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Development of Teaching Materials Using Problem-Based Learning (PBL) Models with Ethnomathematics Nuances to Improve Students' Critical Thinking Ability

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ABSTRACT

This research was conducted at SD Negeri Pakuncen and SD Negeri I Wonosari Kec. Pegandon Kendal in grade IV students and focuses on mathematics. The research focused on mathematics subjects because based on the results of preliminary research conducted by researchers through classroom observations and interviews with teachers it was found KKM achievement mathematics subject scores was still very low. This type of research is research development or Research and Development (R&D). R&D research is a research method used to produce certain products, and test the effectiveness of these products. Researchers developed teaching materials in the form of student pocket books with a Problem Based Learning model with ethnomathematics nuances to improve students" critical thinking in grade IV. the pocket book model Problem Based Learning with ethnomathematics nuances is considered very valid fulfilling the suitability criteria of critical thinking teaching materials with a score of 4.25 very good, the content of teaching materials a good 4.17, presentation of teaching materials a score of 4.68 very good, the structure of presentation of teaching materials a score 3.95 is fine. The results of the development of teaching materials using the Problem Based Learning model with ethnomathematics nuances of Sunan Abinawa's grave have fulfilled the elements of practicality and effectiveness as evidenced by a score of 75.15% on observing student activities in the "good" category and a score of 81.5% on observing the implementation of learning in the "very good" category.

Keywords: Teaching Materials, problem-based learning, Ethnomathematics

INTRODUCTION

Learning is the activity of carrying out the curriculum in educational institutions so that students can achieve the goals that have been set. The purpose of education is basically to lead students towards changes in behavior, both intellectual, moral, and socio-cultural. The learning process emphasizes the interaction between students, educators, models, curricula, facilities, and learning resources in an environment to achieve learning competence. Competence will be maximally achieved if all learning components are fulfilled according to their respective functions. In carrying out learning, educators must be able to choose and determine approaches, strategies, and models that are adapted to their abilities, the peculiarities of learning materials, the condition of facilities, and the conditions of students, in addition to paying attention to the principles of curriculum development. Thus, educators must have extensive knowledge about learning models, student conditions, and how to carry out effective

and meaningful learning in order to carry out their duties in a professional manner. Educators also need broad insight into teaching and learning activities so that their tasks can be carried out properly and results can be obtained according to the expected goals. According to Majid (2016), a learning strategy is an action plan or a series of learning activities that contain methods and utilize various resources and strengths in order to achieve learning objectives.

The success of learning is influenced by many factors, both internal factors from within the students as well as external factors that come from outside the students. Critical thinking ability is one of the internal factors that influence student learning success. Critical thinking is the thought process of a person managing his deeper way of thinking - not how to think out loud, but how his critical thinking skills are processed in more detail, something that is made concrete. Thinking is an activity to find the correct knowledge (Slameto, 2015). According to Pehkomen in Alhaddad (2013), mathematical creative thinking is a combination of logical thinking and divergent thinking based on intuition, but in an awareness that pays attention to fluency, flexibility, and novelty. Divergent thinking is used to obtain as many ideas, options, or alternatives as possible, and then logical thinking helps to select the truth or draw these ideas into creative and correct solutions. According to Susanto (2016), mathematical creative thinking ability is the level of students' ability to find as many answers to a problem in various and relevant ways in a smooth, original, and detailed manner based on available data.

In addition to internal factors, the success of learning can also be influenced by external factors. One external factor that greatly influences the success of student learning lies with the teacher. The teaching model used by the teacher affects understanding and student learning outcomes. Teaching materials and the right way of delivering learning materials will improve students' thinking skills and affect student learning outcomes. Thus, the selection of appropriate teaching materials and learning models is one of the keys to success in the learning process, especially in subjects that require logical abilities such as mathematics. Mathematics in Law RI Number 22 of 2006 is one of the materials that must be taught to students at school. Learning mathematics is also a requirement for continuing education at the next level. By learning mathematics, students will learn to reason critically, creatively, and actively. Mathematics are abstract ideas that contain symbols, so mathematical concepts must be understood before manipulating these symbols (Susanto, 2016).

This research was conducted at SD Negeri Pakuncen and SD Negeri I Wonosari Kec. Pegandon Kab. Kendal with grade IV students and focuses on mathematics. The research focused on mathematics because, based on the results of preliminary research conducted by researchers through classroom observations and interviews with teachers, it was found that the KKM achievement in mathematics subject scores was still very low, and researchers also found that students' critical thinking skills in answering questions were not yet visible. This can be seen from the answers of students, who are only based on the questions and answers in the book but cannot answer new questions and are still lacking in terms of teaching materials. So far, the teaching materials used are still limited to textbooks, evaluation sheets, and worksheets. Limited teaching materials led to a lack of learning tools that can improve students' critical thinking skills in solving mathematical problems. In addition, the mathematics learning model used so far is the conventional model with lectures, giving sample questions and exercises, and a lack of utilization of the surrounding environment. Conventional learning is also known as traditional learning, also known as the lecture model, because this model has long been used as an oral communication tool between teachers and students in the learning process (Djamarah & Zein, 2013).

In connection with the importance of teaching materials, in order to improve students' critical thinking, teaching materials are needed that are in accordance with the needs of teachers and students and are associated with local culture. As a development of teaching materials for learning, researchers use student pocket books, which are intended to facilitate teachers in delivering mathematics subjects. The student pocket book is specifically designed and only intended for Pakuncen Elementary School students. The pocket book contains all the discussions regarding examples of math problems and their solutions. Thus, the existence of the pocket book can be an additional teacher's reference in the process of learning mathematics. Much research has been done on the use of pocket books, including research by Hilmiyah et al. (2020), which examined "Development of mind mapping pocket books on material four to improve self-regulation learning for VII graders of junior high school". states that the pocket book learning medium meets the criteria of high validity, practicality, and effectiveness. In addition, pocketbook media is also proven to be able to increase student independence and learning outcomes. Of the several pocket book developments that already exist, most only modify the model or method, and only a few uses the culture of the students (ethno) in them. According to Tarigan et al (2020), Utilizing ethnomathematics, or the culture that exists in the environment around students, makes it easier for teachers to guide students to solve math problems but can also improve students' critical thinking skills by providing problems related to real life. Ethnomatematics is a cultural approach that exists around students through a mathematical approach so that students understand mathematics as something that is considered abstract (Munahefi et al., 2021). So it is very necessary to include culture in pocketbook teaching materials to improve students' critical thinking. Problem-Based Learning (PBL) is the use of various kinds of intelligence needed to confront real-world challenges, including the ability to deal with new and existing complexities (Rusman, 2010). Problem-based learning (PBL) models emphasize finding their own concepts related to everyday life. Learning by applying the problem-based learning model can foster students' critical thinking skills (Sulthan Ontowijoyo et al., 2022). Then the process is carried out in discussion so as to make the atmosphere more enjoyable, and the knowledge gained also lasts a long time in the memory of students.

Learning by solving problems in the real world, in this case, students are encouraged to think critically by understanding the concepts of the subject matter. So that the use of the problem-based learning (PBL) model will be a suitable learning model because both are interrelated, that is, both are related to the problems of everyday life. So, the problem-based realistic learning model is a learning approach that provides a real problem to emphasize that students think more critically when solving the problem. Based on some of the results of previous research and related to the background of the problem that SD Negeri Pakuncen has not implemented problem-based learning with ethnomathematics nuances, in this study researchers will explore ethnomathematics forms of local culture in Pekuncen Village and develop pocket-book teaching materials based on local culture.

LITERATURE REVIEW

Pocket Book Teaching Materials

Teaching materials are materials used by teachers to convey teaching material sources to students (Azman et al., 2022). The learning success of students is also influenced by the teaching materials used. Based on the Big Indonesian Dictionary, a pocket book is a small book that can be put in a pocket and is easy to carry anywhere. Another understanding is that books are small, pocket-sized, or can be put in a pocket and contain information about a particular theme.

Problem-Based Learning Model

Sofiyah et al. (2018) explained that problem-based learning is a curriculum that plans learning to achieve an instructional goal. The Problem-Based Learning model is effective for peer feedback and problem-solving skills so that students think critically (Naimnule et al., 2020). According to Mandagi et al. (2021), problem-based learning is a learning approach that uses real-world problems as a context for students to learn about critical thinking and problem-solving skills, as well as to acquire knowledge and core concepts from subject matter.

Ethnomathematics

According to Barton in a quote by Zulkifli et al. (2020), ethnomathematics is a study that examines the way a group of people from a certain culture understand, express, and use the concepts and practices of their culture, which are described by researchers as something mathematical. Meanwhile, according to Indah Rachmawati in her research, ethnomathematics is a special method used by a certain group of people in mathematical activity (Linda Indiyarti, 2017).

Critical Thinking Ability

According to Azizah et al. (2018), people who are able to think critically are people who are able to conclude what they know, know how to use information to solve problems, and are able to find relevant sources of information to support problem solving. According to this definition, critical thinking emphasizes reasonable and reflective thinking. Reasonable and reflective thinking is used to make decisions.

MATERIALS & METHODS

This type of research is called research and development or R&D. In this study, researchers developed teaching materials in the form of student pocket books with a problem-based learning model with ethnomathematical nuances to improve students' critical thinking. Development uses the ADDIE model (analysis, design, development, implementation, and evaluation). The subjects in the study were 60 students, consisting of 30 students from SD Negeri 1 Wonosari and 30 students from SD Negeri Pekuncen. Data analysis techniques use the results of expert validation tests, practicality tests, and effectiveness tests of teaching materials.

RESULT and DISCUSSION

The research was conducted at SDN Pakuncen as an experimental class with 30 students as respondents and at SD N 1 Wonosari with as many as 30 respondents as a control class. In its application, the teacher explores students' initial abilities regarding mathematics material by using problems with the problem-based learning model using an ethnomathematics approach. Exploring students' initial abilities is carried out through simple questions related to activities at Sunan Abinawa's grave.

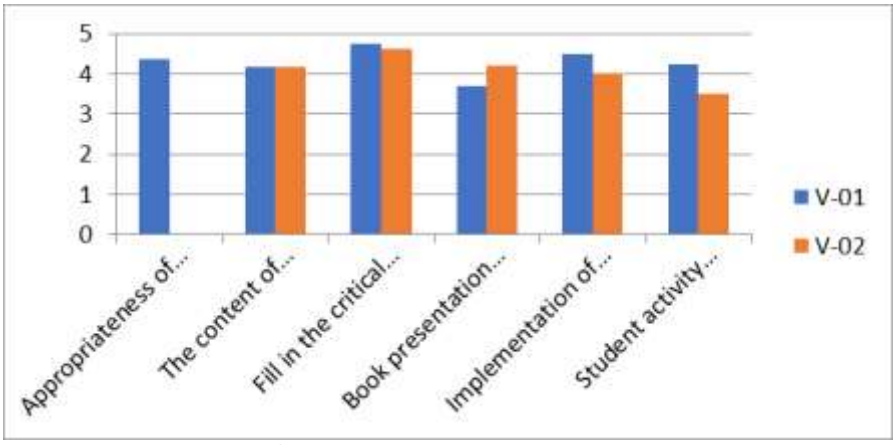
Mathematics learning using pocket book teaching materials with a problem-based learning model with Ethnomatematics nuances and activities at Sunan Abinawa's grave requires students to be able to think critically and reflectively and be able to provide improvement. Learning with pocket book teaching materials gives a new and interesting impression to students because the material taught is related to real life around them and becomes part of the local culture of Pekuncen village, namely the tomb of Sunan Abinawa. By linking mathematics learning with culture at Sunan Abinawa's tomb, it is hoped that students will be able to use and apply mathematical knowledge in everyday life with objects that they often encounter in their surroundings. In addition, students are also expected to like mathematics and feel comfortable learning it because it relates to their culture and everyday lives. The results of the analysis of the validity, practicality, and effectiveness of the items used in this study show that:

Expert Validity Aspect

The learning tools in this study were in the form of student pocket books, and the research instruments used had been validated by two validators who were experts in their fields. The results of the validity of the pocket book and research instruments are shown in the following table:

Device Average	Validator Score		Average total	Category
	V-01	V-02		
Appropriateness of critical thinking teaching materials	4,38	4,12	4,25	Very good
The content of critical thinking teaching materials	4,17	4,17	4,17	Good
Fill in the critical thinking book	4,75	4,62	4,68	Very good
Book presentation structure	3,7	4,20	3,95	Good
Implementation of learning	4,50	4,00	4,25	Very good
Student activity observation sheet	4,25	3,50	3,87	Good

The table above shows that all indicators of teaching materials developed in this study are in accordance with the validator's suggestions. For more details, see the graph below:



Graph 1: Graph of Teaching Materials and Instruments Validation Scores

The use of a pocket book with a problem-based learning model with the ethnomathematical nuances of Sunan Abinawa's tomb in the implementation of learning is considered very valid because it meets the suitability criteria for critical thinking teaching materials, the contents of critical thinking teaching materials, the structure of presentation of critical thinking teaching materials, and teaching materials developed to improve critical thinking skills.

The results of the analysis regarding the validity aspect show that all the sets of teaching materials used in this study (appropriateness of critical thinking teaching materials, content of critical thinking teaching materials, contents of critical thinking teaching materials, structure of presentation of critical thinking teaching materials, implementation of learning, and student activity observation sheets) have met the validity aspect because they are in accordance with the validator's suggestion. The results of this study are in line with the research of R. Rifandi et al. (2010), which examined the need for the development of pocket books as complementary materials in supporting students who study material equations through online learning. The results of the study show the validity of pocket books and that lecturers need to design pocket books to support students in the online learning process because they are in accordance with the needs of student independence in solving problems in learning.

Practicality Aspect

The practicality aspect includes the results of observing the activities of teachers and students in using pocket books in the

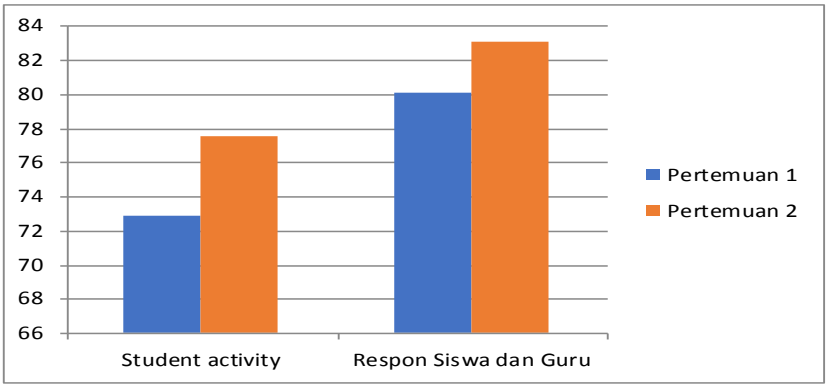
minimum good category. The results of observations and use of the pocket book are shown in the following table:

Table 2 Observation Results of Learning Activities

Observation Aspect	3rd meeting		Score average	Category
	1	2		
Student activity	77,5%	72,8%	75,15%	Good
Student and Teacher Responses	80%	83%	81,5%	Very Good

In table 2 above, it can be seen that student activity in learning is quite good, with an average score of 75.15%. This can be interpreted as meaning that the use of a pocket book with a problem-based learning model with ethnomathematical nuances at Sunan Abinawa's tomb has fulfilled the practical element in the good category. While the responses of students and teachers can be seen in the implementation of learning conducted by the teacher in accordance with the Learning Implementation Plan (RPP), which had been prepared previously and was categorized as very good, the level of implementation of learning is classified as fulfilled at each meeting.

For more details, the implementation of learning can be seen in the following graph:



Graph 2: Graph of Learning Implementation

Based on the results of the analysis, it is known that in the practical aspect of problem-based learning with ethnomathematical nuances, Sunan Abinawa's tomb has fulfilled the practicality element. This is evidenced by a score of 75.15% in the observation of student activity, which is classified in the "good" category, and a score of 81.5% in the observation of the implementation of learning, which is classified in the "very good" category.

The results of this analysis prove that, based on the practical aspect, the student's pocket book used with the problem-based learning model at SD N Pakuncen fulfills the practical aspect. The results of this study are in line with the results of research conducted by Hilmiyah et al. (2020), who examined "Development of a Mind Mapping Pocket Book on Material Four to Improve Self-Regulated Learning for VII Graders of Junior High School." Based on the validity, practicality, and effectiveness tests, it was stated that the pocket book learning media met the criteria of high validity, practicality, and effectiveness. In addition, pocketbook media is also proven to be able to increase student independence and learning outcomes.

Aspects Of Effectiveness

Aspects of effectiveness assessed in this study include: the average value of students' critical thinking skills in the experimental class using pocket books with the Problem Based Learning model with ethnomathematics nuances of Sunan

Abinawa's tomb is better than the control class with conventional learning models; the proportion of students' critical thinking skills mastery in the Problem Based Learning model with ethnomathematics nuances of Sunan Abinawa's tomb is greater than the proportion of students' critical thinking completeness in conventional learning models, and there is a positive influence of students' pocketbooks on their critical thinking skills.

The results of the N-Gain test on experimental and control respondents obtained the following test results:

Table 3 N-Gain test results

	Experiment Class	Control Class
Average	80,82	18,0
Minimum	70,26	0
Maximum	94,44	75

Based on the results of the calculation of the N-Gain score test, it can be concluded that the average N-Gain score for the experimental class was 80.82 or 80.8% included in the effective category, with a minimum score of 70.26% and a maximum of 94.44%. Thus it can be concluded that the use of pocket books is very effective in improving the critical thinking skills of fourth grade students at SD N Pakuncen in the mathematics subject for the 2021/2022 academic year.

Based on the analysis of the practicality aspect which includes the results of observing the activities of teachers and students in using pocket books, it was found that student activities in learning obtained a score of 75.15% and were in the good category. The results of the analysis on the criteria for implementing learning obtained an average score of 81.5% and in the very good category as evidenced by the increased critical thinking skills of the experimental class. This proves that teaching materials using the Problem Based Learning model with ethnomathematics nuances at Sunan Abinawa's tomb have fulfilled the element of effectiveness.

The results of this study are in line with the research of Putri Reno Lenggo Geni & Isti Hidayah (2017) which concluded that ethnomathematics problem-based learning is effective in increasing students' problem-solving abilities and increasing students' love of local culture. Similar research was also conducted by Sarwoedi et al (2018) which resulted in the conclusion that ethnomathematics-based mathematics learning proved effective in increasing students' mathematical understanding abilities.

CONCLUSION

The products produced in this research and development are teaching materials with an ethnomathematically nuanced PBL model. This teaching material provides an active learning experience for students who use it. Based on the results of research and development, it can be concluded that teaching materials using the PBL model with ethnomathematic nuances are in great demand by students. All students who became part of the experimental group had a high interest in the teaching materials being developed. Likewise, the response to this teaching material was positive; all students gave a positive response. In terms of learning outcomes, this research proves that there are differences in learning outcomes between students who use this teaching material and students who do not use it. This is indicated by the average N-Gain score for the experimental class, which is included in the effective category. Because the average value of the experimental class is greater than the average value of the control class, it can be concluded that this teaching material is effective in terms of student learning outcomes.

Declaration by Authors

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