misunderstandings and an ebook developed as a teacher mentoring book. During the implementation of learning, observations were made on students' TPACK abilities in learning using conventional learning tools and students' TPACK abilities in learning using learning tools based on student understanding errors.

As a reinforcement to test the validity of the research results, the student's TPACK ability will be compared with the accompanying teacher's TPACK ability which is obtained through documenting the accompanying teacher's learning process on the same content as that taught by students.

2. Result and Discussion

2.1. Implementation of Learning

A. Phase I (Problem Orientation)

The teacher gives the following problems. The pocket money that Doni has every week is Rp. 70,000,-. Within the 6 effective days of school, there are special days (Tuesday, Wednesday and Friday) Doni attends additional and extra-curricular lessons which are carried out after school. This makes Doni need additional pocket money to become Rp. 10,000,- every day. If Doni wants to have a savings of Rp. 25.000,- Every week, how much is Doni's daily allowance?

B. Phase II (Organizing Students)

Through question and answer, teachers and students identify problems.

1) The teacher asks "What problems can you find?"

Analysis of possible student errors:

Some students will answer "How much is Doni's daily pocket money?"

This answer is incomplete, because there is a special condition that Doni wants, namely "to have a savings of Rp. 25.000,-

So that the complete answer of the students is: "If Doni wants to have a savings of Rp. 25.000,- Every week, then how much is Doni's daily pocket money?".

C. Phase III (Guiding Individual or Group Investigations)

The teacher provides scaffolding (assistance) in the form of questions (without giving answers):

1. Is it true that Doni's pocket money is IDR 10,000?

2. Can Doni directly divide the weekly allowance into the number of school days?

3. Did the few days that Doni used to take extra and extra-curricular lessons affect the distribution of Doni's pocket money?

4. What other factors affect Doni's allowance?

Students in each group discuss the solution to the problem within the limits of the questions given by the teacher.

D. Phase IV (Development and Presentation of Works)

1. Representatives from several groups present the results of their answers in class

2. Other students are given the opportunity to respond to the results of the exposure

E. Phase IV (Analyze and Evaluate Problem Solving Process

1. The teacher and students analyze and evaluate the problem solving process

2. Analysis of possible student errors:

3. Some students will answer “Rp. 10,000,-“, the answer is not quite right because this is just pocket money on the day Doni takes extra or extra classes

4. Some students will answer “(Rp. 70,000 – Rp. 25,000)/7”, the answer is not correct because the number of school days is 6 and there are special days with certain pocket money

5. Some students will answer “(Rp. 70,000 – Rp. 25,000)/6”,

6. This answer is not correct because there are days when Doni takes extra or extra classes with an allowance of Rp. 10,000,-

2) Students explore the concept of algebraic forms through the following question and answer activities.

a. The teacher gives a statement “For example, the activity for example Doni’s daily pocket money whose amount is not yet known with a certain symbol is an expression of algebraic form.

b. The teacher introduces the elements of algebraic forms IDR 45,000 = 3x + IDR. 30,000 x is known as a variable, i.e. a certain symbol that we choose to represent a certain amount that we don’t know yet 3 in 3x is known as the variable coefficient, indicating the number of variables Rp.45,000 and Rp. 30,000 is known as a constant

c. There is another element in algebraic form, namely mathematical operations, in this example it is addition

2.2. The results of the study present various findings, as follows.

The results of the TPACK Preliminary Ability (Technological knowledge (TK) dimension) for Mathematics Teachers, show that students’ ability to choose teaching aids has a higher value than teachers. This is related to the problems used by students that are more actual in students’ lives than the problems taken by the teacher. Students use the context of the problem of pocket money management, while the teacher takes the context of the number of balls in the box and the number of visitors to the aquarium. This is in line with the opinion regarding the choice of question content that involves everyday events, helping students to understand the context of the conversation that they want to appear without limiting the imagination that will be raised (5,6). The representation of the environment in a visualization forms a network of concepts called schemas.

These schemas are used to form new schemas that have the same information structure through the assimilation process. According to constructivism theory, the learning process is a continuous process of constructing and reconstructing understanding. This learning process is known as learning, relearning, and unlearning. The learning process is the process of learning something new using the understanding of previous knowledge or experience in accordance with the contextual problems presented. While relearning is strengthening what has been learned. Meanwhile, unlearning is a process of learning new things that correct what was originally understood or overhaul the construction of their understanding(3,7).

The results of the TPACK Preliminary Ability (Pedagogical knowledge (PK) dimension) for Mathematics Teachers, show data that students still need flight hours to be able to balance seniors in terms of the ability to manage classes so that students do not get bored in learning.

The results of the TPACK Preliminary Ability (Content knowledge (CK) dimension) of Mathematics Teachers, show data that students are more facilitated to develop HOTs-oriented material content. This can be seen from the content used to orientate the problem, which is done by students by presenting problems that need to be solved related to pocket money management with various information that needs to be solved using an algebraic approach. While what is done by the teacher, problem orientation uses questions where the answers can be directly found by students through observing pictures and complete information that has been given by the teacher in the matter, in this case pictures of cardboard and balls and information on the percentage of aquarium visitors in introducing variables, constants, coefficients and operations. numbers as part of an algebraic form. Although oriented towards HOTs, the learning carried out by students can still be understood by students, this is due to the use of problems that are very close to students' lives so that students can also choose visual aids (in this case banknotes) to be able to overcome problems related to the amount of pocket money. every day. This event is in line with the statement that students will rearrange their experiences to suit the problems they face, in other words cognitive processing involves recreation from direct sensory experiences [8,9]. In addition, the weakness of the problems raised by the teacher, is only able to facilitate students to make algebraic forms of an event. Students will lose the opportunity to know the benefits that will be obtained if he can make these algebraic forms. This is not relevant with the intent of Probel based Learning (PBL) is learning that uses real (authentic) problems that are not

structured (ill-structured) and are open as contexts for students to develop problem-solving skills and critical thinking as well as build knowledge at the same time. new (8)

The results of the TPACK Initial Ability (Technological Content knowledge (TCK) dimension) for Mathematics Teachers, showed that there was no significant difference.

The results of the TPACK Ability (Pedagogical Content knowledge (PCK) dimension) of Mathematics Teachers, show the data that the ability to choose appropriate learning methods to overcome students' difficulties in understanding the material possessed by students and teachers does not experience a difference. The interesting thing about this ability is that in planning students already have learning scenarios that are prepared with predictions of possible student errors. Students are well aware that the answers can vary depending on the students' comprehension which affects students' errors. As can be explained through Newman's Error Analysis which states several causes of student errors, including reading errors, comprehension errors, transformation errors, and process skill errors. ; and errors in writing the final answer (encoding error) (9). While the planning of the teacher is not visible. It's just that, during the implementation of learning, with the experience they have, the teacher can improvise so that the difficulties of students are handled well by the teacher. This supports the results of research from Pratama Year 2020 which states that the number of teaching hours has a significant effect on teachers' pedagogic competence(10)

The results of the Preliminary Ability TPACK (Technology Pedagogical knowledge (TPK) dimension) for Mathematics Teachers, show the data that the ability to choose the appropriate learning method to overcome students' difficulties in understanding the material possessed by students and teachers does not experience a difference. The interesting thing about this ability is that in planning students already have learning scenarios that are prepared with predictions of possible student errors. While the planning of the teacher is not visible. It's just that, during the implementation of learning, with the experience they have, the teacher can improvise so that the students' difficulties are handled well by the teacher. This supports the results of research from Pratama Year 2020 which states that the number of teaching hours has a significant effect on teachers' pedagogic competence (10)

The results of the TPACK Initial Ability (Dimension of Pedagogical Technology and Content knowledge (TPACK)) for Mathematics Teachers, show that there is no significant difference.

3. Conclusion

There are several findings of differences in the TPACK of prospective teachers, including: 1) Students' ability in understanding content has a better chance of presenting problems that are more actual in nature and providing opportunities for students to develop higher-order thinking skills. In this case, students introduce algebraic concepts (variables, coefficients, constants and real number operations) in pocket money management problems, while the teacher gives problems with the number of balls in a cardboard box; and 2) student planning already has a learning scenario prepared with predictions for possible student errors. While the planning of the teacher is not visible. It's just that, during the implementation of learning, with the experience they have, the teacher can improvise so that the difficulties of students are handled well by the teacher.

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