Analysis The Ability of Thinking Abstractly of Mathematics And Self-Efficacy Through Tpack

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Abstract. The purpose of this study is to analyze the ability of thinking abstractly of mathematics and self-efficacy through TPACK learning. This research is quantitative with survey method and conducted on 7th grade students. The Data were collected using interview, questionnaire sheets and the ability thinking abstractly of mathematics tests. The results of this study are several indicators of the ability of thinking abstractly of mathematics, found indicators that have been achieved but some of them have not yet been reached as making generalizations. The results of the questionnaire and interview it was concluded that most students still assume that mathematics is difficult to learn and the ability

1. Introduction

Information, communication and technology has a lot of influence on the way of life, work, act, and also learning [1]. The progress of ICT is making science, technology, and rapidly developing information [2], technology and information have an important role in everyday life [3], humans become highly dependent on technological equipment in their lives.

The rapid development of ICT is also occurs in the world of education. The students are already familiar with the technology. It encourages teachers and schools to integrate ICT in learning. [4] argues that technology can help students learn individually or groups. That is, the technology can be used to enhance the practical aspects of teaching and the investigation. In addition, the technology has some benefits in such learning can provide interactive content, providing feedback, diagnosing learning of students, or as a tool that can be used to improve learning outcomes [5].

Knowledge is needed from prospective teachers or teachers associated to how to utilize technology in learning by integrating it in the learning process or commonly referred to as Technological Content Knowledge Pedagocial abbreviated TPACK. TPACK is an integration of technology, materials and pedagogy that interact with each other to produce ICT-based learning. By integrating technology in accordance with the material being studied is expected to make abstract concepts more concrete so that students better understand concepts in depth and the indicators contained in these materials can be achieved with maximum and no misconceptions occur.

TPACK is the ability of the teachers to integrate technology in learning [6]. The framework derived from the construct on Pedagogical Content Knowledge (PCK). [7] argues that prepare teachers or prospective teachers with general pedagogical skills and knowledge of the subject matter, such as mathematics, separately insufficient. In its place is the necessary foundation of teaching which is at the intersection between the subject matter and pedagogical content. A math teacher is expected to have a good PCK in order to conduct an effective math learning process. Furthermore, the development of PCK TPACK by teachers is very important to do that teaching with technology integration becomes
effective. Just as in the development of PCK, prospective teachers or teachers actively assess various methods to prepare teachers to teach with diverse technologies. The challenge is how to identify the route to learn prospective teachers or teachers to guide them in developing such knowledge. As an illustration of the route to learn is how big they are already engaged in activities related to the components of knowledge: the technological knowledge (TK), content knowledge (CK), knowledge of pedagogy (PK), knowledge of pedagogical content (PCK), knowledge of pedagogical technology (TPK), and technology content knowledge (TCK), a new science called TPACK. The following figure is an TPACK frame along with related knowledge component. The challenge is how to identify the route to learn prospective teachers or teachers to guide them in developing such knowledge. As an illustration of the route to learn is how big they are already engaged in activities related to the components of knowledge: the technological knowledge (TK), content knowledge (CK), knowledge of pedagogy (PK), knowledge of pedagogical content (PCK), knowledge of pedagogical technology (TPK), and technology content knowledge (TCK), a new science called TPACK. The following figure is an TPACK frame along with related knowledge component. The challenge is how to identify the route to learn prospective teachers or teachers to guide them in developing such knowledge. As an illustration of the route to learn is how big they are already engaged in activities related to the components of knowledge: the technological knowledge (TK), content knowledge (CK), knowledge of pedagogy (PK), knowledge of pedagogical content (PCK), knowledge of pedagogical technology (TPK), and technology content knowledge (TCK), a new science called TPACK. The following figure is an TPACK frame along with related knowledge component. The challenge is how to identify the route to learn prospective teachers or teachers to guide them in developing such knowledge. As an illustration of the route to learn is how big they are already engaged in activities related to the components of knowledge: the technological knowledge (TK), content knowledge (CK), knowledge of pedagogy (PK), knowledge of pedagogical content (PCK), knowledge of pedagogical technology (TPK), and technology content knowledge (TCK), a new science called TPACK. The following figure is an TPACK frame along with related knowledge component. The challenge is how to identify the route to learn prospective teachers or teachers to guide them in developing such knowledge. As an illustration of the route to learn is how big they are already engaged in activities related to the components of knowledge: the technological knowledge (TK), content knowledge (CK), knowledge of pedagogy (PK), knowledge of pedagogical content (PCK), knowledge of pedagogical technology (TPK), and technology content knowledge (TCK), a new science called TPACK. The following figure is an TPACK frame along with related knowledge component.

Figure 1. TPACK and Knowledge Framework Components

There are three components of the teacher's knowledge is subject material, pedagogy and technology. This model has three equally important intersection is the intersection between the body of knowledge that is expressed as PCK (pedagogical content knowledge), TCK (technological content knowledge), TPK (technological pedagogical knowledge), and TPACK (technology, pedagogy, and
content knowledge). In the simple ways TPACK can be described as the teacher's knowledge about when, where, and how to use technology, while guiding students to improve their knowledge and skills in a particular field of study.

TPACK can be assessed with five different levels using the modelRoger about an innovative decision process. [8] defines this level as follows:

- Recognizing (knowledge), teachers can use ICT and recognize harmony with the content but do not integrate technology into their teaching did.
- Accepting (persuasion), teachers form a favorable attitude toward learning or not content with the appropriate technology.
- Adapting (decision), the teachers involved in activities that direct the choice to adopt or reject learning with ICT as appropriate.
- Exploring (implementation), teachers are actively integrating learning with appropriate ICT.
- Advancing (confirmation), where teachers evaluate the results of decisions about integrating learning denganteknologi accordingly.

TPACK is attempt to revolutionize learning in the global era. The results of the learning process in schools not only give birth to individuals who have the skills of science and mathematics, but also creative, mastering ICT, and be able to have a problem-solving abilities, so the purpose of the development of learning approaches TPACK is to prepare students to have the skills needs of the various fields.

The use and application of mathematics in sharing fields is certainly inseparable from one's mathematical abilities so that he is able to use mathematics to solve problems encountered in his work. Therefore learning mathematics should be important to continue to be improved. [9] says that, the essence of mathematics education has two directions of development that meets the needs of the present and the future. To meet the needs of the present, leads to an understanding of mathematics learning of mathematics and other sciences. As for the future needs to have a broader meaning is to give logical reasoning ability, critical and careful and think objectively and openly indispensable in everyday life as well as the face of ever-changing future. Thus mathematics should develop processes and thinking skills of students.

One of the important mathematics ability to develop is the ability to think abstractly. This is because the object is an abstraction or a mathematical basis is often referred to mental objects [10]. Basic mathematical objects include: facts, concepts, and principles of operation or relations [11]. [12] says that the ability of students to learn mathematics related to the understanding of the concepts and principles of mathematics.

The concept is an abstract idea that can be used to grouping set of objects, while a series of several concepts together and the relationship between these concepts is a principle [13]. Between concepts and principles are important in mathematics, because the understanding of concepts and principles of mathematics learning are indispensable to memecahakan problem. The process of forming an abstract concept called abstraction and abstraction characteristics are the same searches or general nature of a set of real examples [14].

Each student has the ability abstractions different and unique. A student has his own way in the process of abstraction to construct a mathematical concept. Differences in the process can be influenced by a knowledge that di miliki by the student [15]. Therefore, teachers should be aware of how the process of abstraction of students in order to improve the way of thinking of students in learning mathematics.

In addition, there are several factors that can influence student learning activities. The factors of the students that can affect student learning of which is, environment [16], intelligence, readiness, talent, willingness to learn, as well as the interests of students. While factors outside the student includes model presentation of the subject matter [17], personal and attitudes of teachers, teaching atmosphere, the competence of teachers, as well as the condition of the public. One important factor affecting student learning is a person's self confidence of students (self-efficacy).

Self-Efficacy is a person's belief in the ability [18] to do the tasks or jobs that must be completed so that it can determine success. A student who has a high self-efficacy will be able to confront and transform these problems into challenges to be faced [19]. However, But when an individual feels that
he has no confidence in his abilities. Thus making a perception that the task he faces is considered
difficult without knowing the capabilities that exists within him. It will make an individual to avoid the
difficult task and prefer to do the task easier. The situation reflects the low self-efficacy owned so will
result in low performance of a person [20].

2. Method
This research is descriptive quantitative research with survey method. The sample was 58 students,
consisting of 28 students 7thA Grade (using TPACK) and 30 students 7thB Grade (non-TPACK). The
instrument used, among others, observation sheets, interview, test sheets and questionnaires.

3. Results And Discussion
The results of the analysis of data the average score of abstract thinking ability of students to learn with
TPACK and Non-TPACK can be seen in the following table.

| Table 1. Abstract Thinking Ability Scores |
|------------------------------------------|
| Class | N  | mean | St. deviation |
|-------|----|------|---------------|
| TPACK | 28 | 69.57| 4.854         |
| Non-TPACK| 30 | 68.37| 4.422         |

Based on the table it can be seen that the average for the class TPACK better than non-TPACK class. As for seeing the average score of the ability to think abstractly at any level of abstraction can be seen in the following table.

| Table 2. Description of the Level Abstraction |
|----------------------------------------------|
| level Abstraction | Description | TPACK | Non-TPACK |
|-------------------|-------------|-------|-----------|
| Introduction       | Recalling previous activities relating to the matter at hand | 72.32 | 71.32 |
|                    | Identify the previous activities related to the matter at hand. |       |           |
| representations    | Declare the results of the previous thinking in the form of mathematical symbols, words, graphics to help reflection | 71.67 | 70.55 |
| Abstract Structural| Reflecting previous activities to the new situation | 66.53 | 66.15 |
|                    | Develop a new strategy for a problem, which previously has not been used |       |           |
| Structural awareness| Giving an argument correctly against the decisions made and is able to summarize their activities properly during troubleshooting and structurally connected. | 66.13 | 65.78 |

Based on the table it can be seen that the highest average for each class that is at the level of recognition and the lowest level of structural awareness.
The results of the analysis of students' mathematics self-efficacy can be seen in the following table.

**Table 3. Self-Efficacy Scores**

| Class    | N  | Mean   | St. deviation |
|----------|----|--------|---------------|
| TPACK    | 28 | 78.23  | 2.18          |
| Non-TPACK| 30 | 72.46  | 3.65          |

Based on the table it can be seen that the average self-efficacy for TPACK better class of non-TPACK class.

Seeing the results of the analysis that has been presented, the ability of abstract thinking can be developed through learning TPACK, this is made possible because the characteristics of TPACK integrating technology in learning [21] can help students understand the concept of the material being studied and makes students more challenged in develop the ability to think mathematically.

In the process of abstract thinking, the role of this technology is very beneficial, especially at this stage of abstraction and structural awareness. Technology can be a bridge [22], which can help students to describe an abstract mathematical concept into which the concrete problems.

Implementation TPACK are still some things that need to be improved [23], including the preparation is done should be nice and appropriate to the learning objectives to be achieved, nor instruments of learning, including learning media. This is necessary because the technology which will be displayed should be appropriate and have significant value in supporting the learning process.

But overall, students' mathematical abstract thinking ability is still lacking, it can be seen from the average in each group showed results that brought the minimum value standard is 70. Tests abstract thinking ability is considered something new for most students [24], so that they had difficulty in completing the test.

Learning by using TPACK also be used to develop students' self-efficacy mathematically, this can be seen from the average achievement of students in learning self-efficacy that uses TPACK. Through this lesson students become more confident, not easy to give up and have a more positive outlook towards learning, the technology is already very close to everyday [25] they make learning math more fun. But overall, students' mathematical self-efficacy is low, this can be seen from the results of observations and interviews with teachers, most of them are still in doubt and fear when working on math problems or express their ideas or opinions.

### 4. Conclusion

First, the ability to think abstractly is an ability that might be essential for students to learn mathematics, but this capability is not widely used as a focus of teachers in learning, so that most students still have the ability to lower abstraction. Second, self-efficacy mathematically should always be developed on any mathematical learning [26], it is intended that learning is done to be more effective and enjoyable. Students no longer considers mathematics as something scary and should be avoided. Third, TPACK learning may be one way to develop the ability to think abstractly and students' self-efficacy. The technology integrated in perceived learning can help students to better understand the concept of the material being studied.

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