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Batak Toba culture on mathematics learning process at Medan high school

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Abstract. The studi aims to determine the validity, practicality, and effectiveness of teaching materials, and find out the improvement of students' mathematical problem-solving abilities by using teaching materials that are developed. This type of research is the development using the Dick and Carey development model. This research was conducted at Markus Medan High School, trial I was conducted in class X-IPA while trial II was in class X-IPS. Mathematics learning uses Guided Discovery Learning Model. The results showed that the developed Batak Toba culture based teaching materials could meet valid, practical and effective criteria. Based on expert opinion, the response of students and teachers also states teaching materials can be used easily. Teaching materials meet the completeness of student learning outcomes in a classic way. As for the ability to solve mathematics problem-solving students have increased by 3, 33%. In the first experiment of 83.33% of students who completed, while in the second experiment amounted to 86.66% of students who completed. The conclusion of the research development of teaching materials based on Batak Toba culture fulfills valid, practical and effective criteria. Teaching materials can improve students' mathematical problem-solving

Introduction Student-centered mathematics learning based on local cultural models and instruments for high-level valid and effective mathematical thinking abilities are used in mathematics teaching for junior high schools [1].

The importance of students having the ability to solve mathematical problems because in everyday life students are always faced with a problem, both an easy problem or a difficult problem, and students are required to be able to solve it [2]. In addition, Wardani et al [3] revealed that "The background or reason why a person needs to learn to solve mathematical problems is the fact in this twenty-first century that people are able to solve life's problems productively". Correspondingly, [3] states that "People who are skilled at solving problems will be able to race with their needs, become more productive workers, and understand global issues". Learning in school must be related to the student's environment or culture. This is in line with the findings of [4] and [5] finding an increase in students' mathematical communication skills and independent learning through a realistic mathematical approach based on Batak Toba culture. The result is students' mathematical communication skills are higher than students who are given regular learning.

Based on the description above, it is concluded that the ability to solve mathematical problems is one of the most important abilities possessed by students, because this ability is a provision for students to live productively in this day and age. Given the importance of mathematical problem solving skills, these abilities have been made part of a very important



mathematics curriculum because in the learning process and its completion, students are able to gain experience using knowledge and skills already possessed to rediscover the concepts learned and to solve everyday problems that are around him.

Since long time Polya [6] detailed the steps of problem solving activities as follows: (a) Activities to understand the problem, (b) Activities to plan or design problem solving strategies, (c) Activities of carrying out calculations, and (d) The activity of checking the correctness of results or solutions. Thus, the essence of learning to solve problems is so that students are accustomed to working on problems that not only rely on good memories, but students are expected to relate to real situations that they have experienced or thought of. Then the student explores with concrete objects, then will learn mathematical ideas informally, then learn mathematics formally.

In addition, it can also be seen from the findings of observations at Markus Medan High School. From the observations that began with an interview with one of the mathematics teachers in class X Markus Medan High School, Dra Lidia Pakpahan said that: Many students have difficulty in solving questions on SPLTV material, especially non-routine questions. This is because students are not accustomed to solving problems that are non-routine. When working on non-routine problems, students do not know what to do first and do not know what methods or formulas to use to solve problems, especially in answering questions related to daily life. So that it results in the low learning outcomes of students

The next observation is that the researcher tries to give a problem to measure the ability to solve the mathematical problem of grade X students at Markus High School Medan held on October 30, 2017. The researcher gives a problem, namely:

"A fruit trader buys 15 kg of oranges and 10 pieces of durian. The price of 1 kg of orange is Rp. 2,000.00 less than the price of a durian. If the amount paid is IDR 245,000, determine the price of 1 piece of durian and 1 kg of oranges?"

Based on the results of student answers can be seen that:

1. Students do not understand the problem, namely: what is stated and what data is given.
2. Students lack knowledge of the theories used in solving these problems.
3. Students find it difficult to complete and prove that the steps used are correct.

From the results that have been done, it is obtained that the results are quite alarming namely from 38 students only 7 students who can solve the given problem correctly. This shows that when students are faced with a problem that is non-routine, then students will have difficulty in solving these mathematical problems. But in fact, based on the results of observations made at the research site, namely in Markus Medan High School, the fact is that mathematics learning by teachers involves students actively, resulting in negative student responses to mathematics learning, where students assume that mathematics is a complex and difficult subject to understand.

The results of the study have to potential to develop learning tools based on Batak Toba culture to improve mathematical performance, especially mathematics problem solving ability.

2. Method

This research is a development research using the Dick and Carey teaching material development model, because researchers want to develop teaching materials. Development research is oriented towards product development in which the development process is described as thoroughly as possible and the final product is evaluated. The development process is related to activities at each stage of development. The final product is evaluated based on established product quality aspects. Thus, the product in this research is a teaching material through guided discovery learning model based on Batak Toba culture which is valid, practical and effective along with all the research instruments needed for the process of developing teaching materials. Teaching materials that will be developed in this study are teaching materials which include Teacher's Manual (BPG), Student's Book (BS), and Student Activity Sheet (LAS).

This research was conducted in Markus Medan High School class X odd semester 2018/2019 on the material system of three-variable linear equations. The reason for choosing this school is because similar research has never been carried out. The teaching material used does not suit the

needs of students and there is no compatibility between the teaching materials themselves. Furthermore, learning mathematics in Markus Medan High School has so far been conventional with learning that is dominated by teachers, Passive students, and interaction between students and students and students and teachers is rare.

The subjects in this study were students at X with 30 students each. Whereas as the object of research is mathematical teaching material through guided discovery discovery learning based on Batak Toba culture with material system of three-variable linear equations. Where developed in the form of BPG, BS, and LAS.

2.1. Procedure for Developing Teaching Materials

The Dick and Carey Model [7], this model contains several components that will be traversed in the design of device development. These components are identification of learning objectives (Identify Instructional Goal), conducting teaching analysis (Conduct Instructional Analysis), identification of initial behavior (Identify Entry Behaviors Characteristics), writing performance goals (Write Performance Objectives), developing benchmark reference tests (Develop Criterion tests) Referenced Test Items, developing instructional strategies (Develop Instructional Strategy), developing and selecting teaching materials (Develop and Instructional Materials), designing and implementing formative tests (Design and Conduct Formative Evaluation), designing and implementing summative tests (Design and Conduct Sumative Evaluation).

3. Result and Discussion

3.1. Research Result

This research is a research development (development research), so the product of this research development is teaching materials that meet the valid and effective criteria.

Table 1 Comparison of Problem Solving Capabilities in Trials I and II

Information	Field Trial I	Field Trial II
Average	76,11	80,38
Percentage of students who take the score ≥ 75 (%)	83,33	86,66
Percentage of students who did not reach the score ≥ 75 (%)	16,67	13,34

The average value of the teacher's ability to manage / carry out learning for each activity observed in field trial I, namely: 3.50 for preliminary activities; 3.78 for core activities, 3.83 for closing activities; 3.50 for processing time; and 3.72 for the classroom atmosphere. Where the average value of the total ability of teachers to manage learning is 3.67 with quite good criteria. This average value is obtained from the quotient of the average number of indicators of each aspect for each observer with the number of observers, namely two observers.

Table 2 Comparison of Teachers' Ability to Manage Learning in Trials I and II

No	Observed activities	Trial I	Trial II
1	Preliminary activities	3,50	4,25
2	Core activities	3,78	4,34
3	Closing activities	3,83	4,06
4	Processing time	3,50	4,33
5	Observation Classroom atmosphere	3,72	4,25
Average		3,67	4,19
Teacher ability criteria		Good Enough	Good

The average value of the teacher's ability to carry out preliminary activities was 3.50 in the first field trial and 4.25 in the second field trial from the time available for each learning process. This average value is in the interval of the tolerance value of the teacher's ability to manage learning that has been set in chapter III. Overall, if the average value of the teacher's ability to manage learning is referred to the criteria that states the teacher's ability to manage learning set in chapter III, it can be concluded that the teacher's ability to manage learning meets the specified criteria.

Table 3 Comparison of Percentage of Student Activities in Trials I and II

No	Observed activities	Trial I	Trial II	Ideal time criteria
1	Pay attention/listen to the teacher/friends explanation actively	12,41	13,89	9-19
2	Read/understand contextual problems in students books	10,92	11,67	6-16
3	Solve problems/find answer and ways to answer given contextual problems	33,89	36,11	33-43
4	Discuss/ask friends/teacher	21,67	22,77	19-29
5	Draw a conclusions about dusty procedures/concept	11,67	12,96	8-18
6	Behavior that is not in accordance with the activities behind teaching	1,30	0,93	0-5
(%) Total Average		91,86	98,33	
Criteria		many	many	

The average percentage of time students do the first activity that is Active listening / listening to the teacher / friend's explanation is 12.41% in field trials I and 13.89% in field trials II of the time available for each meeting. The percentage of time this activity is at the ideal time tolerance interval specified. Overall, if the average percentage of student activity time is referred to the criteria for achieving the ideal percentage of student activity time set, it can be concluded that the percentage of student activity time has met the criteria for achieving the specified ideal percentage of time.

3.1.2. Description Comparison of Student responses.

The average percentage of student responses in both trials is presented in Table 4. From this table it can be seen that students' responses tend to be consistent (not much change). The aspect that has increased is the aspect of language clarity, because the words and questions used in LAS and Student books have been revised.

Table 4 Average Percentage of Student Responses in Trials I and II

No	Aspect	Trial I (%)	Trial II (%)
1	Pleasure in the learning component	92,66	95,33
2	Novelty to the learning component	76,68	94,00
3	Interest in following further learning	90,00	96,67
4	Language clarity	88,34	95,00
5	Interest in appearance	92,31	95,00

The average percentage of students' responses to the device and the learning atmosphere in both trials was above 80%. This percentage has met the established criteria. Overall, all aspects of student responses have increased except the second aspect in trial I, namely the novelty of the learning component.

Based on Table 4, it can be seen that student responses have increased in every aspect, especially in the second aspect which has the greatest increase compared to the others. However, it does not affect the effectiveness of teaching materials because positive responses to be achieved by 80%. And the results of student responses obtained both in trial I and trial II > 90%.

3.2. Discussion

In developing teaching materials through guided discovery learning models based on the Batak Toba culture researchers used the Dick and Carrey development model, where the development model will go through 10 stages. The end of this development is to produce products in the form of teaching materials that include teacher books, student books, and student activity sheets and

their instruments. But in developing these teaching materials must be tested for quality, such as validity, practicality and effectiveness. As [9] has found that A high quality material is referred to three quality criteria namely validity, practicality and effectiveness, in other words a material is said to be of quality if it fulfills aspects, among others: validity, practicality (practicality), and effectiveness (effectiveness). So that the learning tool developed will be suitable for use by students and teachers in learning if these three things have been fulfilled in accordance with the indicators.

In producing teaching materials that meet these three aspects in this research, two things will be carried out, namely: (1) one-on-one evaluation by experts (expert review), followed by revision and trial of the instrument, and (2) Field trials (field evaluation) with large groups. Whereas field trials will be conducted twice, namely field trials I and II. From the data obtained from the results of field trials I and II, it will be known whether the formulation of the problem and the research questions raised have been answered or not. The results of data analysis obtained from trials I and II show: (1) The validity of teaching materials through the guided discovery learning model based on the Tobacco culture developed; (2) The practicality of teaching materials through guided discovery learning models based on the Batak Toba culture developed; (3) The effectiveness of teaching materials through the guided discovery learning model based on the Batak Tobacco culture that was developed; and (4) Improvement of students' mathematical problem solving abilities taught using teaching materials through guided discovery learning models based on the Batak Tobacco culture developed

3.2.1 The validity of guided discovery learning based on the Toba Batak culture.

Validity criteria were obtained through the assessment of expert teams on teaching materials through the guided discovery learning model based on the Batak Toba culture developed. Obtained valid teaching materials, caused by several factors, including: first, teaching materials through guided discovery learning models based on the Toba Batak culture. developed have met the validity of the content. That is, in the development of teaching materials through guided discovery learning models based on the Toba Batak culture, tradition in accordance with the demands of the existing curriculum. The demands of this curriculum relate to the core competencies and basic competencies that must be achieved by students in learning activities that are tailored to the subject matter or content provided and adjusted to the steps of the guided discovery learning model. The above is in line with the opinion of [10] which states that teaching materials have criteria of content validity if the teaching materials reflect a match between learning objectives, learning materials and assessments to be provided.

Second, teaching materials through the guided discovery learning model based on the Batak Toba culture developed have fulfilled construct validity. That is, in the development of teaching materials through the guided discovery learning model based on the Batak Toba culture, it is in accordance with the concepts and indicators of mathematical problem solving abilities which are then combined with guided discovery learning. Teaching materials developed are arranged in a complementary way between BS, BG, LAS which are adjusted to the guided discovery learning model based on Batak Toba culture to measure students' mathematical problem solving abilities. The same thing is in accordance with the opinion of [11] also stated that teaching materials are said to be valid if the consistent linkages of each component of teaching materials are developed with the characteristics of the applied learning model. The validity of this content is often referred to as curriculum validity. In addition [12] states that teaching materials meet the construct validity criteria seen from the existence of the relationship between the components of each teaching material component that is developed with the learning characteristics applied. Furthermore, the results of the validation of the mathematical problem-solving ability tests are in the category of assessment is quite valid and valid for content validity, can and is very understandable for language and writing questions and is recommended without revisions and minor revisions. After making revisions, the questions developed have met the valid criteria and can be used to measure students' problem solving abilities in field trials. But before the instrument is tested in development research, the test instrument must be tested to see its validity and

reliability.

Thus based on the opinion above and the results of expert validation that refer to the established criteria, it was found that the development of teaching materials carried out on BPG, BPD, LAS through guided discovery learning models based on the Batak Toba culture based on personal categorization is valid because it meets two aspects of validity, namely the validity of the content (content validity) and construct validity [12].

3.2.2. Practicality of Teaching Material Based on Guided Discovery Based on the Batak Toba Culture

In addition to validity, the criteria that must be possessed for a material to be said to be quality is practicality. A teaching material is said to have practical criteria if the instructional material compiled can be easy to understand and also easy to implement or use by students and teachers [10, 11]. The purpose of the practical assessment in this research is to find out how the function and role of teaching materials are developed in helping students understand the subject matter and assist the teacher in delivering the subject matter to improve students' mathematical problem solving abilities, especially in the subject matter system of three-variable linear equations.

In addition students feel happy and helped in using student books that were developed on the grounds that the books are arranged differently from books in general, and in this book have been equipped with student activity sheets which are first given problems and examples that have alternative answers quite clear, and easy to understand. Students also feel happy with the problems raised because they are raised from problems not far from their lives. Besides that the problems that exist relate previous students related to the system of linear equations of three variables, so students know the relationships in learning mathematics itself or with real life students and with other disciplines.

From the results of the validation of the expert team and the results of the interview, it can be concluded that the teaching material through the guided discovery learning model based on the Batak Toba culture that has been developed has a role in helping students and facilitating students in understanding the material system of three-variable linear equations in particular in other words that this teaching material "Practical" to be used in learning.

3.2.3. The Effectiveness of Teaching Material Based on Guided Discovery Based on the Batak Toba Culture

The developed learning device is said to be effective in terms of: (1) the achievement of classical mathematical problem solving abilities; (2) learners' activities within the specified ideal time tolerance; (3) the ability of teachers to manage learning against the learning component components developed; (4) and student response questionnaire Each aspect of effectiveness is explained below:

3.2.3.1. Achievement of Classical Problem Solving Ability

In the first field trial, the average problem solving ability of students was 76.11 with the percentage of students achieving reach 75 values of 83.33%. The results obtained do not meet the established classical achievement criteria of $\geq 85\%$. From the learning process that is observed and the activities of students in solving the problem given, it is used as a reference for the revision of teaching materials for field trials II.

From the observation results obtained that students are not accustomed to taking steps to solve problems, especially in evaluating the problem solving steps that have been done. Furthermore, the average problem solving ability of students in field trials II was 80.38 with the percentage of students achieving ≥ 75 values of 86.66%. From these results it appears that the classical achievement criteria have been met.

The fulfillment of classical achievement criteria is due to the material and problems that exist in the student book and student activity sheets that are developed according to the needs and refers to guided discovery learning. With the application of these teaching materials, students will be actively involved in solving a problem. This is reinforced by Bruner [13] who considers that

learning by the discovery method is in accordance with the active search for knowledge by students. Bruner further suggested that students should learn by actively participating with concepts and principles so that they obtain knowledge through experiences by conducting experiments to find their own solutions to the problems and the accompanying knowledge.

In addition Slavin[14] adds that guided discovery learning emphasizes understanding the structure or important ideas of a discipline through active student involvement in learning, and the teacher encourages students to gain experience by designing activities that enable students find concepts or principles independently. However students are not released just to find their own mathematical problem solving. This is because students with low mathematical abilities need guidance and direction from the teacher in finding mathematical problem solving. Therefore in guided discovery learning, the teacher acts as a facilitator who guides students through questions that lead students to connect the knowledge they have in solving a problem.

Thus through the use of teaching materials based on the discovery of guided culture based on Batak Toba culture, it will be able to improve students' mathematical problem solving abilities. This is supported by the results of research by [15] which produced learning tools based on guided discovery learning that are of good quality and suitable for use in the learning process. Each component of the teaching material fulfills valid, very practical, and effective criteria. In addition, the results of [5] research conclude that the problem-solving ability of students has increased after being taught with Batak culture based on Batak Toba. So it can be concluded that teaching materials are based Batak Toba culture based guided learning is able to help students achieve classical learning achievement.

3.2.3.2. Achievement Percentage of Student Activity Time

On the observation of student activities can be seen that the percentage of student activity time is in the criteria for limiting the effectiveness of learning as described in chapter III. In the first field trial, the questioning aspect reached 21.67%. Even though it is still within the established criteria, the tendency to ask questions is done to the teacher not to other students in the same group. Whereas in the field trial II this aspect increased to 22.77. Nevertheless, in the field trial II the students had already asked a groupmate (another student).

3.2.3.3. Teacher's Ability to Manage Learning

The effectiveness criteria which were reviewed from the teacher's ability to manage learning had fulfilled the effectiveness criteria. In the first field trial, the teacher's ability to manage learning did not meet the established effectiveness criteria, which was 3.67 with poor criteria category. While in field trials II the ability of teachers to manage learning has met the criteria set out in chapter III. Based on the results of the analysis of field trial II data, it is found that the average value of the ability of teachers to manage learning is 4.19, where the criteria for the ability of teachers to manage learning set in chapter III, the average value obtained is in the good category $4 \leq \text{NKG} < 5$).

This is in line with research by [16] which states that this research instrument is used to obtain data on the ability of teachers to manage learning activities using learning tools through guided discovery learning. Observation is carried out during learning takes place (from the beginning of learning until the end of learning) and observations were made by two observers. Vigotsky [16] also emphasizes the role of the teacher at the stage of giving questions that are guided and active when there are difficulties experienced by students through direction, encouragement, helping them in the event of stagnation of thinking and subsequent processes more emphasis on the activeness of students, so learning is not centered on the teacher.

3.2.3.4. Student Response Questionnaire

Questionnaire student responses to learning that have been carried out are given at the end of learning trial I and trial II which aims to see or find out the students' responses after applying learning using teaching materials through Guided discovery learning model based on Batak Toba

culture. This questionnaire contains positive and negative statements consisting of four aspects of the question.

From the results of the questionnaire responses given by students as a whole students feel helped and happy with teaching materials through the guided discovery learning model based on the Batak Toba culture developed, in other words the response given by students after being given learning by using this learning tool is very positive. in the second trial of the components of teaching materials through the guided discovery learning model based on the Tobacco culture based on the effectiveness criteria. The results of student responses to the learning component questionnaire can also be illustrated in the following diagram.

3.2.4. Improving the Problem Solving Ability by Using Teaching Materials Using the Guided Discovery Learning Model.

Problem solving is one of the most important aspects in mathematics learning, [17] says that solving problems other than as an objective of learning mathematics is also a major tool in learning mathematics. In addition, [18] says "problem solving mathematics has long been seen as an important aspect of mathematics, mathematics teaching, and mathematics learning. "While the ability to solve problems is one of the important aspects in problem solving [19].

Students are said to be able to solve problems that if solving problems meet 4 stages, namely understanding the problem, making plans, implementing plans, and checking again [20]. However in this study problem solving is focused on meeting the three indicators of problem solving ability. the three indicators are developing action plans, minimizing completion actions, and evaluating completion actions [21]. The main obstacle students recognize in solving problems, especially at the stage of developing an action plan and evaluating the completion of the action. This causes students to be unable to become good problem solvers. As stated by [22] that "at the stage of implementing a plan, good problem solvers are able to implement their plans and demonstrate the ability to think metacognitively during the implementation of the plan. To be able to carry out the guided discovery model in solving problems properly, students must be at the level of development of formal operations so as to be able to think abstractly. Students in class X high school are generally aged 15-16 years. Piaget [23] said "at the age of 11 years children are at the formal operational level, the main progress in children is not needing to think with the help of concrete objects because children have the ability to think abstractly". So it should be the 10th grade students of SMA who have good problem solving skills in problem solving.

Through the development of teaching materials through the guided discovery learning model based on Batak Toba culture, students are accustomed to solving problems in learning activities. Problem solving skills can also be improved through the provision of questions that use the guided discovery model of each problem solving, both questions written on teaching material, as well as those asked directly by the teacher.

Teaching materials developed in this study have met the criteria of valid, practical, and effective. Based on the results of the post-test analysis of students' problem solving abilities in the first try and the second try showed that the students' problem solving abilities improved. The improvement of this problem solving ability can be seen by the students' calculations in each trial. Where in the first try when the effectiveness criteria were all met, an increase in students' problem solving abilities was in the moderate category. While in the second trial after the effectiveness criteria were met, an increase in students' problem solving abilities medium category. Improvement of problem solving skills is better in trial II, this is because the quality of teaching materials has been improved based on the weaknesses found in trial I. The results indicate that the use of teaching materials using the Guided Discovery model developed has an impact on increasing the ability to solve student problem.

The problem solving ability can be increased due to the teaching materials applied to students who have met the criteria for good quality teaching materials, with the good teaching materials used and with the application of guided learning models based on Batak Toba culture, the ability of problem solving students increases. Therefore, in this study it can be concluded that teaching materials through the guided discovery learning model based on Batak Toba culture developed

can improve students' problem solving abilities. This study is also relevant to the findings of [24] who found there are differences in the mathematical representation ability of students who learn by using the 7E learning cycle model and those who learn by using discovery learning based on the Angora Batak Culture. Likewise, [25, 26, 27] found that mathematics learning by mathematics teachers can be done by approaching and linking learning material that integrates local culture in learning in schools.

4. Conclusion

Based on the results of research and discussion in this study put forward some conclusions as follows:

1. Batak Toba cultural teaching materials using the Guided Discovery Learning model developed to meet valid, practical, and effective criteria
2. Mathematical Learning Process with a valid, practical and effective Batak Culture based on: (1) cultural perception, (2) representation and problem solving with group interaction patterns using Batak Toba culture, (3) presenting and developing student work, (5) analyze and evaluate the results of problem solving
3. The ability to solve mathematical problems of students taught using Guided Discovery Learning teaching materials has increased.

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