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The Analysis Practicality Of Problem-Based Learning Model Accompanied By Metacognition Instructions To Improve Statistical Reasoning Skill Students

Nur Rusliah[1], Ahmad Fauzan[1], I Made Arnawa[2], Daharnis[1]

[1]Doctoral Program of Education Sciences, Universitas Negeri Padang

[2]Department of Mathematics, Faculty of Mathematics and Sciences, Universitas Andalas

Abstract – This research is focused on the prototype development stage to see the practicality of learning devices in developing a Problem-Based Learning model accompanied by Metacognition Instructions. This type of research is qualitative research with a descriptive approach. The informants in this study were students of Mathematics Education at IAIN Kerinci and lecturers of Mathematics at IAIN Kerinci. This study uses instruments 1) In-depth interview sheets for students and lecturers of Mathematics at IAIN Kerinci; 2) Participant Observation; and 3) Documentation. The results of the data analysis, the practicality of learning devices has an average with an excellent category for all aspects. It means learning devices developed based on the Problem-Based Learning model accompanied by Metacognition Instructions to improve statistical reasoning skill students is practical.

Keywords – Practicality Analysis, Problem Based Learning, Metacognition Instruction, Statistical Reasoning Skill.

I. INTRODUCTION

One of the objectives of learning educational statistics is to form and develop students' statistical reasoning skills. In Garfield (2003) statistical reasoning abilities will introduce a person to the concepts and logic of statistical thinking. Statistical reasoning provides an introduction to the level of practical ability to select, generate and interpret methods of both descriptive statistics and statistical inferencing appropriately. Meanwhile, Chance (2002) states that statistical reasoning involves understanding the entire investigative process starting from the questions asked for data collection, selecting the analysis to be used for testing assumptions, understand how a model can be used to simulate random phenomena, understand how data is generated to estimate probability, recognizing how, when, why investigation tools might be used, and able to understand and utilize the context of a problem to plan and evaluate investigations and to draw conclusions.

The development of students' statistical reasoning abilities is very important and urgent to be pursued by lecturers, especially lecturers in the education statistics subject. One way to develop statistical reasoning skills is to consistently invite students to solve daily problems by applying statistics. The hope is that students 'statistical reasoning abilities will continue to develop properly so that it will indirectly improve the quality of students' thinking and knowledge.

Ironically, statistical reasoning skills among educators are also problematic. The results of Martadiputra (2010) study on statistical literacy, statistical reasoning, and statistical thinking of junior high school and high school mathematics teachers in

Bandung, illustrate that: 1) the average statistical literacy ability has reached 88.38% so that it got a good category; 2) the average statistical reasoning has only reached 46.45% so that it is in the moderate category; 3) the average statistical thinking ability reaches 32.15%, with a low category. Based on the study, it was found that the statistical literacy skills of SMP/SMA mathematics teachers were already good so that teachers tended to teach statistics by emphasizing statistical literacy skills. Meanwhile, the statistical reasoning abilities and statistical thinking abilities of junior high school mathematics teachers can be categorized as medium and low respectively. This condition is thought to cause students' reasoning abilities and statistical thinking abilities to still have problems. Therefore, this issue must be of concern to policymakers in the field of education and higher education institutions, both public and private, that produce teachers.

Currently, statistical learning has not touched students' statistical reasoning abilities. Students still have difficulty applying statistics in their daily lives and solving educational problems. Learning is still a technical calculation that is not meaningful. This condition is in line with the conditions of statistical learning internationally. As stated in the *Australian Education Council (1994); National Council of Teachers of Mathematics (1989, 2000); The School Curriculum and Assessment Authority & Curriculum and Assessment Authority for Wales (1996)* states that there is a need for international statistical education reform at all levels of education (Jones *et al*, 2000; Wulansari *et al*, 2019). Furthermore, Jones *et al*, (2000) suggest using a broader approach in studying statistics, including describing, organizing, representing, analyzing, and interpreting data. To broaden this perspective, further research on learning and teaching statistics is needed (Shaughnessy *et al*, 1996; Rusliah, 2016). Ben-Zvi and Friedlander (2010) stated that when given real problems, conventional statistics learning activities tend to be unreal and relatively shallow. This indicates that conventional statistics learning is less meaningful for students. And in conventional statistics learning, educators emphasize more on statistical literacy skills, not on statistical reasoning abilities.

The existing learning model has not paid special attention to statistical reasoning abilities. The learning model that is thought to improve statistical reasoning skills is the Problem Based Learning Model with Metacognition Instruction (PBM-IM). This model tries to combine aspects of problem-solving as well as aspects of metacognition to complement each other. This is because PBM, which is currently widely used by educators, has not paid special attention to metacognition aspects. In fact, in several studies, it was found that the problem-solving aspects of metacognition were in harmony. As stated by O'Neil and Brown (1997; Rusliah *et al*, 2020) that to build problem-solving strategies, metacognition plays an important role as a process by which a person thinks about his thoughts to build the strategy. From this explanation, it can be said that there is a need for a learning model that modifies the problem solving and metacognition aspects. It is hoped that the PBM-IM learning model can accommodate these two aspects. With the PMB-IM model, every proposed statistical problem will be seen how the student starts planning, processes information, arrives at the final result as well as the correct interpretation of the results. Each stage of problem-solving will be accompanied by metacognition instructions.

The PBM-IM learning model is not directly used but must be tested. The aspect that needs to be tested is the practical aspect of the model. Practicality is a very important element in the PBM-IM research process to improve statistical reasoning skills. Practicality relates to the ease of use of the products produced. According to Suharsimi Arikunto (2006: 62), a teaching material has high practicality if the teaching material is practical, which is easy to implement, and is equipped with clear instructions. In line with that, Sukardi (2008) states that practicality can be assessed from the following aspects: 1) Use, including ease of management, storage, and can be used at any time; 2) Its use only requires a short time, fast and precise; 3) Fostering the attractiveness and interest of students in using the device; 4) Easy to understand or use by the teacher; and 5) Has the same equivalence.

II. Methods

This research is a research development or *Research and Development* (R & D). Development research is a research method used to produce certain products. The model used is a model development Plomp which consists of three phases, namely the phase of preliminary investigations *(preliminary research),* phase of development or manufacture of prototypes *(development or prototyping phase*), and the phases of assessment *(assessment phase***).** At the initial stage, we analyzed the context and needs in the learning of student education statistics. At the prototype stage, products produced from preliminary studies were developed, namely in the form of model books, student books, and PBM-IM-based lecturers' books. Prototype production includes designing, developing, and formative evaluation. The evaluation stage is the stage of assessing the resulting prototype using practicality and effectiveness tests. At this stage, semi-summative is also applied. Formative evaluation includes *self-evaluation, expert review, one-to-one, small group,* and *field test*. A summary of the stages is provided in Fig 1 below.

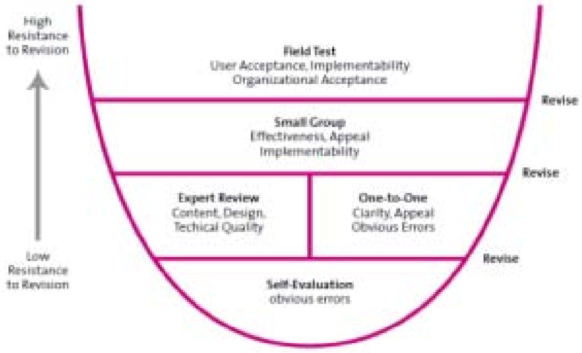

Fig 1. Formative Evaluation (Source: Tessmer, 1993; Plomp, 2013)

This research will discuss the practicality of model books, student books, and lecturer books based on PBM-IM. Practicality is carried out in two activities, namely *one to one and small groups.* One to one involves three students, namely students with high, medium, and low abilities. *Small groups are* carried out by applying the PBM-IM model book to 6 students, namely 2 high-ability students, 2 medium-ability students, and 2 low-ability students. In the implementation of the small group, the researchers directly applied the mathematics learning tools and the teacher as an observer. After the implementation of the small group, the researchers gave a practical assessment questionnaire to the teachers and students involved in the small group: the practicality of the product was obtained from the practicality checklist data sheet on a Likert 1-5 scale. Furthermore, the data analysis of validity and practicality was carried out using the steps adopted from Riduwan (2005), namely determining the percentage using the formula:

$$Prosentase\ Valid\ atau\ Praktis = \frac{Jumlah\ skor\ jawaban\ masing - masing\ item}{jumlah\ skor\ ideal\ masing - masing\ item}\ x\ 100\%$$

Note: Formula in Indonesian language

The valid and practical criteria are shown in Table 1 below.

Table 1. Validity and Practicality Criteria

No	Percentage of Achievement	Validity	Category Practicality Category
1	≥ 81%	Very Valid	Very Practical
2	61% - 80.99%	Valid	Practical
3	41% - 60.99%	Enough Valid	Quite Practical
4	21% - 40.99%	Less Valid	Less Practical
5	≤ 20.99%	Invalid	Not Practical

Source: Ridwan (2005) modified

III. RESULTS

A. Practicality Analysis in Phase One to one

In Table 2 it can be seen that every aspect has reached the desired criteria, namely instructions with a value of 100%, learning outcomes 81.6%, material 100%, worksheets 86.6%, validity 91.2%, graphics 91.2% and benefits 93.4%. The practicality of the learning device assessed by the student response questionnaire has an average of 92% with the very practical category.

Table 2. Results of the questionnaire practicalities of one to one

Aspect	Val ue	Criteria
Instructions	100	SP
Learning Accomplishment	81.6	SP
Materials	100	SP
Worksheet	86.6	SP
Linguistic	91.2	SP

Kegrafikaan	91.2	SP
Benefits	93.4	SP

Note: SP = Very Practical

B. Small group analysis

In the stage *small group,* researchers teach in small groups of 6 students. The researcher taught 5 meetings to try out the PBM-IM-based student books. The students chosen by the researchers represented all the student ability criteria and were different from students in phase *one two*. The researcher asked the lecturer for help to select 6 mathematics majors who would be included in the activity *Small group*. Then the students were divided into two groups, each group consisting of 1 high-ability student, 1 medium-ability student, and 1 low-ability student. The researcher asked the mathematics lecturer to be an observer during the testing of the device in the phase *small group*. The researcher gave the observation sheet to the lecturer as a reference for the assessment as an observer. Lecturers assess the implementation of PBM-IM-based books. Lecturers during the learning process carried out by researchers by filling out observation sheets. The results of observations of the practicality of learning devices carried out by the lecturer on the learning process carried out by researchers in the phase *small group* can be seen in Table 3 below.

Table 3. The results of the lecturer observation sheet on the implementation of the small group

Aspects assessed	I	II	III	IV	V	Score
Syntax	83.72	89.3	88.84	88.37	86.51	87.35
Reaction Principle	72.73	81.82	85.45	83.64	87.27	82.18
Social System	75.56	77.78	80	77.78	73.33	76.89
Average	78.22	85.56	87.15	86	86.89	84.77
Criteria for	P	SP	SP	SP	SP	SP

Notes: P = practical, SP = Very Practical

In the Table, it can be seen that there is 1 meeting with the practical category, namely the first meeting with a value of 78.22%. Meanwhile, 4 meetings were categorized as very practical, namely at meetings II, III, IV, and V with the respective values of 85.56%, 87.15%, 86%, and 86.89%. The practicality of the learning device as assessed from the observation sheet filled in by the lecturer has an average of 84.77% with a very practical category. The table also shows that the results of observations for each meeting do not always increase. However, the decline in assessment from the previous meeting was not a problem because the results were still within practical criteria. The small group also assessed practicality by using the student response armature. Student response questionnaires are given after the fifth meeting is over, then students are given a questionnaire to find out its practicality from the student's point of view after using the device. The results obtained can be seen in Table 4 below.

Table 4. Practicality questionnaire results small group

Aspect	Practicality Score Small Group	Criteria
Guidelines	86.6	SP
Learning Outcomes	90.8	SP
Material	91.6	SP
Worksheet	92.2	SP
Languages	86.6	SP
Graphic	91.2	SP
Benefit	100	SP

In Table 4 it can be seen that every aspect has reached the desired criteria, namely instructions with a value of 86.6%, learning outcomes 90.8%, material 91.6%, worksheets 92.2%, validity 86.6%, graphics 91.2%, and 100% benefit. The practicality of the learning device assessed by the student response questionnaire has an average of 91.28% with the very practical category. The practicality of model books, student books, and lecturer books based on PBM-IM was tested through the one-to-one phase and a small group had practical criteria. Practicality is assessed from several aspects, namely instructions, learning outcomes, materials, worksheets, validity, graphics, and benefits. The practicality of the learning tools assessed by the student response questionnaire in the one-to-one phase had an average of 92% in the very practical category, in the small group phase it had an average of 91.28% with the very practical category.

The practicality value of one-to-one compared to the small group decreased from 92% to 91.28%, namely 0.72%. However, the decline that occurred from the one-to-one phase to the small group phase did not affect the practicality of the device, because the device was still in the very practical category. Based on the analysis carried out, the decline that occurred did not significantly affect practicality.

The decrease in practicality value occurred because the small group phase involved more students than the one-to-one phase. The one-to-one phase-only involved three students, while the small group phase involved 6 students. So that the one-to-one process is easier to implement compared to the small group, all students also get good guidance in the one-to-one phase compared to the small group phase.

Practicality is also assessed from the learning process carried out in the small group phase. The assessment is carried out by observing the learning process carried out by the researcher. The observer in this study was a lecturer who taught educational statistics. Observations were made to see the practicality of the assessment of lecturers who teach educational statistics when the device is applied directly in learning. The results of the observations show that the device has met the practical criteria.

IV. CONCLUSION

Based on the result of the study, it was concluded that the Practicality of the Problem-Based Learning Model Accompanied by PBM-IM to Improve Statistical Reasoning Skill Students were very practical based on observation, students and lecturer response questionnaire.

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