

Validity of Physics Lesson book Oriented Metacognitive Strategies for Problem Solving Skills of Teacher Candidates

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Received October 12, 2018; Revised November 16, 2018; Accepted December 07, 2018

Abstract This was a research and development study which focus on metacognitive strategies to improve the problem solving of physics teacher candidates. Problem solving is viewed as an essential part of physics education for teacher candidates in higher education. Thus, it was necessary to produce a fundamental of physics lesson book which focus on problem solving skills. The objective of this study was to produce a valid physics lesson book. This research was implemented in three phases, namely define, design, and development using the 4-D model of Thiagarajan. Data were collected through validation sheet and had been measured by the experts. Data then analyzed by using descriptive analysis techniques. The result show that the physics lesson book had been declared as a valid instructional device for improving problem solving of physics teacher candidates.

Keywords: *physics lesson book, metacognitive strategies, problem solving*

Cite This Article: Dewi Sartika, Arie Arma Arsyad, and Mutmainna, "Validity of Physics Lesson book Oriented Metacognitive Strategies for Problem Solving Skills of Teacher Candidates." *American Journal of Educational Research*, vol. 6, no. 12 (2018): 1605-1608. doi: 10.12691/education-6-12-3.

1. Introduction

Problem solving skill was a special skill that must be owned by every science student, especially for prospective teacher in physics education program. Problem solving skill has been the concern of many countries in order to prepare a quality generation.

Based on the Consortium's report on education of countries such as the United States, Australia, Belgium, Germany, Japan, Norway, and Luxembourg, problem solving was noted as an additional domain in PISA 2003. Several survey results show that the average in OECD countries (*Organization for Economic Cooperation and Development*) there are 50% of students who are not able to solve more complex problems. **Another surprising fact is that Indonesia ranks 39th out of 40 countries in the world [1].**

Furthermore, preliminary research (*elementary research*) that has been conducted by the researcher on the identification of problem solving ability of physics teacher candidate in Physics Education Study Program of West Sulawesi University [2], **shows a poor result.** The average student physics teacher candidate of Physics Education Study Program has difficulties in solving physics problems. The student does not have the skills to solve the physics problem as expected. Physician candidates are difficult to understand problems in the form of more complex

problems, work less systematically and less attention to problem solving steps. This shows that physics education students are not skilled in solving problems scientifically.

Moreover, this fact exposure becomes a big warning for the education in our country, especially for educators in the field of physics. The teacher as the main facilitator in the learning process has a vital role in improving students' problem solving skills. Therefore, every physics teacher candidate surely must understand physics and they are also required to have skill in solving various problems in the field of physics.

In order to prepare physics teacher candidates to become professional teachers in the future, the development and application of a physics lesson book capable of practicing problem solving skills in every subject becomes very important. Learning-oriented metacognitive strategies in fundamental of physics courses are expected to improve the problem solving skills of students of physics teacher candidates in Physics Education Program of Universitas Sulawesi Barat.

1.1. Purpose of Research

- Developing a fundamental of physics lesson book oriented metacognitive strategies to improve problem solving skills of teacher candidate students.
- Produce a fundamental of physics lesson book oriented metacognitive strategies to improve the problem solving skills of teacher candidate students who meet the valid criteria.

2. Literature

Flavel in [3] defines metacognition as. *One's knowledge concerning one's own cognitive processes and products and anything related to them. Metacognition refers, among other things, to the active monitoring and consequent regulation and orchestration of these processes in relation to the cognitive objects or data on which they bear.*

Metacognition is the knowledge of a person concerning the process and the cognitive product of the person himself or anything related to the process and the product. Metacognitive relationships, one of them, with active monitoring, consequent control, and organizing these monitoring and control processes in conjunction with cognitive purpose, so that these processes can support a number of concrete objectives in general.

Huitt [4] defines metacognition as one's knowledge of his cognitive system, one's thinking about thinking, and one's essential skills in "learning to learn". Flavell argues that metacognition is a person's knowledge of his own learning and about how to learn. Metacognition is defined as the ability to understand and monitor thinking through its assumptions and implications in conducting activities [5]. Furthermore, Baylor [5] emphasize that metacognition should be trained to be a skill that will guide students to learn and discover their own knowledge. Students with high metacognition levels will demonstrate good metacognitive skills, such as *planning their thinking processes, monitoring their thinking processes and evaluating the processes and outcomes of thinking.*

From several understandings of the metacognition described above, then metacognition is defined as a knowledge of students' cognition involving their own thinking awareness in terms of thinking capacity planning, monitoring thinking processes, evaluating thinking processes and students' thinking outcomes when solving problems.

According to Muin [6] the efforts undertaken by educators is to implement metacognitive strategies consisting of 3 stages:

1. Planning stage, the educator explains the learning objectives, the planting of the concept takes place with the questions given by the educator.
2. Monitoring phase, learners work independently to complete the training questions provided. Educators provide individualized metacognitive feedback, and walk around to guide learners in solving problems.
3. The evaluation stage undertaken by the educator/learner, the evaluation of the educator leads to greater consolidation and application.

Based on some of the opinions expressed above, it can be concluded that metacognition strategies tend to raise awareness of the process of thinking and learning that prevails so that when this aspect can be realized, then one can guard his mind by designing, monitoring and assessing what he or she learns.

In particular, the definition of problem solving is used for the purpose of writing from several literatures: "Problem solving is cognitive processing directed at achieving a goal when no solution method is obvious to the problem solver" [7]. This indicates that problem solving is a cognitive process directed towards achieving goals when there is no clear solution method for problem solvers.

According to Froschouer [8], "Students' ability and inclination to solve effective problems depend on their knowledge, skills and attitudes.

Based on some opinions above, it can be concluded that problem solving is one important component in daily life. Therefore, problem solving is very important to be integrated in all the implementation of learning activities in classroom.

3. Method

3.1. Procedure of Research

This research is a development research of *Research and Development*. The development model used is the *four D* model (Thiagarajan, Semmel & Semmel: 1974) or 4-P Ibrahim model [9]) consisting of 4 stages, those are *define, design, development, and disseminate.*

a. Defining Stage

The definition stage aims to establish and define learning conditions that include learning objectives and limitation of learning materials. The activities in this stage are: (1) curriculum analysis, (2) Student Analysis, (3) Concept Analysis, (4) Task Analysis, and (5) Specification of learning objectives.

b. Designing Stage

Moreover, the design stage has the main goal of producing prototype lesson book. Further lesson books produced at this stage along with research instruments are referred to as prototype-1

c. Developing Stage

Furthermore, the purpose of this stage is to produce the final form of lesson book. At this stage, expert interpretation is required that is content validity. Validity is obtained by calculating the average value of all validators, then the value is confirmed with the validity category determination interval of lesson books, namely:

Very Valid (SV) : $3,5 \leq M \leq 4$
 Valid (V) : $2,5 \leq M < 3,5$
 Quite Valid (CV) : $1,5 \leq M < 2,5$
 Invalid (TV) : $M < 1,5$

The criteria used to declare the lesson book has a sufficient degree of validity where the average value of validity for all aspects is at least in the quite valid category and the validity value for each aspect is at least in the valid category.

3.2. Instrumen and Data Analysis

The data that has been filtered through the instrument and validation sheet is analyzed by the following steps:

- a. Assessment by each expert on each instrument is summarized in a table called the Research Instrument Feasibility Assessment Table.
- b. Criteria, if the data frequency is feasible to use or not feasible to use with more revisions than for certain instruments, then the instrument will continue to be used.

If there are suggestions given by experts and written on the assessed instrument, then it will be considered to revise the intended instrument.

4. Result and Discussion

In this section, researchers will describe the results of research in the form of lesson book products in accordance with the research objectives that have been described previously. The results of the research at each stage are described as follows:

In the defining stage, Activities completed at this stage are curriculum analysis, student analysis, subject analysis, task analysis, and objectives specification of learning. This activity is set first as a base for stepping into the next development stages. The results of each activity in the defining stage are described as follows:

- Curriculum analysis result

The curriculum used in universities refers to the Indonesian National Qualification Framework. The qualification framework is the instrument to determine the qualification level based on the Description of the Learning Achievement. The description is a tool to map one's skills and career, as well as to develop an educational curriculum. Learning Achievement is a statement about what a person knows, understands, and can do, after completing the learning process. Learning Achievement formulation is organized into 4 elements, ie attitudes and values, work ability, knowledge mastery, and authority and responsibility.

- Student Analysis Result

Students who become the subject of this research are students of Physics Education Study Program in the first semester of 2017/2018 academic year. Based on the data from the Student Welcoming Committee, students come from several districts, both inside and outside West Sulawesi. Although most of the students come from mandar's tribe with mandar's languages, not a few of them are from South Sulawesi and some tribes with different regional languages. However, by considering their latest educational background from secondary school, Indonesian language becomes the language that will be used in learning progress.

As a freshmen year student, they are in a state of adaptation to the world of university. This causes them to tend to be passive. The educational background of the freshmen student candidates for class of 2017/2018 varies from SMA and MAN (IPA and IPS) and SMK. Different educational backgrounds indicate that their background of knowledge, especially on the subject to be discussed in the course "Basic Physics" in this case the subject of *Kinematics* is different. Therefore, it is important to enable students in learning by directing them to use cognitive strategies in understanding the subject.

- Concept Analysis Result

Activity completed at this stage is to identify, detail, and systematically organize the main subjects students studied, then the subject is arranged hierarchically. Teaching subject in this research is the subject of *Kinematics*.

In Designing stage, this stage aims to design the prototype of lesson book. The results of the designing stage are three sets of lesson book. The results of each activity at the design stage are described as follows:

- The Format Selection

The selection of learning package format aims to select a format for designing lesson book, strategy selection,

approaches, learning methods and learning resources. The content of the learning package is set based on the nature and the syntax of the learning based metacognition strategy. The format includes (1) Lecture plan/Lesson plan which refers to the rule of the Education and Culture Minister of Indonesia Republic Indonesia No. 49 Year 2014; (2) *Kinematics* Textbook.

- Preliminary Design Result

The preliminary design is textbook. The draft is called a prototype. The prototype is then developed by validation and revision.

In the developing stage, a revised lesson book has been developed so that it is feasible to be used in research or tested. Activities undertaken at this stage are; expert validation, simulation and test legibility as well as limited trials. The results of the activities in the developing stage become a reference to assess whether the device that have been developed meet the criteria of valid.

Expert validation is done by two experts of the material media who are Physics Lecturers of Universitas Negeri Makassar. Based on the assessment by validators, the lesson book can be used and applied in classroom. The following summary of the lesson book validator's assessment shown in [Figure 1](#).

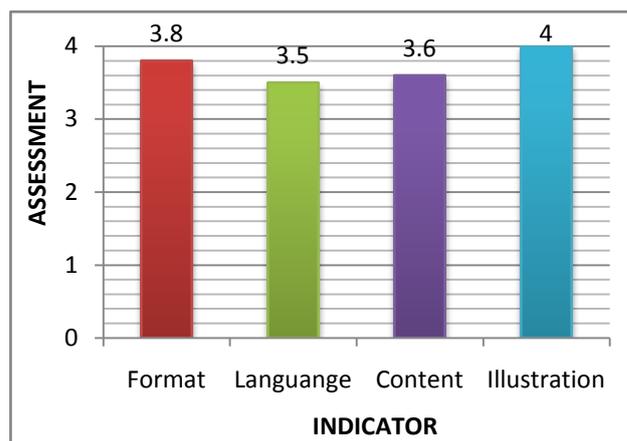


Figure 1. Description of the results of expert assessment of lesson book

5. Conclusion

Based on the results obtained, the conclusion of this study can be described as follows:

- Physics lesson book oriented metacognitive strategies have been successfully developed to improve the problem solving skills of physics teacher candidates students.
- Physics lesson book oriented metacognitive strategies to improve problem solving skills of physics teacher candidates have met the very valid criteria.

Acknowledgements

This research supported by Indonesian Ministry of Research, Technology and Higher Education. We thank our colleagues from Universitas Sulawesi Barat and Universitas Negeri Makassar who provided insight and expertise that greatly assisted the research.

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