

Development of Pan Obibul (*Papan Operasi Bilangan Bulat*) Media to Improve Mathematic Higher Order Thinking Skills of Elementary Students in Problem Based Learning Model

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Abstract

Mastery of mathematical concepts is still an obstacle for elementary school students. They still consider mathematics as an abstract concept, so it is necessary to provide learning media that can help students to master the concept well. Problem solving based media is believed to be able to help students to practice higher order thinking skills (HOTS). Therefore, Pan Obibul media was developed to train higher order thinking skills which at the same time had an impact on mastering mathematical concepts. This research aims to determine the validity, practicality, and effectiveness of the Pan Obibul learning media that is implemented with the Problem Based Learning model on students' HOTS abilities. The type of research is R & D, and the research data were obtained through interviews, teacher and student needs questionnaires, validator questionnaires, teacher, and student response questionnaires, as well as pretest and posttest. The research was conducted at a public school in Wedarijaksa district, Pati Regency with a total of five schools. The results showed that the feasibility assessment by lesson material validators obtained an average percentage of 94.55% which is included in the very suitable category. The responses of teachers and students to the Pan Obibul media product trial obtained an average percentage of 85.25% and 87.5% with a very suitable category. The the mathematics HOTS abilities improvement can be known by the paired sample test and N-Gain test. In paired sample t-test, it was obtained that an average Sig (2-tailed) score 0.000 and included in effective category. The results of the N-gain test obtained the value of 0.606 and included in the high category. From those results, it can be concluded that the development of Pan Obibul media to improve the HOTS skill of elementary school students through the PBL learning approach obtained Pan Obibul media, which is valid, practical, and effective in learning mathematics.

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INTRODUCTION

Mathematics lessons must begin at elementary school age, it aims to make students able to think logically or have good thinking skills so they are able to solve problems in everyday life (Taufikurrahman & Nurhaswinda, 2021). It should be done, so the students are able to find concepts from experiences in the surrounding environment (Rohim, 2019). According to Finisia et al. (2018) mathematics as the basis of science is the foundation of various sciences and the work fields. Various kinds of formulas are learned and memorized by students without knowing what the benefits of studying the material are. Mathematics learning which is still abstract makes students find it difficult to learn mathematical concepts. Learning mathematics has not provided a sense of meaning for students. The teacher only offers learning material without explaining the benefits of studying the learning material which is related to daily issues (Widyastutik, F. Sary, R. M. Damayani, 2019). Therefore, to face the challenges that will face the world of education, the 2013 curriculum is considered capable for answering these problems and the implementation of HOTS is very needed to improve educational performance which is far behind developed countries in the world (Sofyan, 2019).

Mathematics needs a learning model that can improve skills, understanding concepts, and problem solving independently of new knowledge. Teacher must ensure that students have mastered the prerequisite material, design ways of delivering teaching materials with effective communication and pay attention to the family and social conditions of students, so there will be no more learning difficulties for students in the future (Nurjannah et al., 2019).

The learning process that can create students' skills and independence in problem solving can help students interpret a knowledge in learning. Along with the development of the world of education, there are many learning models that teacher can use during the learning process. Learning models that can improve

understanding of concepts and learning outcomes is referring to learning models that require independent problem solving. The learning model that emphasizes problem solving to new knowledge is Problem Based Learning (PBL). One of its roles is mathematics can make students think critically, creatively and actively. Zakiah et al. (2021) stated that learning mathematics aims to develop and deepen understanding of mathematical concepts and relation when they create, compare, and use various representations.

The PBL model usage provides better learning result because here, students are encouraged to learn mostly through active involvement in understanding concepts and principles in conducting experiments and observations (Anugraheni et al., 2018). The advantage of the PBL model is students can increase activities in learning, solve problems and develop good character or traits of students (Umardianti et al., 2021).

Another problem in learning mathematics is the lack of innovations in mathematics learning which makes students less interested in mathematics learning and caused so many students did not understand the learning concept when the teacher was explaining examples. Safuro et al. (2020) stated that students consider mathematics to be a complicated and difficult subject to understand. Basically, the role of learning media in supporting the learning process and outcomes is very important. Learning media in terms of education is also a basic component whose main position is to support the learning process (Damara et al., 2018). Learning media is less supportive so there are many students do not understand the material and find it difficult to solve problems in mathematics. Another factor that influences is the level of understanding of students regarding students' understanding of the concepts of integer arithmetic operations material is still low so that they have difficulty understanding the concepts of integer arithmetic operations material. The difficulty of learning integer arithmetic operations lies on understanding the concepts of students (Wangge, 2021).

The teacher as a facilitator in the learning process is very important to ensure that the mathematics learning that the teacher conveys is well received and understood. So the use of teaching aids is very important basis for the growth of students' high-level understanding. Andhani (2019) states that mathematics teaching aids are concrete objects that are made, collected, and arranged intentionally. It is used to help and deepen or slow down the mathematical concepts. The use of teaching media (properties) in mathematics subjects to bring up student activity and creativity so it can stimulate student interest in that subject. Thus learning outcomes and student results can be improved (Indraleka, 2017).

The urgency of optimizing thinking skills in learning is based on the fact that some students are not able to make connections between what is learned in school and how to implement and apply it in everyday life. Learning in elementary schools tends to focus on aspects of memorizing, less understanding and meaning given. The learning that students have done seems to be separated from real life so the learning is meaningless because they cannot apply what they have learned (Acesta et al., 2020). The PBL learning model is a learning model with a student learning approach to authentic problems so that students can construct their own knowledge (Nurbaiti, 2018). Students are expected to be able to think in high order skill or High Order Thinking Skills (HOTS). This is appropriate with the objectives of learning mathematics. High Over Thinking Skills is a thinking process of students at a higher cognitive level which is developed from various cognitive concepts and methods and learning taxonomies (Aryani & Ariani, 2020). Mathematics subjects are closely related to students' thinking abilities, especially high-level thinking skills. Rapih & Sutaryadi, (2018) stated that HOTS is a very important aspect to be developed in mathematics learning because in solving real problems that are not routine students need critical thinking skills and creative abilities (Susanto & Retnawati, 2016). Novianto et al. (2020) stated that the higher-order thinking

ability of students who get high math scores tended to be better than students who get low math scores.

Based on the results of teacher interviews and observations in elementary schools throughout Wedarijaksa District, the learning carried out by teachers still refers to the conventional learning model. The reason for using the conventional method in this case is the lack of learning media that can be used. Conventional learning is a relatively monotonous learning. Teachers are more active and play an important role in the learning process. Learning activities in the conventional model are more dominated by teachers. The learning method used is the lecture method, giving assignments, and asking questions. Students only do or record what is instructed by the teacher, so it does not provide opportunities for students to build their own knowledge, so it can cause students' low understanding of the mathematical concepts they have learned. In fact, mathematics has an important role in primary school education so teachers must be able to explore students' abilities to the maximum as stated by Kurniati et al. (2015) which states that the importance of the role of mathematics education in elementary schools in developing mathematical critical thinking skills, so the role of mathematics teachers in training thinking skills for students in elementary schools becomes very meaningful.

This research aims to determine the validity, practicality, and effectiveness of the use of Pan Obibul learning media implemented with the Problem Based Learning model on students' high order thinking skills (HOTS) in learning mathematics. The expected benefit of this research is that it can improve students' higher-order thinking skills / HOTS mathematics students in mathematics lessons on the subject of arithmetic operations of addition and subtraction of integers. In addition, the research results can also be used as a reference for teachers to develop effective learning media to train students' abilities in using critical thinking skills.

METHODS

The type of research used is Research and Development or research and development. The development model used uses the ADDIE (Analysis Design Development Implementation Evaluations) method with the following stages: 1) analysis, analyzing the need to develop learning models or media; 2) design, is a systematic stage starting from the stage of setting goals, designing media development scenarios; 3) development, product design realization at the design stage; 4) implementation, application / implementation in real learning in the classroom; 5) evaluation, after being implemented, an initial evaluation is carried out in the form of feedback on the use of the new learning media, the results of the evaluation will be used as material for improvement at the next stage (Winarni & Marlina, 2020).

This research was conducted in Cempaka Cluster, Wedarijaksa District, Pati Regency. The Cempaka Cluster consists of seven elementary schools, they are SD Negeri Tluwuk in Tluwuk Village, Wedarijaksa District, Pati Regency; SD Negeri Tlogoharum 01 and SD Negeri Tlogoharum 02, in Tlogoharum Village, Wedarijaksa District, Pati Regency; SD Negeri Trangkilan in Sidoharjo Village, Wedarijaksa District, Pati Regency; SD Negeri Bangsalrejo in Bangsalrejo Village, Wedarijaksa District, Pati Regency; SD Negeri Kepoh in Tluwuk Village, Wedarijaksa District, Pati Regency; and SD Negeri Jetak in Jetak Village, Wedarijaksa District, Pati Regency. The subjects of this study were sixth graders in elementary schools in the Cempaka Cluster. SD Negeri Kepoh and SD Negeri Jetak were used as subjects for a limited trial while the other 5 elementary schools were used as subjects for a large-scale trial. The object of this research is the use of Pan Obibul through the PBL learning model to improve students' understanding of mathematical concepts and HOTS skill.

The data collection instruments in this study used: questionnaires, interviews, pretest questions and posttest questions. Questionnaires are used to determine the advisability and

student responses to Pan Obibul Media. Testing the validity of the questionnaire using the judgment expert technique. Interviews were used to obtain deeper information about the respondents. Respondents in this study were sixth grade teachers who were also the research subjects. The test method is used to determine the mastery of the addition and subtraction of integers. This test was carried out before and after the learning process with Pan Obibul learning media. This test is used to determine how much mastery of the material or students' cognitive abilities before and after being given learning treatment. The test questions used were tested first and then tested for validity, level of difficulty, discriminating power, and reliability before being used in the pretest and posttest.

The effectiveness test is used to determine the increase in students' cognitive abilities and understanding concepts after the learning process using Pan Obibul learning media. The effectiveness test in this study used the N-Gain test and the Paired Sample t-test using SPSS 25.

RESULTS AND DISCUSSION

The development of Pan Obibul learning media started from the potential and problems that the researchers did through the identification of problems at the Public Elementary School in Wedarijaksa Pati. Based on the results of interviews with students, students who had never previously used Pan Obibul media. Teachers and students also think that learning will be more interesting with interesting and innovative learning media.

Based on these problems, then It had conducted review from various literatures, material collection, curriculum analysis, needs analysis of teachers and students. Furthermore, the researchers designed a prototype by compiling the material according to the Standard Competency, Based Competency and indicators, making the Pan Obibul design, compiling evaluation questions at the end with the preparation of the Pan Obibul media as a whole. Pan Obibul's media was validated for eligibility to get an assessment and validation of

eligibility by material and media validators. The Pan Obibul learning media was tested for the product. Based on the comments and suggestions of the validator, improvements were made to Pan Obibul's learning media according to suggestions from the material and media validator, and on the responses of students. After being revised, a trial of using Pan Obibul learning media was carried out on 5 public elementary schools in Wedarijaksa District to improve mathematics learning outcomes for Integer Count Operations.

In principle, Pan Obibul media consists of 3 parts, they are the board, question cards and numbers. The first part consists of the positive and negative boards, which are made of thick Yellow Bolt cardboard measuring 35 cm x 53 cm, 3 mm foam heart and a printed image of the MMT banner, which contains a column of positive squares on the right and a negative column of squares on the left. The first part in the form of a game board can be seen in Figure 1.

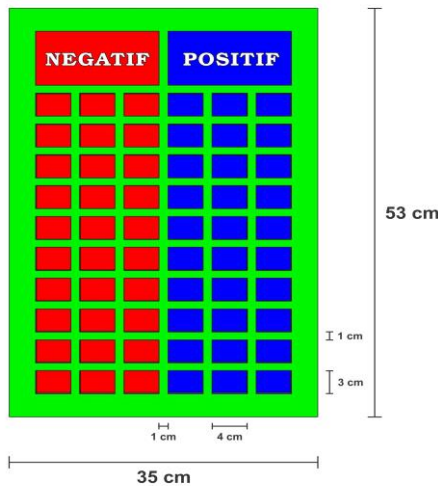


Figure 1. Pan Obibul Media (At Front)

The second part is a number made from 3 mm thick heart foam, with a size of 4 cm x 3 cm, which is coated with blue for positive and red for negative, used as question cards that must be inserted into the board. The integers can be seen in Figure 2.

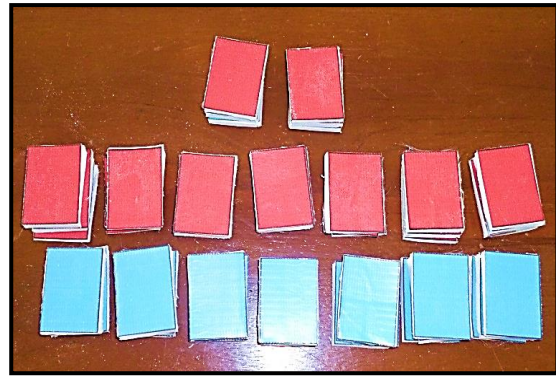


Figure 3. Numbers

The third part is a question card made of BC or Buffalo paper with a size of 6 cm x 9 cm, inscribed with integer arithmetic operations questions. The question card can be seen in Figure 3.

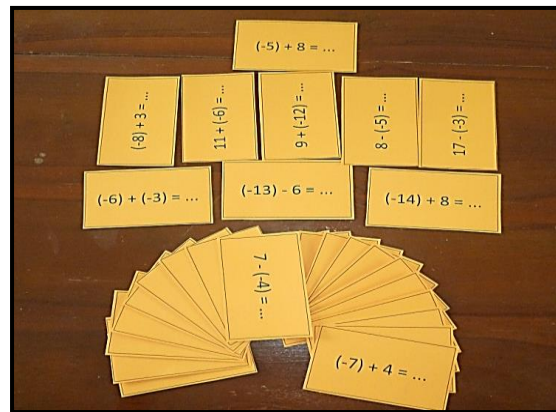


Figure 4. Question Card

In principle, this media can be used in independent learning and classical learning. The use of this media is very dependent on the creativity of the teacher in designing learning designs. The core of this media is a tool in integer arithmetic operations. Pan Obibul's media is designed to improve elementary school students' HOTS math skills through a PBL learning approach. PBL learning design is designed through student activities given problems related to count integers. Problems are given in the form of story questions that require an understanding of the concept of counting integers. HOTS skill is tested with math problems in the form of HOTS questions with various forms of challenges. Through this Pan

Obibul media, students will find it easier and faster to calculate. The developed Pan Obibul learning media is implemented in learning using the Problem Based Learning model to determine the effectiveness of using the media. The use of the Problem Based Learning learning model can improve critical thinking skills and learning outcomes in solving story problems in mathematics subjects (Oktaviani, 2018). This is done because it refers to the results of research by Susilo et al. (2012) which states that the SAVI-based PBL model learning to develop students' creativity in the test class circle material is better than the results of students' creativity tests with conventional/class standard learning. The PBL learning model is considered the most suitable for the implementation of Pan Obibul learning media because the PBL learning model is one of the constructivist learning models that can improve students' problem solving abilities (Muhyidin et al., 2013). Problem-solving-based learning that is solved independently by students is proven to increase their learning outcomes scores compared to students who do traditional learning (Abdi, 2014). Daryah (2020) states that the Problem Based Learning model is able to improve students' mathematics learning outcomes.. Gunantara et al. (2014) also stated that the PBL learning model can improve problem solving skills in mathematics subjects.

The validity and advisability of using Pan Obibul's media can be known after the validity test is carried out by the lesson material validator and media validator. In addition, teacher and student responses were also carried out on the developed media. The data collection instrument is on a scale of 1-4. For the advisability questionnaire with information very good, good, not good, and very bad. As for the responses of teachers and students with statements strongly agree, agree, disagree, and strongly disagree. The advisability assessment by the material validator and media expert validator got an average percentage of 88.57% and 94.55%, respectively, which was included in the very proper category. Winarni & Marlina (2020) stated that the media developed was included in

the appropriate category in PBL learning because the media materials used in learning had been adapted to the basic competencies, indicators, learning objectives, and problem-solving steps on learning devices referring to the steps PBL. The validation results from the material validator show that the Pan Obibul media which was developed to improve students' mathematical HOTS abilities through PBL learning, is very proper to be tested with revisions according to comments and suggestions from the material validators. Comments and suggestions from the material validators are 1) Pan Obibul media is made more practical so it can be reproduced easily, 2) Pan Obibul media is easy, very good and creative, 3) the media had been realated with the material being taught.

The responses of teachers and students of grade VI SD in Wedarijaksa District to the Pan Obibul media product trial showed an average percentage of 85.25% and 87.5% with a very proper category. The results of the validation and trial show that the use of instructional media is needed to improve the quality of the teaching and learning process, especially in mathematics. The use of learning media in the form of boards in mathematics has proven effective in improving student learning outcomes. This is in accordance with the results of research by Lestari et al. (2018) which states that the application of the PBL learning model assisted by the chessboard media can improve student learning outcomes as shown in student learning outcomes. Maharani et al. (2018) states that in order for mathematics learning to be conveyed well and accepted by students, so the latest innovations in learning mathematics are needed, which is by using learning media in order to improve students' want to learn mathematics and reduce students' anxiety in learning mathematics.

The ability of addition operations in children with learning difficulties when it is done with the addition board learning media and when not done with the addition board learning media the results increase and are stable. Thus, the addition board media is effective in

increasing the ability of addition operations for children with learning difficulties (Matondang & Martias, 2020). This is in accordance with research Gradini (2019) which states that learning that aims to develop students' HOTS skills must be explicitly designed to help students acquire and use in-depth knowledge, skills, and dispositions to solve higher order thinking challenges. Pranata & Respati (2019) also stated that mathematics teaching and learning activities become more fun when using number cards as the media. Students become more active and enthusiastic when learning because of the media,

so that there is an increase in student understanding as evidenced by an increase in learning outcomes that are included in the high category.

The use of Pan Obibul media which has been through a validation process was carried out in 5 public elementary schools in the Wedarijaksa district to determine its effectiveness in learning. The effectiveness of using Pan Obibul media can be known through the N-Gain Test and t test. The learning outcomes of a student before using Pan Obibul media and after usage can be seen in Figure 4.

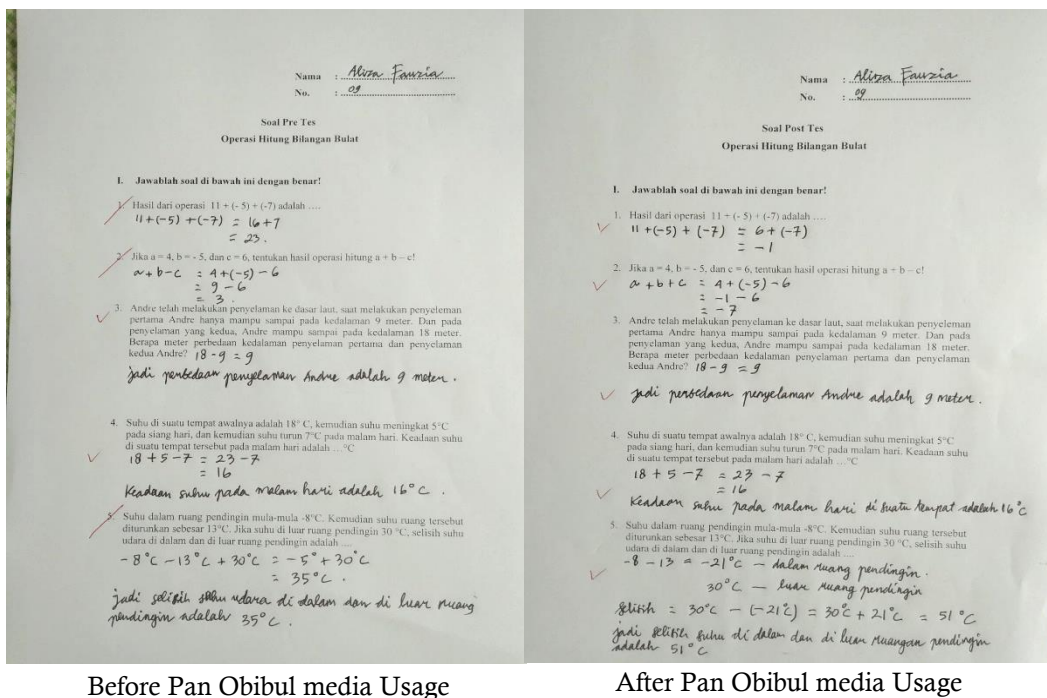


Figure 4. Learning Outcomes of a Student Before And After Using *Pan Obibul* Media

Figure 4. shown to us the difference between student answer before and after learning process using Pan Obibul media. The answer before learning process, show that the student answer the question without evaluate and analysis it. So, the answer's just consist of what is shown in the question and it will caused the answer were incorrect. The answer after learning process, show that the students start to analys and evaluate what is the main purpose of the question. It caused that the answer. Rapih & Sutaryadi (2018) state that in HOTS, students

are required to manage a knowledge at the level of analyzing (Analyze), evaluate and create, so that the reasoning power and critical thinking power of students are needed in HOTS.

The N-Gain test was carried out on product trials to determine the increase in learning outcomes after using Pan Obibul media. The results of the N-gain test using the Pan Obibul media in class VI SD Negeri in Wedarijaksa District can be seen in Table 1.

Table 1. N-Gain Test Result

No	School	Pretest	Posttest	N-Gain	Category
1	SD N Tluwuk	57.273	77.273	0.430	Medium
2	SD N Tlogoharum 01	55.385	75.385	0.76	High
3	SD N Tlogoharum 02	63.889	78.889	0.438	Medium
4	SD N Trangkilan	46.857	75.429	0.430	Medium
5	SD N Bangsalrejo	58.500	79	0.97	Very high
Average of N-Gain				0.606	High

From Table 1. it can be concluded that the use of Pan Obibul media can improve understanding of concepts and ways of thinking with HOTS which is indicated by the average N-Gain value which is included in the high

category. Pretest and posttest values were used for t-test, which aims to determine the effectiveness of using Pan Obibul media. The results of the t test can be seen in Table 2.

Table 2. t-test Result

No	School	Sig score	Category
1	SD N Tluwuk	0,000	Effective
2	SD N Tlogoharum 01	0,000	Effective
3	SD N Tlogoharum 02	0,000	Effective
4	SD N Trangkilan	0,000	Effective
5	SD N Bangsalrejo	0,000	Effective

From Table 2., it can be concluded that the use of Pan Obibul media is effective in increasing understanding of concepts and ways of thinking with HOTS which is indicated by the results of the t-test of the five samples which are included in the effective category.

The results of the N-Gain test and t test indicate that the development of Pan Obibul learning media is effective to be used to improve the HOTS ability of sixth grade elementary school students in learning mathematics. This is in accordance with the research of Safuro et al. (2020) which states that the integer board

learning media is expected to be a support in learning mathematics in grade IV Elementary School. The results of Prastanti F (2021) research on the development of card games also states that card games can be used to train students' numeracy skills. The results of Oktayana Mahardika & Putra (2020) research using card media also stated that the question card media also had a good influence on students' science knowledge competence because in using this question card media students were

required to be alert and able to think critically in reading the instructions and intentions of problem in the questionnaire. So, in the learning process, students become enthusiastic.

The effectiveness of the use of Pan Obibul learning media through the PBL learning model approach to improve HOTS skill is strongly influenced by the teacher's skills in teaching and students' interests during the teaching and learning process. This is in accordance with the research results of Sumarwati et al. (2020) which states that to foster student interest and improve student academic outcomes, the learning process must be a fun process and be able to challenge students to think. The effectiveness of Pan Obibul's media in training how to think with HOTS is really needed, according to the statement of Kurniati et al. (2015) which states that the initial cognitive development of students in mathematics will affect the development of further mathematical thinking and affect the mastery of other subjects. Thus, mathematics education in elementary schools must be able to provide basic mathematical thinking skills in

order to develop students' critical thinking skills because through higher-order thinking skills students are accustomed to in-depth and extensive thinking skills processes that involve processing information critically and creatively in dealing with and solve complex problems and involve skills in analyzing, evaluating and creating (Primayana, 2019).

Teaching and learning activities through the PBL model to train the HOTS way of thinking are in accordance with the statement of Hendriawan & Usmaedi (2019) which states that we can improve thinking skills by understanding processes that involve thinking activities. By getting used to activities that require thinking activity, our brains will be educated and accustomed to thinking. With this habit, it will result in an increase in our ability to think. Ningsih et al. (2019) also states that the application of the PBL learning model can increase the effectiveness of teaching teachers. Mashuri et al. (2019) learning was due to the position of students in PBL that was no longer passive. Mathematics learning that gives access to students to solve math problems freely and allows them to actively observe, find patterns, find the right definition, will make students understand the concepts learned independently and accurately. Students who are trained in solving problems to find a concept and supported by other students will produce meaningful learning (Hidayat et al., 2018). Learning achievement can be seen from the change in the results of personal input in the form of motivation and hope to succeed. Improving student learning outcomes is influenced by many factors, one of which is motivation to learn (Hamdu & Agustina, 2011). Learning that triggers students to think at a higher level requires the use of active student-oriented learning strategies, so that students have the opportunity to observe, ask questions, reason, try, and communicate, this kind of approach is very much in line with the expectations of the 2013 curriculum (Fanani, A., & Kusmaharti, 2014).

This development research has succeeded in proving a mathematics learning media

product in the form of Pan Obibul media which is implemented with a Problem Based Learning approach to improve HOTS abilities in mathematics lessons for elementary students. Pan Obibul media is a mathematics learning media for Integer Operations which consists of 3 parts. The first part consists of positive and negative boards, the second part consists of numbers, and the third part consists of question cards. The development of learning media for mathematics has been carried out by Andhani (2019) previously in the form of a Number Line Board. The difference between the Pan Obibul media and the Number Line Board lies in its form and how it is used. In addition, the Number Line Board media only affects students' understanding of the concept of integer arithmetic operations, while in Pan Obibul media, students are also trained to improve their HOTS abilities. Prastanti F (2021) also developed learning media in almost the same form as the "Plumi CV" Card Game. The difference between Pan Obibul media and Plumi CV lies in its manufacture and function. The Obibul Pan has a simpler shape than the Plumi CV making it easier to build. In addition, Plumi CV has proven to be effective in learning mixed integer arithmetic operations without training students' HOTS abilities. Pan Obibul media has better benefits because it is proven to be able to increase students' HOTS abilities. The development of learning tools to develop students' HOTS abilities was also carried out by Susanto & Retnawati (2016). The tools developed are in the form of lesson plans and worksheets without any other learning media that can help improve students' HOTS abilities such as the Pan Obibul media.

CONCLUSION

The results of developing Pan Obibul learning media obtained a advisability assessment by the material validator and the media expert validator getting an average percentage of 88.57% and 94.55%, which are included in the valid category. The responses of teachers and students of grade VI elementary

school in Wedarijaksa District to the Pan Obibul media product trial showed an average percentage of 85.25% and 87.5% with a very proper category. The results of the t-test on the use of Pan Obibul media obtained a significance value of 0.000, so it can be said to be effective. From these results, it can be concluded that the development of Pan Obibul media to improve the mathematics HOTS abilities of elementary school students through a Problem Based Learning learning approach obtained Pan Obibul media that is valid, practical, and effective in learning mathematics.

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