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The Development of Metacognitive Skills-Based Teaching Materials

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ABSTRACT

It is necessary to develop metacognitive skills-based teaching materials to foster mathematical problem-solving abilities. This research is a research and development. Method used for development using four phases: Design, Construction, Testing, Evaluation and Revision. The criteria used to assess the quality of the learning device refer to the material quality criteria namely: validity, practicality, effectiveness. Subject of trials in this research are 25 students of XI IPA-4 and 25 students of XI IPA-2. Two indicators of this study are metacognitive skills and problem solving. Metacognitive skills are: prediction skills, planning skills, monitoring skills, and evaluation skills. Indicators of problem solving are: understanding the problem, devising a plan, carrying out the plan, and looking back. The data are collected by giving Tests and questionnaires, and through observations. The research instruments are: questionnaire of validation for teaching materials, student questionnaire responses to instructional materials, observation sheet activities of learners, observation sheets of learning implementation and learning management observation sheet. The result of this research is metacognitive skills-based teaching materials are succeeded (fulfilling the criteria of valid, practical, and effective) to emerge students mathematical problem-solving.

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1. INTRODUCTION

Nowadays, it is necessary to develop teaching materials that can foster students' mathematical problem solving ability because the math skill of students in Indonesia is quite apprehensive. The study of TIMSS 2011 for students of VIII classes shows that Indonesia ranks 38 out of 45 countries in mathematics. Similarly, the 2009 PISA test results in math, students Indonesia ranks 61 out of 65 countries. Other facts show, more than 50% of high school students in Pare-Pare, South Sulawesi, lack of ability in solving mathematical problems. It is possible due to metacognitive skills that have not been widely adopted by teachers in the learning process of mathematics, so that students are not accustomed to using metacognitive skills in learning. Metacognitive skills-based test result showed 29.61% of students use prediction skills, 22.37% use planning skills, 15.13% using the monitoring skills, and 2.38 using the evaluating skills in solving problems. This is because of less optimal presentation of metacognitive skills in learning, due to the unavailability of a device that is designed learning metacognitive skills training for students to learn to solve problems. To fulfill these objectives, it is required careful preparation. Before the teacher teaches, he is expected to prepare teaching materials that will be taught.

It is noteworthy that the teaching materials become a handbook for teachers in implementing the learning both in the classroom, lab and outside the classroom. Permendikbud No. 65 Years (2013), confirm that the teaching materials are part of the learning plan. Teaching materials meant is limited to the student

books and student activity sheet (LKS). Student books an important part in achieving the Basic Competency (KD) of the learners. Permendiknas No. 2 years (2008), stated that students' books as one of the teaching materials, in type of printed material that is substantially functioning for students' knowledge, compiled based on the analysis of the curriculum, to facilitate teachers in learning and students to achieve competency defined by curriculum, with attention to the language, the attractiveness, and reflects the idea of the author. Books that facilitate students in learning carry out the study are called the students book, and the books that allows teachers to implement learning called teachers book. Student's book and teacher books, each has a distinctive structure and components. To support the teaching materials in the achievement of basic competencies (KD), students are also given the student activity sheets (LKS). This LKS is a student guide that is used to conduct an inquiry or problem solving [1]. This activity sheet can be a guide for the development of cognitive training and guidance for the development of all aspects of learning in the form of experiment guidances or demonstrations. Flow analysis of materials development is as follows. Flow analysis of materials development shown in Figure 1.

Figure 1. Flow analysis of materials development

A question would be a problem if a person does not have any rules / specific law which can immediately be used to find answers to that question [2-4]**.** Furthermore, it is mentioned that three terms of matter is said to be a problem: if the problem is not yet known how the procedure done, if the matter according to the level of thinking and the prerequisite knowledge of students, questions that are too easy or too hard is not a problem, if students have the intention to solve it [5]. A question to be a problem depends on the individual and the time. That is, a question is a problem for a child, but it may not be a problem for other children. For example, "*Andi has 9 dozen of glasses. How many cups are owned by Andi?"* is a problem for students grade 1 (one) but is not a problem for junior high school students. As for the following is one example of a problem for junior high school students. "*A basket of apples consists of green apples and red apples. One fifth of them are green apples. The average weight is 10 grams for a green apple while the average weight of 80 grams for the red apple". What is the average weight of the whole apples?* Or, a question is an issue for one child at a time, but is not a problem anymore for the next time since he has already known how or the process of solving the problem.

Problem Solving is an effort to find a way out of the difficulties in order to achieve goals that are not so easy to achieve immediately [2], [6] means that the problem solving is a process of problems acceptance as challenges to solve them. Solving the problem is not just a goal of learning mathematics but it is a major tool to perform or work in mathematics [4]. Problem solving ability is general purpose in teaching mathematics, even stated as the heart of mathematics; it means problem-solving ability is a basic ability in learning mathematics. Furthermore, it is said that mathematical problem solving can improve students' creativity and analytical ability; and can assist them in applying these capabilities in different situations.

There is four types of knowledge developed through solving the problem raised Copley (2000), namely: declarative knowledge, procedural knowledege, schematic knowledge, and metacognitive knowledge. The problem in mathematics is devided into six parts, namely: a routine, non-routine, regularly applied, routine non-applied, applied non-routine, non-routine non-applied [2]. Routine problems are problems that simply repeat the settlement procedure, such as algorithmic. There is no routine problem and there are only problems that require planning settlement procedure completion, not just using the formula, theory or proposition. Problems routinely applied, routine problems associated with the real world / the daily life of the standard settlement procedures as they have been taught. Non-routine problems applied routine matter more to math than is associated with the real world / everyday life. Non-routine problems of applied, problem solution requires planning by correlating real world / everyday life and the solution may be open-ended. The problem of non-regular non-applied, problems related purely on mathematical relationships. It should be noted, there are four steps proposed phases of problem solving [6], namely to understand the

problems, plan solutions, solve problems and check back all the steps that have been undertaken.

One of knowledge that can help in solving the problems is metacognitive skills. Metacognitive skills refer to a person's cognitive activity for solving problems [7]. While a person's cognitive activity during solve the problem referring to the three phases, namely: understand the purpose of the issue, calling back / organizing knowledge, and to devise strategies to resolve the problem[8]. Cognitive skills are different from metacognitive skills. Cognitive skills required carrying out the task, while the metacognitive skills necessary to understand how to fulfill their tasks [9]. Metacognitive skills can be described as a routine representing mental processing specific actions that are part of the complex process and is done in order to achieve goals such as understanding what has been read [10]. Thus, metacognitive skills have a role in solving mathematical problems.

Metacognitive skills holding is one important role for learning successfully [11-13]. Furthermore, said students who use metacognitive skills have a better performance than students who do not use metacognitive skills or have poor metacognitive skills. It is found that metacognitive skills are believed to play an important role in many types of cognitive activities including comprehension, communication, attention, memory, and problem solving [14].

Metacognitive skills are closely related to mathematical problem solving [15]. If any learning activities conducted in accordance with metacognitive skills, then the problem solving ability of students will undoubtedly be easily achieved optimal. Because with metacognitive skills, math problem-solving process for students should understand the problem, planning the completion strategy, making decisions about what to do, and to implement the decision. In the process they are supposed to monitor and check again what she had done. If decisions are not appropriate, then they should try other alternatives or make a judgment. The process of realizing their error, monitor the results of the work as well as find other alternatives are few aspects of metacognition skills required in solving mathematical problems. Fauzi (2013), mathematical problem solving ability of students strongly influenced by chance and exercises to develop metacognitive skills. The application of problem-solving oriented learning strategy with metacognitive approach can improve learning outcomes of students [16]. A person's success in resolving the issue also influenced by the activity metakognisinya [7], [17], [18]. Metacognitive skills refer to the four aspects, namely, prediction skills, planning skills, skills monitoring, and evaluation skills [19].

When keeping the above, it is necessary to immediately develop teaching materials designed to train metacognitive skills to enhance the problem solving math learners. The problem is, how the process development of teaching materials based metacognitive skills to improve problem-solving skills of learners? How the results of the development of metacognitive skills-based teaching materials to improve problem-solving skills of learners? Does metacognitive skills-based teaching materials produced quality (valid criteria, practical, and effective)?.

2. RESEARCH METHOD

Methods used in this reserch are the research and development. Research and development are used to produce a particular product, and test the quality of the product [20]**.** Research developments of a process or steps inflate new products or enhance existing products, which can be accounted for. Steps in research and development are shown as follows.

Subject trials in this research, students of class XI IPA-4 and grade XI-2 respectively numbered 25 students. Indicators of this study there are two ministered metacognitive skills and problem solving. Metacognitive skills include: prediction skills, planning skills, skills monitoring, and evaluation skills. The indocator of problem solving includes understanding the problem, devising a plan, carrying out the plan, and looking back.

Data collection techniques in stage 1, carried out through informants, conducted at the time of data collection that is used to locate the problem and the potential that exists on the object of research, so that the data obtained can be used as consideration in making the design of a product (teaching materials) second stage of data collection was required at the time will make the design / drafting. Here, the researchers asked the informant about the design considerations such as what products need to be made to help with the kind of mathematical problem solving.

The data collection phase 3 testing is required at the design or product design. At this stage the researchers ask for opinions, comments and suggestions of experts and practitioners that, when analyzed, then used to revise the design. The technique of collecting data was using questionnaires. After the design was revised, and then made into products is still a prototype or instructional materials. The products were tested for a limited field, in the testing process needs to collect the data (data collection 4th) with observation and questionnaires.

Based on data from the results of limited test is analyzed, and the results are used for product revision. After the product is repaired, we then tested again called by the main field test. The data were collected and analyzed, then produced prototype (the final product).

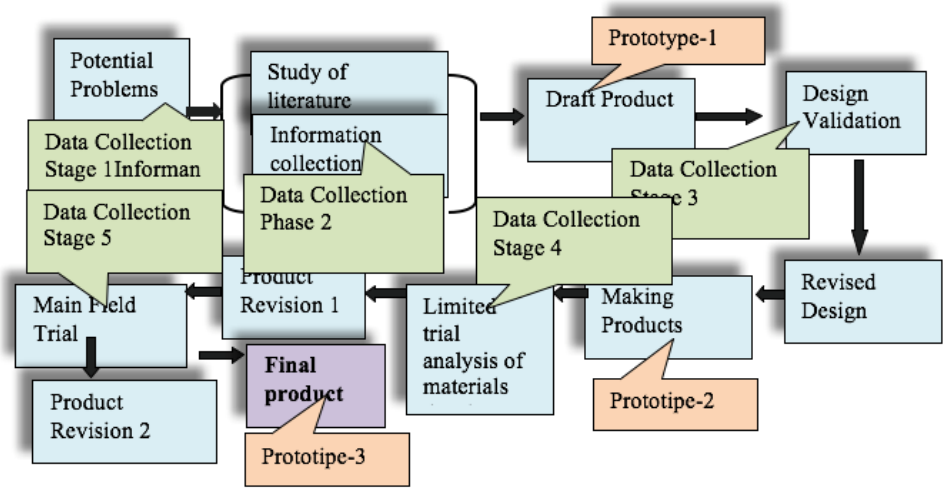

Figure 1. Activities position of data collection and analysis in research and development

The model of development used, referring to the model of development of education in general [21] which consists of five phases: the initial assessment phase, the design phase, the phase of realization/ construction phase of the test, evaluation, revision, and implementation phases.The criteria used in checking products' quality (teaching material) in this research follow criteria [22]. It is proved as qualified if the have these aspects: validity, practicality, and effectiveness.

The data collected by conducting test, questionnaire, and observation. Research instruments includes: validation questionnaire of teaching material and its instruments, questionnaire of students' responses to the teaching material, observation sheet of students activities, observation sheet of learning implementation, and observation sheet of learning management. Before using it, the instruments are validated first by several experts and practicioners from education and development field. It can be used to assess or measure if the analysis result by the experts show: the whole components of instruments and teaching material are valid, reliable, or reaching its validity and reliability.

The criteria used to summarize that teaching material reaches the qualified validity extent (i) is presented by $\overline{X}$ for whole minimum aspect in "quite valid" category, and (ii) as $\overline{A}_i$ for each minimum aspect in "valid" category. Next, the reliability of the assessment sheet of teaching material which is measured by using Borich's (1994) *percentage of agreements* formula as follows:

$$Percentage\ of\ Agreements = \left[1 - \frac{A-B}{A+B}\right] \times 100\%$$

Description:
A = *The larger frequency counts of observer*,
B = *The smaller frequency counts of observer*.

The assessment sheet of teaching material is reliable if the reliability is equal to or greater than 0,75 = (R) ≥ 0.75 [23].

The criteria used to summarize that the teaching material has proper implementation is presented by $\overline{A}_i$ and $\overline{X}$ as minimum extent in "half implemented" category. Next, the reliability of the observation sheet of implemented teaching material which is measured by using Grinnel's (1998) *percentage of agreements* formula as follows:

$$\text{Percentage of Agreement (R)} = \frac{Agreements(A)}{Disagreements(D) + \text{Agreements (A)}} \text{ x } 100\%$$

Description:

A is the proportion of matching frequency between the datas from two observers;
D is the proportion of non-matching frequency between the datas from two observers,
R is the reliability coefficient of the instruments.

The criteria of the implemented learning model considered as reliable if the reliability (R) ≥ 0,75 [23]. The standard of learning achievement in learning mastery criteria aspect is obtained by a student who gets score (S) ≥ 75 achieves mastery learning of individual. If there are 75% students at least achieving 75 as minimum score, then mastery learning classical is achieved.

The standard of learning achievement by the aspect of the application of metacognitive ability in solving problems is achieved if a student at least gets "fair" category. While the mastery learning as general is achieved if three aspects (solving problem, learning mastery, ability standard to optimalize metacognitive skill in solving math problems) can be fulfilled.

The standard criteria for claiming the students which have positive responses to the teaching material are more than 50% compared to those who positively respond 70% as minimum involving aspects. Students' positive responses to the developing teaching material is proved if the criteria of students' positive responses by the aspect of teaching material (textbook and student's worksheets) are achieved.

The criteria used to summarize that the teacher's skill (*kemampuan guru/KG*)in managing learning by using the developing teaching material is proper if the minimum category of KG categorized as "fair". Next, the standard criteria to claim the effectiveness of the developing teaching material positions as 3 of 4 effective model standards, such as (1) learning achievement standard, (2) learning management standard, (3) students' activities standard, and (4) students' responses standard , which is fulfilled by the first standard above (learning achievement standard involving how to solve mathematic problems, learning mastery, and students' metacognive skill) have to be achieved.

3. RESULTS

Here are below the following summary of validator assessment to the teaching material

Table 1. The Data Result of Validation

Criteria	Teaching Material		Description
	Textbook	Student's worksheets	
Validity	3.66	3.67	Achieving the validity standard
Reliability	0.86	3.82	Achieving the realibility standard

Table 2. The Data Result of Field Test

Criteria	Teaching Material		Description
	Trial I	Trial II	
Practicality	$\overline{X}$ = 1.67	$\overline{X}$ = 1.7	Achieving practicality standard
• Effectiveness	44%Completeness	76%Completeness	
• Learning achievement	Active	Active	Achieving
• Aktivitas	Good	Very Good	effectiveness
• Learning management	Positive	Positive	standard
• Students' responses			

Based on the validity analisis to the teaching material based on metacognitive skill (textbook and students' worksheets) as seen on Table 1, is obtained average score of $\overline{X}$ = 3,66 and $\overline{X}$ = 3,67 with reliability of (R) = 0,86 and R = 0,82. The score categorized as "very valid" (3,5 ≤ $\bar{x}$ <4,0) andreliable (R) ≥ 0,75. Specifically, there are several aspects of the teaching material that should be fixed or added by the validators' suggestion. However it can be summarized that the whole component of the teaching material proved as valid, reliable, and can be implemented in small revision.

Table 2 explains the Trial I as a whole observation of the teaching material component which is obtained by the average score $\overline{X}$ = 1.67. Based on the approved criteria of the implemented teaching material, the score categorized as "completely implemented" ($1,5 \leq \bar{x} \leq 2,0$). Therefore, the two observers agree that the implemented teaching material component achieve*percentage of agreement* (PA) = 0, 98%. If confirmed with the implementation criteria (R) ≥ 0,75, then it can be concluded that the teaching material component are completely implemented.While on the Trial II as a whole observation of the teaching material component in Table 2 which is obtained by the average score of all the model components as $\overline{X}$ = 1,7. Based on the approved criteria of the implemented teaching material, the score categorized as "completely implemented" ($1,5 \leq \bar{x} \leq 2,0$). Therefore, the two observers agree that the implemented teaching material component achieve*percentage of agreement* (PA) = 100%. If confirmed with the implementation criteria (R) ≥ 0,75, then it can be concluded that the teaching material component are completely implemented.As the result, based on the apprroved criteria of the implementation, metacognitive skills-based teaching materials are proved as practical through two trials.

Data analysis of the students' learning mastery in the Trial I as listed in Table 2 shows the students' learning mastery in which only about 44% of the students scored above 7.5, thus the the students' learning mastery in the Trial I did not meet the criterion of learning mastery. While the data analysis of the students' learning mastery in the Trial II, as in Table 2, shows that there are 76% of the students who scored above 7.5 or met the criterion of learning mastery. Thus, in the Trial II the students' learning mastery met the criterion of learning mastery.

Theresults of the data analysisonthestudents' activities in the Trial I as listed in Table 2 show thattherewereonly 5 of 8 activitiesmeetingthecriterion. Although 5 of 8 activitiesmetthecriterion, buttherewasstill a coreactivitythatdidnotmeetthecriterion. Thus, thestudents' activities in the Trial I didnotmeettheexpectedcriterion. Meanwhile, the Trial II shows thattheoverallactivitiesmetthecriterion, thenthestudents' activities in the Trial II mettheexpectedcriterion.

The results of the data analysis on the teacher's ability to manage teaching and learning with metacognitive skills-based teaching material in the Trial I as in Table 2 reveal the mean score of the teacher's ability of 3.6 (classified as very good). According to the criterion, the ability of the teacher to manage teaching and learning with metacognitive skills-based teaching material is as expected. Although in general the ability of the teacher to manage teaching and learning with metacognitive skill-based teaching material is considered good, there is something of which implementation needs to be improved in the Trial II. Meanwhile, the results of the data analysis on the ability of the teacher to manage teaching and learning with the metacognitive skill-based teaching material in the Trial II (Table 2) show that the mean score of the ability of the teacher is 3.6 (classified as very good). According to the criterion, the ability of the teacher to manage teaching and learning with metacognitive skill-based teaching material is as expected.

Students' responses to the implementation of the metacognitive skill-based teaching material are divided into two aspects, namely responses to the students' books, and responses to the students' worksheet (LKS). The results of the analysis of the students' responses to the implementation of the metacognitive skill-based teaching material in the Try Out I as shown in Table 2 show that there are 84% of the students who gave a positive response to the students' books, and 68% of the students who gave a positive response to the students' worksheet. Thus according to the criterion, in the Trial I students responded positively to the teaching and with metacognitive skill-based teaching material.

4. DISCUSSION

Based on the results of the validity test that have been described in the research findings earlier, it can be concluded that metacognitive skill-based teaching material entirely meets the validity criteria, but the suggestions of the validator must be taken into account.

Theoretically, based on an expert's assessment, metacognitive skill-based teaching material is feasible to implement in the classroom. Empirically, based on the observation, the implementation of the POKM model in the Trial I meets the criteria of practicality and increases in the Trial II. For each component of the POKM model, however, there are still some aspects of which implementation still needs to be improved in the Trial II.

Factors that make some aspects of learning with metacognitive skill-based teaching material not implemented in the Trial I include: (1) the teacher was not familiar with the implementation of metacognitive skill-based teaching material, especially its integration with a new aspect (metacognition skill) in teaching and learning, (2) the teacher was still difficult to manage the class well, because the implementation of this

material requires the habits of the students' learning to change from the previous learning to a learning that follows the implementation of the metacognitive skill-based teaching material that requires considerable time.

Based in the consideration above, before the Trial II was implemented, the teacher was trained more intensively in implementing the metacognitive skill-based teaching material, especially related to the training process of implementing metacognitive skills for the students, so that the results of the observation of the implementation of metacognitive skill-based teaching material in the Trial II can be maximized. In this case, in the Trial II, the teacher should have been familiar with the application of metacognitive skill-based teaching material.

As previously explained, the effectiveness of teaching and learning with metacognitive skill-based teaching material is determined by four components including: learning achievement, students' activities, the teacher's ability to manage teaching and learning, and the students' responses to the teaching material.

Of the four components mentioned above, in the Trial I there were only two components met; the ability of the teacher to manage learning with metacognitive skill-based teaching material and the students' responses to metacognitive skill-based teaching material. However, in the Trial II met all these components.

Two components of effectiveness that were not met are learning achievement and students' activities. Both aspects mutually affect each another. The characteristics of metacognitive skill-based teaching material are the students' activities in terms of following the training process of implementing metacognitive skills in problem solving in addition to the knowledgeconstruction activities. If the students are less actively involved in the training process of implementing metacognitive skills, then automatically the students' problem-solving ability in mathematics is not optimal.

5. CONCLUSION

Metacognitive skill-based teachingmaterial as a product of thisresearch and developmentisconsideredvalid. On the one hand, in the Trial I, the resultsachievedinclude: (1) the implementation of metacognitiveskills-basedteachingmaterialwaspractical, (2) the implementation of metacognitiveskills-basedteachingmaterialwas not effective, because the classicalcompletenesswas not reached and the studentsactivitieswere not as expectedeventhough the students' responseswere positive and the ability of the teacher to manage teaching and learningwasclassified as "good" or "excellent". On the other hand, in the Trial II, the resultsachieved are: (1) the implementation of metacognitiveskill-basedteachingmaterialwaspractical, (2) the implementation of metacognitiveskill-basedteachingmaterialwas effective, because the classicalcompletenesswasreached, the students' activitieswere as expected, the ability of the teacher to manage learningwasclassified as "very good", and the students' responses to the materialwere "positive".The metacognitiveskill-basedteachingmaterialproducedis of ahighquality (meeting the validitycriteria, practical, and effective) through a developmentprocess, and indicated to be able to improveproblemsolvingability in mathematics

REFERENCES

[1] S. P. Trianto and M. Pd, "Models of Constructivist Oriented Innovative Learning (in B," *Jkt. Prestasi Pustaka*, 2007.
[2] H. Hudoyo, "Mathematics and Implementation in Front of the Class (in Bahasa)," *Jkt. Dep. Pendidik. Dan Kebud.*, 1990.
[3] H. L. Schoen and T. Oehmke, "A New Approach to the Measurement of Problem-Solving Skills," *Probl. Solving Sch. Math.*, pp. 216-227, 1980.
[4] F. H. Bell, "Teaching and Learning Mathematics (in secondary schools)," *WC Brown Company*, 1978.
[5] E. T. Ruseffendi, "An Introduction to Helping Teachers Develop their Competence in Teaching Mathematics to Improve CBSA (in Bahasa)," *Bdg. Tarsito*, 2006.
[6] G. Polya, "How to solve it: A New Aspect of Mathematical Method," *Princeton university press*, 2014.
[7] C. A. Gama, "Integrating Metacognition Instruction in Interactive Learning Environments," *University of Sussex*, 2005.
[8] M. Kayashima, A. Inaba, and R. Mizoguchi, "What Do You Mean by to Help Learning of Metacognition?," in *AIED*, 2005, pp. 346–353.
[9] G. Schraw, "Promoting general metacognitive awareness," *Instr. Sci.*, vol. 26(1-2), pp. 113–125, 1998.
[10] D. J. Hacker, J. Dunlosky, and A. C. Graesser, "Handbook of metacognition in education," *Routledge*, 2009.
[11] J. A. Livingston, "Metacognition: An Overview. http," *Www Gse Buffalo EdufasshuellCEP564Metaeog Htm*, 1997.
[12] S. Imel, "Metacognitive Skills for Adult Learning. Trends and Issues Alert," 2002.
[13] S. A. Coutinho, "The relationship between goals, metacognition, and academic success," *Educate~*, vol. 7(1), pp. 39–47, 2007.

[14] J. R. Howard, "Discussion in the College Classroom: Getting Your Students Engaged and Participating in Person and Online," *John Wiley & Sons*, 2015.
[15] T. Laurens, "Pengembangan Metakognisi dalam Pembelajaran Matematika," in *Disampaikan dalam Seminar Nasional Matematika Juli*, 2011.
[16] I. Sudiarta and G. Putu, "Penerapan Strategi Pembelajaran Berorientasi Pemecahan Masalah dengan Pendekatan Metakognitif untuk Meningkatkan Pemahaman Konsep dan Hasil Belajar Mahasiswa pada Matakuliah Statistika Matematik I Tahun 2006/2007," *J. Pendidik. Dan Pengajaran UNDIKSHA*, vol. 40(3), p. 590, 2007.
[17] H. T. Yong and L. N. Kiong, "Metacognitive aspect of mathematics problem solving," in *3rd East Asia Regional Conference on Mathematics Education (ICMI Regional Conference)*, 2005.
[18] A. Panaoura and G. Philippou, "The measurement of young pupils' metacognitive ability in mathematics: The case of self-representation and self-evaluation," in *Proceedings of CERME*, vol. 4. 2005.
[19] A. Desoete, "Off-line metacognition in children with mathematics learning disabilities," *Ghent University*, 2001.
[20] D. R. Sugiyono, "Metode Penelitian," *Bdg. CV Alvabeta*, 2000.
[21] T. Plomp, "Educational and training system design," *Enschede Neth. Univ. Twente*, 1997.
[22] N. Nieveen, "Prototyping to reach product quality," in *Design approaches and tools in education and training*, Springer, pp.125–135, 1999.
[23] G. D. Borich, "Observation skills for effective teaching: research-based practice," Routledge, 2016.