Design of instrument Technological Pedagogic Content Knowledge (TPACK) for prospective mathematics teachers

I Wahyuni¹,²,*, Zaenuri³, Wardono³, Y L Sukestiyarno³, S B Waluya³, Nuriana³, and N Aminah⁴

¹Doctoral of Graduate School Universitas Negeri Semarang, Indonesia
²Department of Mathematics Education, Universitas Swadaya Gunung Jati, Indonesia
³Mathematics Department Faculty of Mathematics and Sciences Universitas Negeri Semarang, Indonesia
⁴Department of Mathematics Education, Universitas Swadaya Gunung Jati, Indonesia

*Corresponding author: ik.math84@gmail.com

Abstract. This study aims to design a measuring tool for Technological Pedagogic Content Knowledge (TPACK), especially for prospective mathematics teachers. This research uses design research and Development (R n D) which refers to the ADDIE development model, which includes Analysis, Design, Development, and Evaluation. Based on the results of expert validation on the TPACK capability instrument, namely the TPACK ability questionnaire instrument and sheets teaching practice observations based on the TPACK aspect are included in the very valid category.

1. Introduction

The Technological Pedagogical Content Knowledge (TPACK) framework is integration between aspects of Technology (T) in aspects of Pedagogical Content Knowledge (PCK) [1,2]. Conceptualization PCK as an integrated understanding of four components: pedagogy, eye content lessons, student characteristics, and the environmental context in learning [3]. Thus, TPACK can be seen as how a teacher or prospective teacher integrates technology to teach the material with a certain method [4]. Although generally, it is a belief that if the mathematics teacher has excellent mathematical knowledge, he will be the best person to teach mathematics. But do they mature but he cannot teach math well. Teachers should not only have a strong knowledge capability but teachers must also have the ability to how to help students to learn correctly [5]. The use of technology in teaching activities is in synergy with the demands of the 21st Century [6].

Students in the 21st century are expected to have abilities, one of which is literacy information and communication technology. One type of technology that can be integrated into teaching in the 21st Century is ICT-based technology [7,8]. The development of information and communication technology (ICT) which is growing rapidly is enabled people to be smarter in understanding all aspects of life. It's possible that in the field of education can also be carried away by the globalization to be implemented in the education system based on information and communication technology [9]. TPACK math teacher in teaching material in the 21st century needs to be known because the pack can help determine the effect of an intervention. TPACK is also a professional development program to characterize descriptively above the development of teacher knowledge. This shows that TPACK is an important factor which can be used as a reference for improving the quality of education. By seeing the ability...
TPACK teachers, the government can determine the policies to be set to develop teacher professionalism. Seeing the importance of TPACK on quality education, many researchers have developed several types of instruments to measure it. The existing TPACK measurement is to use a questionnaire, as previously mentioned performed by N Aminah [10]. Respondents were instructed to fill out a Likert 1 scale questionnaire to 5 or 7. Measured aspects of Technological Knowledge (TK) focus on digital technology computers and troubleshooting, web, social media. While on the aspect Pedagogical Knowledge (PK), only measures the knowledge of pedagogy in general (making planning discussions, monitoring the implementation of learning, and implementing strategies learning). Another TPACK instrument is in the form of a journal, where the participant is asked to fill it in about how IT skills are integrated into English learning conducted by prospective teachers. The TK aspect focus on ICT both software and hardware. The PK aspect also has not shown its concern about learning to reduce misconceptions. TPACK measurement using the technique: interview depth, Planning Unit, and reflection on the planning or planning unwritten learning by integrating technology [11].

The three instruments used to assess the effectiveness of the school teacher professional development program junior high in the field of social knowledge. Research on professors who teach online courses at the higher education level. The TK aspects are emphasized on how the professor uses the learning management system (LMS). Research does not show how the management of learning in misconceptions. Based on these results, no research shows how technology literacy management by the learning topic. Besides, I haven't shows that there is class management that emphasizes improving misconceptions. With this, the type of TPACK instrument needs to be further developed and adjusted accordingly in technological literacy in the 21st Century, so that it can be used as a guide for teachers to carry out learning. Based on this background, the formulation of the problem in this research is how to design capability instrument of the Technological Pedagogic Content Knowledge (TPACK) for Mathematics Teacher is Valid? So that the purpose of this study is to produce design instrument capabilities for Technological Pedagogic Content Knowledge (TPACK) is valid.

2. Methods
This study uses a Research and Development (R n D) design which refers to the ADDIE development model developed by Dick and Carey, includes Analysis, Design, Development, Implementation, and Evaluation [12]. However, in this research, several stages are not carried out such as implementation because of the limitations of researchers. The analysis stage is the stage of gathering all the information that can be used as a basis for product development. The design stage is the concept design stage product to be developed. The development stage is the development stage TPACK instrument in the form of a questionnaire and observation sheet based on teaching activities TPACK aspects, involving 3 reviewers by expert judgment.

The instrument for assessing TPACK developed in the form of an observation sheet teaching activities and surveys (questionnaires) which refer to the operational definition of the seven aspects TPACK, namely TK, PK, CK, TPK, TCK, PCK, and TPACK [13]. Each of these definitions is operational developed into 3 to 6 indicators. Meanwhile, each indicator is developed into one statement. The first time a questionnaire was compiled consisting of 29 statements, where the respondent must respond to the statement by the conditions experienced. The validation result data is a score of each criterion based on the validation rubric with score ranges of 1-4 that were developed from Riduwan [14]. The data of the instrument validation results were analyzed by using quantitative descriptive. This analysis is carried out on every aspect (point) of each criterion. The evaluation stage is carried out after the instrument is validated by an expert. The validator provides input/suggestions related to the instrument that has been made. The results of the validator input are the made researcher's consideration to improve the instrument that has been made to be better.

3. Results and Discussion
The first activity is to analyze the characteristics of the teacher according to the design development of the TPACK instrument in the form of a questionnaire related to indicators that have been developed.
TPACK indicators that are tailored to the needs of the teacher. Second, analyzing the types of TPACK instruments through a literature review of the results of previous research. Then, analyze the conditions in the field regarding the forms form of the TPACK instrument, as well as the importance of why TPACK needs to be measured or known. Third, determine the purpose of developing the TPACK instrument. The next stage is designing the instrument. Namely designing the TPACK instrument in the form of questionnaires and teaching practice observation sheets based on the TPACK aspect. On these steps are divided into three parts, the first is to determine the operational definition from each aspect in TPACK. TPACK in research consists of 7 aspects, namely Pedagogical Knowledge (PK), Content Knowledge (CK), Technological Knowledge (TK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), Pedagogical Content Knowledge (PCK), and Technological Pedagogical Content Knowledge (TPACK) [15,16].

Table 1. Results of the Validation of the TPACK Ability Questionnaire and teaching Practice Observation Sheet Based on TPACK.

| No | Validated components | Questionnaire Score | Observation sheets Score | Information |
|----|----------------------|---------------------|--------------------------|-------------|
|    |                      | V1 V2 V3 average    | V1 V2 V3 average         |             |
| 1  | Content              |                     |                          |             |
|    | a. Statement in accordance with TPACK indicator | 4 4 4 4 | 4 4 3 | 3,67 | 1,00-1,50: less valid |
|    | b. Purpose is clear  | 4 4 4 4 | 4 4 3 | 3,67 | 1,51-2,50: enough valid |
| 2  | Construction         |                     |                          |             |
|    | a. Statement in every ordered section systematic | 4 4 4 4 | 4 4 3 | 3,67 | 2,51-3,50: valid |
|    | b. Grain's question describes the direction of the goal which is desired | 4 4 4 4 | 4 4 3 | 3,67 | 3,51-4,00: very valid |
|    | c. Statement item formulation no raises double interpretation | 4 3 2 3,3 | 4 4 2 | 3,3 |             |
| 3  | Language             |                     |                          |             |
|    | a. Sentence on grain statement easy to understand | 4 4 3 3,67 | 4 4 3 | 3,67 |             |
|    | b. Grain statement use Indonesian Language is good and right | 4 3 3 3,3 | 4 3 4 | 3,67 |             |
|    | Average              | 3,75                | 3,62                     |             |

TPACK's operational definition is prepared based on development need stack. Based on this operational definition, achievement indicators are developed. One aspect consisting of one competency achievement indicator, and each achievement indicate competence is developed 3 to 7 statements. Validators are asked to review each statement based on the following criteria: a) substance every statement on the indicators of competency achievement; and b) deep linguistic aspects of every
statement. Experts review each statement by providing suggestions and comments instruments as well as relevant or irrelevant information on the validation sheet. Validation results presented in Table 1.

Based on the results of expert validation related to the TPACK ability questionnaire and observation sheet teaching practice based on the TPACK aspect is included in every valid criterion. For the assessment of the content, the component is included in the very valid criteria, while for the assessment construction components fall into the valid category and component assessment language is included in the valid category. This means that the TPACK ability questionnaire is appropriate with the TPACK indicator and the purpose of the statement is visible. In terms of construction, the statements in each section are ordered and systematic, question items describe a clear direction of purpose and the formulation of statement items does not lead to double interpretation. In terms of language, the sentences in the questions are easy to understand and use good and correct Indonesian. The average results of the questionnaire validation TPACK ability are 3.75 in a very valid category. While the average validation results teaching practice observation sheet based on the TPACK aspect was 3.62 in the very valid category.

4. Conclusion

Based on the results of expert validation on two instruments of TPACK's ability, namely the instrument TPACK ability questionnaire and teaching practice observation sheet based on aspects TPACK is included in the very valid category. Therefore, this instrument can be further investigated to see its practicality.

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