Development of students worksheets for brain based learning is oriented towards mathematical literacy skills

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**Abstract**. This research is based on the low mathematical literacy skills of students and the lack of learning tools in the form of good worksheets that can support the process of learning mathematics in schools. This research aims to produce mathematical worksheets with BBL approach oriented to mathematical literacy skills of good quality, based on validity, practicality, and effectiveness. This reserach uses the ADDIE development model which the stages of analysis, design, development, implementation, evaluation. A total of 23 students in class VII8 MTsN 2 Bima town were used as research subjects. The research instruments used were validity sheets, teacher assessment, student assessment, observation sheets of learning accomplishments, and tests of mathematical literacy. The results showed that the quality of the product developed based on the validity aspect had met the valid criteria with an average score of 114 in the good category. The practicality quality shows that the learning tools the practical criteria with a score based on teacher's assessment of 42 (excellent), student's evaluation of 38.78 (good), and percentage of learning accomplishment of 94% (excellent). The quality of effectiveness shows that the learning tools met the effective criteria with an average percentage of mathematical literacy skills test of 73.91% (good).

1. Introduction

Mathematics learning is a process of gaining knowledge about mathematics which not only takes place at school but also at home [1]. The mathematical trend of this century is influenced by the increasingly widespread areas of life that require mathematical applications such as in the field of technology. The trend has implications for the need for mathematical thinking ability, mathematical argumentation and communication, composing mathematical models, displaying problems and solving them, using mathematical representations, using and understanding mathematical symbols and using tools and technology such as calculators, computers, mathematical software such as geogebra which are skills in mathematical [2].

PISA and TIMSS develop instruments to measure students' mathematical literacy abilities. PISA assessment not only ensures students' ability to produce knowledge but also tests how well they can extrapolate what they have learned and can apply knowledge to unfamiliar situations both inside and outside of school [3]. The TIMSS assesses the ability to solve mathematical problems in various situations with about two thirds of the questions requiring students to use application and reasoning skills [4]. The concept of mathematical literacy is very much related to the process of mathematical or mathematical modeling [5]. Mathematical literacy helps someone to understand the role and benefits of mathematics in everyday life so that it can be used to make good decisions [6]. Mathematical literacy in modern life is now interpreted generally as a unity of knowledge, understanding, and skills that humans need to function effectively in modern life [7].

Mathematical literacy skills is defined as the ability of a person to formulate, apply and interpret mathematics in various contexts of daily life [8] [9]. This ability helps one to recognize that mathematics plays an important role in every aspect of life and to make reasonable decisions that are also needed constructively, involved and reflective [10]. In fact based on the results of previous studies that students' mathematical literacy skills are still low [11] [12] [13]. Means it can be said that students' mathematical literacy skills need to be improved.

Based on *Permendikbud* No 54 of 2013 concerning the standards for graduation competencies in the 2013 curriculum, learning objectives include attitudes, knowledge, and skills that are elaborated for each education unit [14]. The learning objectives are pursued by learning using a scientific approach, which is basically good learning and can trigger student activity [15]. The learning process that has not been run optimally can also be influenced by the use of learning models that are less effective, so we need a learning model that can improve the ability of students' mathematical literacy.

The Brain Based Learning (BBL) model can be a good choice for dealing with the problem of students' learning challenges because the main element in BBL is learning with real problems that can reduce student saturation so that students feel that learning mathematics is not always abstract and can be applied in daily life –day [15]. In addition, BBL is able to change the physiology of students' brains when students collaborate in learning and interacting with other [16]. BBL is also a learning approach that emphasizes student achievement in empowering brain potential [17]. Brain-based learning builds learning designs where emotions, cognition, reflection, social, and physical are carried out in harmony [18].

Based on the description, the purpose of this research is to develop a Student Based Worksheet Brain Based Learning that is oriented to the mathematical skills of students of good quality, because the success of learning mathematics students, especially in the cognitive domain can be supported by the existence of good mathematical worksheet . Worksheets are sheets of assignments that must be done by students [19], making it easier for students to complete the tasks that are ordered because in the worksheets already listed instructions and steps to complete the task.

1. Method

This type of research is R & D (Research and Development) with ADDIE models which include the stages of analysis, design, development, implementation, evaluation. This research was carried out at *MTs Negeri 2 Bima* town in the even semester in academic year 2019/2020 in class VII8 totaling 23 students.

## Research Procedure

The development procedure in this research consisted of five stages namely analysis, design, development, implementation, and evaluation. The analysis phase is the pre planning stage of product development in the form of worksheets with BBL approach. At this stage the researcher analyzes matters relating to the development of learning tools, including needs analysis, student characteristics analysis, and material analysis; The design phase aims to prepare everything needed for the development of worksheets that can support learning in schools; Development phase that aims to develop worksheets; The implementation phase is the researcher's step in trying out worksheet; The evaluation phase is the step of the researcher evaluating matters related to the development of worksheets based on the results of field trials.

* 1. *Data Collection Techniques and Instruments*

In this research data collection techniques in the form of tests of mathematical literacy skills, teacher and student assessment questionnaire, and observation sheet of the implementation of learning. For data collection instruments used to obtain data about validity, practicality, and effectiveness, in the form of validation sheets, teacher assessment sheets, student assessment sheets, observation sheets of learning implementation, and tests of mathematical literacy skills. The details of each instrument are as follows: Validity instruments include the worksheets validation sheet; Practical instruments include teacher and student assessment sheets, as well as observation sheets of learning accomplishments; The effectiveness instruments include tests of mathematical literacy skills.

* 1. *Data Analysis Technique*

Data analysis techniques were carried out to obtain worksheets with a quality BBL approach that met the aspects of validity, practicality, and effectiveness. The collected data is then analyzed. For validity and practicality data analysis, quantitative data were converted into qualitative data on a scale of five.

1. Result

## Initial Product Development Results

This section describes the process of developing worksheets with the BBL approach based on aspects of validity, practicality, and effectiveness oriented towards students' mathematical literacy skills, using the ADDIE development model. The description of the development steps at each stage, namely:

* + 1. Analysis Phase. At this stage the researcher analyzes the needs by conducting pre-research observations. Based on observations, it is known that learning is still centered on the teacher so that students cannot obtain essential and strategic information in reading mathematical literacy questions related to daily life. In addition, the teacher gives exercises to students that are not much different from the examples that are exemplified, so students are not given the widest opportunity to construct the knowledge that must be possessed. Based on these conditions, it appears that learning in the classroom has not yet developed mathematical literacy skills, so we need a learning device that can develop students' mathematical literacy abilities. Analysis of student characteristics is done by identifying the character of students through observation in class and interviews with the mathematics teacher of the class. Based on observations it is known that students tend to be passive and teachers also have not yet developed learning oriented toward mathematical literacy abilities. Material analysis is done by determining the material used in research in the form of social arithmetic.
		2. Design Phase. The design phase is the next stage after the needs analysis, student characteristics, and material analysis phase are carried out. This stage contains the activity of preparing worksheets which uses the BBL approach.
		3. Development Phase. At this stage, the researcher develops the worksheet based on a planned design consisting of overall value, per-unit value, partial value, purchase price, sales price, discount, gross, tare, net, single interest, and tax.
		4. Implementation Phase. At this stage, the worksheets that have been developed are then trialled in classroom learning. The trial was held six times and two meetings were added to do a mathematical literacy test.
		5. Evaluation Phase. At this evaluation stage, it produces data to analyze aspects of practicality and effectiveness of learning tools. Data on practicality of student worksheets were obtained from the results of teacher assessments and student assessments as well as the percentage of learning accomplishments. The effectiveness aspect is seen from the results of students' mathematical literacy skills.
	1. *Product Trial Results*

Student Worksheets that have been developed are assessed for their validity aspects using expert validation, after being said to be valid by making revisions in accordance with input from the validator, the LKS is tested on the field.

* + 1. Expert Validation. Expert validation in this study involved three validators. The assessment given by the three validators stated that the learning tools used were valid so it was worth testing in the field. The data from the worksheet validation results can be seen in the following table:

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| **Table 1.** Worksheet assessment for each aspect |
| Rated aspect | Average score | Maximum Score | Category |
| conformity to the BBL approach | 26,5 | 30 | Excellent |
| compatibility with mathematical literacy abilities | 8,5 | 10 | Excellent |
| suitability of contents and material | 22,5 | 25 | Excellent |
| layout of student worksheets | 11 | 15 | Good |
| compatibility with the component of language | 17 | 20 | Excellent |
| the suitability of the presentation component | 16 | 20 | Excellent |
| benefits or uses Student worksheets | 13 | 15 | Excellent |

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| **Table 2**. LKS assessment for each validator |
| Validator | Score Total | Category | Remarks |
| I | 106 | Good | Eligible for Use with Revisions |
| II | 122 | Excellent | Proper to use |
| III | 115 | Good | Eligible for Use with Revisions |
|  Average | 114 | Good |

Based on the validator's evaluation of the worksheet, it is known that the worksheet developed has fulfilled the good category. This shows that the worksheets developed using the BBL approach are valid so it is worth testing in the field.

* + 1. Field Trial. The field trial conducted in class VII8 aims to obtain data on the practicality and effectiveness of learning tools with a BBL approach oriented to students' mathematical literacy skills. Practicality data were obtained from the results of teacher assessment analysis, student assessment, and the percentage of learning accomplishments. While the effectiveness data obtained from the results of students' mathematical literacy skills test. Based on the results of the analysis, it was found that the teacher's assessment of the worksheets developed was in the excellent category with a score of 42. While for practicality and effectiveness data can be seen in the following table:

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| **Table 3**. Percentage of student assessments |
| Score Interval | Category | Percentage |
| $$X>42$$ | Excellent | 9% |
| $$34<X\leq 42$$ | Good | 74% |
| $$26<X\leq 34$$ | Enough | 17% |
| $$18<X\leq 26$$ | Deficient | 0% |
| Average  | 38,78 (Good) |

Based on Table 3. it can be seen that the student's assessment of the worksheet is in the Good category with an average grade of 38.78 thus the worksheet with the BBL approach developed can be said to be practical.

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| **Table 4**. The results of observations of the implementation of learning |
| Meeting to- | Percentage | Category |
| 1 | 78% | Good |
| 2 | 89% | Excellent |
| 3 | 94% | Excellent |
| 4 | 100% | Excellent |
| 5 | 100% | Excellent |
| 6 | 100% | Excellent |
| Average | 94% (Excellent) |

Based on Table 4 it can be seen that the implementation of the learning steps using the BBL approach is in the very good category with an average value of 94%. Thus the learning tool can be said to be practical.

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| **Table 5.** Test results of mathematical literacy abilities |
| Score | Score  |
| Average | 77 |
| The highest score | 89 |
| Lowest value | 48 |
| Number of students who have completed | 17 |
|  Percentage of completeness | 73,91% (Good) |

Based on Table 5 it is known that the average score of students' mathematical literacy skills is 77, with the highest score of 89 and the lowest value of 48, so that the number of students who complete as many as 17 students with a percentage of completeness of 73.91% and good category. Thus it can be concluded that the matter of mathematical literacy skills with the BBL approach is said to be effective.

* 1. *Product Revision*

Product revisions were carried out twice. The first revision was made based on input provided by the validator and the second revision was made after field trials.

* + 1. Product revision after validation. Products developed in the form of student worksheets, after the validation stage there are several revisions made based on input provided by the validator including, some wrong writing on the student worksheets such as the prefix on the name of the place and the name of the person does not use capital letters, clarifying the sentence instructions in the student worksheet
		2. Product revision after field trials. After the field trial is conducted, there are some suggestions given by the teacher, including the worksheet that is developed should be accompanied by answers in order to facilitate the teacher to minimize errors in the worksheet, some instructions on the worksheet that are not understood by students.
	1. *Final Product Review*

Student Worksheets developed with the Brain Based Learning (BBL) approach are oriented towards mathematical literacy skills that are developed feasible to be used as a mathematical learning device that meets valid, practical, and effective criteria.

* + 1. Validity. The quality of validity based on validator assessment shows that the worksheets developed have met the valid criteria in Good category.
		2. Practicality. The quality of practicality based on teacher assessment, student assessment, and observations of learning accomplishments shows that the device developed has fulfilled practical criteria with good categories for student assessment, and excellent categories for teacher assessment and observations of learning achievement.
		3. Effectiveness. The quality of effectiveness based on tests of mathematical literacy skills shows that the device developed has met the effective criteria in good category.
1. Conclusion

Based on the results of data analysis conducted that the quality of the product developed based on validity shows that the developed worksheet has fulfilled valid criteria with good categories, for product quality based on practical aspects based on teacher assessment, student assessment, and observations of learning implementation indicate that learning devices these have fulfilled practical criteria with each category excellent, good and excellent. While the quality of effectiveness based on tests of mathematical literacy skills shows that the learning tools developed have met the effective criteria in good category. Based on these explanations, it can be concluded that the devices developed with the BBL approach are oriented towards mathematical literacy skills that are feasible to be used as one of the mathematics learning devices that meet valid, practical, and effective qualities.

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