

Developing of Learning Material Based on Problem Based Learning to Increase Students' Mathematical Reasoning Ability and Self-Efficacy in Grade x SMA Negeri 1 Medan

Anggi Paramita Daulay
Department of Mathematics Education
State University of Medan
Medan, Indonesia
Corresponding Email: anggiparamitadaulay@gmail.com

Dian Armanto
Department of Mathematics Education
State University of Medan
Medan, Indonesia

Waminton R.
Department of Mathematics Education
State University of Medan
Medan, Indonesia

Abstract - The purpose of this research are to describe: 1) the validity, practically, and effectiveness of developing learning materials oriented in the model of Problem Based Learning (PBL), 2) the increase of students' mathematical reasoning ability with the use of the developing learning materials oriented in the model of problem-based learning, and 3) The increase of students' self-efficacy using questionnaire. This research is a research and development, the resulted products are teachers' book, students' book, students' worksheet (LKS), test of mathematical reasoning ability (TKPM), and students' self-efficacy. The development of learning materials oriented in the model of problem based learning (PBL) using Dick and Carey development model. The subject in this research are the students of grade X Mia 3 and grade X Mia 4 of SMA Negeri 1 Medan. From the result of Test I and test II obtained: 1) the developing learning materials fulfill the validity criteria, both in content and construct validity, 2) the developing learning material fulfill the practicality criteria, reviewed from: a) validator assessment and b) implementation of the learning materials, 3) the developing learning material fulfill the effectiveness criteria, reviewed from: a) mastery of learning b) time in teaching, and c) students' positive responses. 4) there is an increase in students' mathematical reasoning ability and 5) there is an increase in students' self efficacy that was tested using questionnaire.

Keywords—developing, PBL, dick and carey, mathematical reasoning ability, self-efficacy

I. INTRODUCTION

Learning is a process of an individual who seeks to achieve learning objectives or learning outcomes, which is a

form of behavior change that is relatively settled (Mulyono Abdurrahman, 2003: 28). Learning math is not just enough to memorize, it takes deep understanding of the concept. The success of the process of learning on learning mathematics could be measured from success students who take activities.

There is students complain about difficulty on trigonometry. Krulik and Rudnick (1999) capability reasoning is aspect key in develop ability think critical and creative from students. Remembering how importance aspect reasoning This, then need existence development ability reasoning students in learning mathematics including reasoning in material trigonometry. As has been mentioned no all activities think base self on reasoning. Reasoning mathematical important for knowing and do mathematics. Ability for reasoning make students could solve problem in life, in and in outside school.

Besides look importance ability reasoning mathematical students in learning, another aspect that needs to be too developed is trust (*self-efficacy*) students. Bandura (1998) defines *self-efficacy* as confidence someone about ability they for produce performance has influence on life them. *Self-efficacy* determine How someone feel, think, motivate self and behave.

Purpose from this research is (1) to analyze mathematical reasoning ability students, (2) to analyze self-efficacy students, and (3) finding device learning effective.

II. LITERATURE

A. Ability Reasoning Mathematical

Term reasoning is translation of the reasoning which means a person's way of thinking. Suriasumantri (2007: 42) says that "reasoning is a process of thinking in drawing a CONCLUSION in the form of knowledge". Keraf (in Sadiq, 2004: 4) explains that the reasoning is "the thought process that seeks relationship facts or evidence of - evidence of which is unknown towards to something CONCLUSIONS".

B. Self-Efficacy

Increasingly someone experience success in life, the similarly high self-efficacy in himself. Besides that, if success achieved more because of by factors externally.

C. Dick and Carey

Dick and Carey's model consists of 10 steps. Each step is very clear intent and purpose so for the beginner designer is suitable as a basis for studying other design models. The tenth step in the Dick and Carey model shows a very clear and uninterrupted relationship between one step and another. In other words, the system found on the Dick and Carey was very quick, but the content is solid and clear from one order to order next.

D. Valid, Practical, and Effective

Device good learning, or is invalid required for each teacher to reach success activities learning optimally. For that need careful planning in arrangement before used in process learning and measure validation with indicator validation content and validation construct. Practical in meaning language means "easy to use in practice". Make it easy in meaning that device structured learning easy for understood and too easy for held or used. Practical indicators namely, (1) validator stated that device learning developed could used with little or no revision and (2) implementation component learning mathematics PBL-based used located on category good or very good.

Effectiveness device defined as "achievement aim learning conducted by students and learning the earn response positive students. Effectiveness learning is results order obtained after implementation learn teaching. The indicator namely: (1) completeness learn Classical minimum 85%, (2) achieve aim minimum learning 75%, (3) time learning efficient, and (4) response students.

III. RESEARCH METHOD

The type of this research is Research and Development. The development model used was the Dick and Carey development model which consisted of 10 development stages.

A. Research Subjects and Objects

Subjects in this study were students of class X MIA-3 and X MIA-4 SMA N 1 Medan academic year 2016/2017 which each class consisted of 32 students. While the object in this study was a mathematics learning tool in SMA N 1 Medan Class X which was orientated in developed learning materials.

B. Learning Tools Development

Learning tools developed in this research were Teacher Handbook (BPG), Student Book (BS), Student Activity Sheet (LAS) and research instrument that was Reasoning Ability Test of Mathematics. Learning tools development was done by using the Dick and Carey development model (1974) [14] which consisted of 10 development stages.

C. Instruments and Data Collection Techniques

The instruments used in this study included the instruments for assessing the quality of learning tools i.e. aspects of validity, practicality and effectiveness. Instruments used were observation sheets, questionnaires, and tests.

1. The Validity of Learning Tools

Learning tools are said to be valid if they meet the criteria of content validity and construct validity. The validity of content was done by 5 validators by giving score 1 to 5 in each assessment column based on aspects: 1) format, 2) language, 3) content, and 4) illustrations. Furthermore the overall expert assessment was processed by calculating the average score to obtain the criteria of content validity assessment as follows:

Table 1. Rate Validity Criteria of Learning Tools

No	Va or Total Average Score	Validity Criteria
1	$1 \leq Va < 2$	Invalid
2	$2 \leq Va < 3$	Less Valid
3	$3 \leq Va < 4$	Valid Enough
4	$4 \leq Va < 5$	Valid
5	$Va = 5$	Highly Valid

Information:

Va is the determination score of the validity scale of the learning tools.

Developing of learning materials that the expected content validity if the validator's average assessment of all learning tools is valid or highly valid. If not meet, then it is necessary to re-do the validation activities. And so on until learning tools that meet the content validity are obtained.

Next, construct validity of reasoning and self-efficacy tests was carried out before being used for field trials. Then reasoning ability test items and self-efficacy questionnaires were tested outside the research subjects to measure validity and reliability. To measure the validity of the item, the

following correlation formula of product moment (Arikunto 2012) [15] can be used:

$$r_{xy} = \frac{N \sum_{xy} - (\sum_x)(\sum_y)}{\sqrt{\{N \sum x^2 - (\sum x)^2\} \{N \sum y^2 - (\sum y)^2\}}}$$

Information :

- r_{xy} : correlation coefficient between variable x and y
- \sum_{xy} : the number of multiplications between x and y
- x : score of test item
- y : total score
- N : number of subjects

Furthermore, to calculate the reliability coefficient of test items, the following Alpha-Cronbach formula (Arikunto 2012) [15] was used:

$$r_{11} = \left(\frac{k}{k-1} \right) \left(1 - \frac{\sum \sigma_b^2}{\sum \sigma_t^2} \right)$$

Information:

- r_{11} : test reliability coefficient
- k : number of questions
- $\sum \sigma_b^2$: the number of variance scores on each questions
- σ_t^2 : total variance

2. The Practicality of Learning Tools

The practicality of the learning tools was observed based on the validator's assessment and the implementation of learning tools. The validator assessment criteria are met if it is found on the validation sheet that all validators states that learning tools can be used with "a few revisions" or "no revision".

Furthermore, the learning tools implementation was observed based on the observer's assessment where they chose score 1 to 5 on each aspect of learning tools implementation that were Teacher Handbook (BPG), Student Book (BS), Student Activity Sheet (LAS). The average total score obtained was categorized into the following percentage of learning implementation.

Table 2. Qualification Percentage of Learning Implementation

The Percentage of the implementation	Category
$k \geq 90$	Very Good
$80 \leq k < 90$	Good
$70 \leq k < 80$	Fair
$60 \leq k < 70$	Poor
< 60	Very Poor

Source: Sinaga (2007) [16]

Information:

k = Average total of learning tools implementation

The criteria of learning tools implementation are met if the minimum average total score is in the Good category.

3. The Effectiveness of Learning Tools

The effectiveness of instructional tools was observed based on: 1) the completeness of students' learning outcomes based on reasoning and self-efficacy, and 2) students' responses to learning components and tools.

Completeness of student learning outcomes was seen based on the results of spatial ability test in the form of essay test consisting of 5 questions. The effectiveness criteria based on students' learning completeness classically are met if $\geq 85\%$ get the score ≥ 2.67 from the scale of 4.

Student responses were observed based on student responses to questionnaire. Effectiveness criteria based on student responses are met if $\geq 80\%$ subject classically give a positive response (Sinaga 2007) [16], that is on all aspects being asked related to the learning tools and implementation.

IV. RESEARCH RESULTS

A. Description Results Research

Research development Dick and Carey model that includes ten stages namely:

- (1) Identify Instructional Goal
- (2) Conduct Instructional Analysis,
- (3) Identify Entry Behaviors, Characteristics,
- (4) Write Performance Objectives,
- (5) Develop Criterion-Referenced Test Items,
- (6) Develop Instructional Strategy,
- (7) Develop and Instructional Materials,
- (8) Design and Conduct Formative Evaluation,
- (9) Revise Instruction, and
- (10) Design and Conduct Sumative Evaluation.

These stages will be described into three groups: 1) the preliminary study, 2) planning, and 3) validation and test trial.

B. Trial I

In class X MIA 3 with 32 students. In practicality learning material the analysis is based on response of experts and a practitioners expresses devices based learning PBL is generally well developed and can be used with little revision.

Implementation learning materials not yet practicality. And effectiveness learning materials not yet effective because test reasoning ability only 65,62%.

C. Revision

Do revision a little on device learning as book students and on test ability reasoning mathematical students.

D. Trial II

In class X MIA-4 with 32 students. The learning materials has practicality and effectiveness because the practicality in

implementation get 84,5%, 82,5% and 86,29%. And the the effectiveness already achieved completeness on classical. Test mathematical reasoning ability (90,62%) and the result for aim learning achieved because achievement aim learning at least 75%. In the time used in learning efficient as learning ordinary. To response students has reach more of 80%. Achieved. And the self-efficacy whole students have an average of 83,08%.

E. Enhancement on learning materials

- Ability Reasoning Mathematical
Test I tried for 76, 56% and test try II by 80.46% so enhancement amounted to 4.90%.
- Self-efficacy
Enhancement greatest there on 2 indicators that *strength* at 0, 67 and enhancement smallest there on 3 indicators namely *generality* 0.32. So it can be concluded that all indicators of *self-efficacy* students has increased from the first trial to trial II.

V. CONCLUSION

Based on results analysis and discussion in research. This was raised some conclusion as:

1. The improvement of students' mathematical reasoning ability of trial I reached 65,62% with total of 21 students and 11 students complete and 90,62% complete with 29 students complete and 3 complete students, increase from trial I to trial II by 25%.
2. Increased *self-efficacy* of students in the first trial in the first indicator reached 2.99, in the second indicator reached 2.88, and in the third indicator reached 3.02. While in trial II in indicator 1 reached 3.53, in indicator 2 reached 3.55, and in indicator 3 reach 3.34. So that in each indicator has increased. And at the percentage level in trial I reached 71.13% and trial II reached 83.08%, so increased by 11.95%.
3. Learning tools developed include Master Books, Student Books, and worksheets based on *Problem Based Learning* is effective for use in learning, because it has met the indicator of the effectiveness of the learning device. The effectiveness indicators are:
 - a. Completeness of student learning outcomes in the minimum classical 85%, on trial I of 65.62% and on trial II of 90.62%. This means trial I has not been effective while trial II has been effective.
 - b. Achievement of learning objectives of at least 75%, in the first test in the goal of learning 3 has not reached the achievement of only 62.50% it means not effective while in the second trial II learning objectives have reached that means for trial II has been effective.
 - c. Criteria of learning time is the achievement of the minimum learning time is the same as regular learning on trial I and trial II. This means the learning time criteria is already effective.

- d. Student responses to the components of learning tools based on PBL developed as well as learning activities are positive.
4. Learning devices are said to be effective if they have characteristics, including:
 - a. Using language and delivery is easy to understand
 - b. Clear and systematic learning materials
 - c. Contains contextual issues
 - d. Presents an interesting image as well as in harmony with the given problem

REFERENCES

- [1] Abdurrahman, Mulyono. 2003. *Pendidikan Bagi Anak Berkesulitan Belajar*. Jakarta : Rineka Cipta.
- [2] Ali, R. 2010. Effect of Using Problem Solving Method in Teaching Mathematics on the Achievement of Mathematics Students. *Asian Social Science*, Vol 6 No.2.
- [3] Arends, Richard I. 2008. *Learning to Teach (Belajar Untuk Mengajar)* Buku 2, Edisi 7. Mc Graw Hill Companies.
- [4] Arikunto, S., 2009. *Prosedur Penelitian Suatu Pendekatan Praktik*. Jakarta : Rineka Cipta.
- [5] Askury. 1999. Kesulitan Belajar Matematika Permasalahan dan Alternatif Pemecahannya. *Matematika*, h.135-145.
- [6] Bandura, A. 1998. *Self-efficacy: Toward a Unifying Theory of Behavioral Change*. Stanford University. (online) (<http://www.uky.edu/~eushe2/Bandura/Bandura1977PR.pdf>. Di akses 8 April 2017)
- [7] Depdiknas. (2006). *Permendiknas Nomor 22 Tahun 2006 tentang Standar Isi untuk Satuan Pendidikan Dasar dan Menengah*. Jakarta : BSNP.
- [8] Desmita. (2010). *Psikologi Perkembangan Peserta Didik: Panduan Bagi Orang Tua dan Guru dalam Memahami Psikologi Anak Usia SD, SMP, dan SMA*. Bandung: Remaja Rosdakarya.
- [9] Dick, Walter dan Lou Carey. 1990. *The Systematic Design of Instruction (third edition)*. Florida : Harper Collins Pub.
- [10] Suherman, E. (2003). *Strategi Pembelajaran Matematika Kontemporer*. Bandung : JICA.
- [11] Sanjaya, W. (2009). *Strategi Pembelajaran Berorientasi Standar Proses Pendidikan*. Jakarta: Prenada Media Group.
- [12] Hurlock, E. B. (1978). *Development Psychology: a Life Span Approach*. New york: MCGraw-Hill Book Company.
- [13] Pitajeng. (2006). *Pembelajaran matematika yang menyenangkan*. Jakarta: depdiknas direktorat jenderal pendidikan tinggi.
- [14] Sinaga, B. (2007). *Pengembangan Model Pembelajaran Matematika Berdasarkan Masalah Berbasis Budaya Batak (PBM-B3)*. Disertasi tidak diterbitkan. Surabaya: Program Pascasarjana Universitas Negeri Surabaya