

Effectiveness of Developing Contextually Based Multiplication Bottle Learning Media to Improve Student Multiplication Ability

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Abstract: The aim of this research is the effectiveness of contextual-based multiplication bottle learning media to improve the multiplication abilities of 2nd grade elementary school students. This research uses a research and development *approach*. The research and development procedure refers to the Borg & Gall development model which consists of 10 steps. The subjects in this research were all 2nd grade students and teachers in 4 elementary schools, namely SDN 1 Labuhan, SDN 2 Labuhan, SDN 1 Sendangmulyo, SDN 2 Sendangmulyo, in Sluke District, Rembang Regency in the odd semester 2022/2023. Data collection techniques use observation, questionnaires, interviews, documentation and tests. The data validity test consists of product validity and independent validity tests. Meanwhile, data analysis techniques test prerequisites for analysis (normality and homogeneity tests) and hypothesis tests (independent sample t test and Wilcoxon test). The results of research on needs analysis through observation and interviews found that teaching media was not in accordance with students' needs, so media needed to be developed contextually based multiplication bottle learning to improve students' multiplication abilities. The choice of media and format for materials and the production of initial versions underlie the main aspects at the design stage. The learning tools referred to in this research are limited to the lesson plan (RPP), used bottles and evaluation questions. Media expert validation obtained a total score of 3.58 (very good), material expert validation obtained a score of 91.6% (valid). The teacher's response received a score of 90% (very decent) and the student's response was 88% (very decent). The results of the limited trial analysis obtained a Sig. value (2-tailed) < 0.05 . Extensive trials obtained a sig value of $0.000 < 0.05$. The conclusion of this research shows that the development of contextually based multiplication bottle learning media is effective in improving students' multiplication abilities.

Keywords: Learning media, multiplication bottle, mathematics

1. Introduction

Education is an effort to obtain learning in order to become a better human being (Afrianti et al., 2018). The learning process is an effort to make students learn, that is, changes in behavior can occur because there needs to be interaction between students and their environment. The learning process is essentially an interaction between students and the object being studied (Anwar, 2017). Activities to improve students' skills and development that are directly related to the material are called learning activities. Mathematics subjects are defined as counting lessons which are always related to numbers. Mathematics is needed for daily activities in solving problems. Mathematics is studied in schools to equip students with several competencies including the ability to think logically, analytically, systematically, critically and creatively as well as the ability to work together (Adegbiya & Fakomogbon, 2012). Mathematics can improve counting skills in everyday life through counting games (Balakrishnan et al., 2007).

Learning mathematics is a mandatory or basic subject at elementary school level. Mathematics learning is given at all levels of education listed in the curriculum, carried out to equip students with the ability to think logically, analytically, systematically, critically and creatively as well as forming independence and the ability to collaborate. Learning mathematics can have an influence in building the character of elementary school students, namely by training students

to behave honestly in doing exercises, independently in answering questions, working hard in calculations, democratically in carrying out agreements (Anggo, 2011).

Mathematics is a subject taught in Indonesia from elementary school to university and can be used as a benchmark for passing students who are tested in the national exam (Fauzan & Arnawa, 2020). One of the basic competencies in mathematics, especially in class II elementary school, is that students can count, the main goal in the counting process is to build logic and mentality, counting is one of the means of training and all its components to have life skills that will be used throughout life. . Almost all areas of life use the ability to count. Numeracy ability is the ability to carry out calculations, such as adding, subtracting, dividing, multiplying using the ability to manipulate numbers with reasoning and understanding (Nosa et al., 2022).

Based on initial observations made by researchers on December 12 2022 in Class II of SD Negeri 1 Labuhan, Sluke District, Rembang Regency, in the mathematics learning process, it shows that the ability to do multiplication is still low, this can be seen from several of the teacher's questions about simple multiplication given to students, almost all of them are not answered by students. Another finding is that when learning multiplication students still use the memorization method. The teacher gives the task to students to memorize multiplication so that students do not know the concept of multiplication actually. So, that students have difficulty understanding and mastering the concept of multiplication, students lack calculation skills.

The problem is that students experience difficulties in mathematics lessons so that they do not achieve the basic competencies that have been determined. Students have difficulty answering math questions given by the teacher or questions in student worksheet books. Difficulties in mathematics lessons, especially in multiplication operations, experienced by students are caused by the absence of learning media that supports the learning process . So we need media that is able to help students understand the learning material, so that the learning material is received more quickly by students in full and attracts students' interest in learning further.

Concepts in mathematics are abstract, while elementary school students think from concrete things to abstract things, so one bridge so that students are able to think abstractly about mathematics is to use educational media and teaching aids (Deak & Santoso, 2021). The use of learning media in the teaching and learning process can foster new desires and interests, generate motivation and stimulation for teaching activities, and even have an influence on the characteristics of students (An, 2021). Learning sources and media can be obtained in any form, as long as they still contain elements of developing students' abilities in understanding learning concepts or materials, because media is one component of the learning process (Vinnie et al., 2021).

elementary school (SD) children when viewed from the stages of cognitive development according to Piaget (1974), children aged between 7 and 12 years are in the concrete operational period. Therefore, learning for class II students in elementary schools must use real objects in the environment around the students so that learning is better understood by students (Schaffer, 2004). Teachers in managing their classes must be more creative and innovative. Choosing the right learning model and media will make students more active and enthusiastic in learning. So that learning becomes more meaningful for students. Mistakes in using media can hinder the achievement of the desired educational goals. To overcome this problem, a teacher is required to design a media (Prihatin et al., 2024). Using appropriate media can increase students' interest in learning. One of the media in mathematics learning that can support the learning process is the multiplication bottle learning media .

The problems found in this research include the low ability of class 2 students in multiplication because the teacher uses the rote method in teaching. Teachers only assign students to memorize multiplication so that students do not know the real concept of multiplication. So students have difficulty understanding and mastering the concept of multiplication, ultimately students lack calculation skills. Apart from that, teachers in teaching do not use media, even though for the characteristics of low class students, objects or media are needed to be able to concretize abstract material. Therefore, teachers must be creative and innovative in creating learning that is fun and attracts students' attention. One way is to use the development of a contextual learning model. Contextual learning is a learning system that can enable students to grasp the meaning of the teaching material being studied and relate new learning material subjects to contexts that relate to students' real lives. So contextual-based multiplication bottle learning media was developed. Contextual-based multiplication bottle learning media is expected to be able to create a pleasant learning atmosphere and students will be active in the learning process , so that students are able to understand the lesson material well.

The development of this multiplication bottle media is a development of the congklak game media so that it is easy to use and make. The development of this multiplication bottle media is adapted to the lesson material. The following is a diagram of the contextual-based multiplication bottle media thinking framework. The aim of this research is to analyze the effectiveness of media development contextually based multiplication bottle learning to improve the multiplication abilities of 2nd grade elementary school students.

2. Methodology

Research and Development research design which consists of 10 steps; Research and Information Collecting, planning, Develop Preliminary Form of Product, Preliminary Field Testing, Main Product Revision, Main Field Testing, Operational Product Revision, Operational Field Testing, Final Product Revision, Dissemination and Implementation.

The 2nd grade students and teachers in 4 elementary schools, namely SDN 1 Labuhan, SDN 2 Labuhan, SDN 1 Sendangmulyo, SDN 2 Sendangmulyo, in Sluke District, Rembang Regency in the odd semester 2022/2023. The sampling technique is *purposive sampling*. Research instruments include interviews, observations, questionnaires, tests and product validation instruments. Quantitative and qualitative data analysis is descriptive.

3. Results and Discussion

The results of the research found that based on the needs analysis, it was discovered that the implementation of learning had not used learning media that suited students' needs to develop mathematical reasoning. Therefore, it is necessary to develop contextual-based learning media for multiplication bottles. The development of this learning media is adapted to the analysis of core competencies and basic competencies of elementary school students in learning multiplication. The aim of the design stage is to design learning devices. Activities at this stage can be carried out after finding the behavior objectives for the learning tools. The choice of media and format for materials and the production of initial versions underlie the main aspects at the design stage. The learning tools referred to in this research are limited to the Learning Implementation Plan (RPP), used bottles and evaluation questions. The next stage is creating a theme, namely calculating operations, determining goals to improve multiplication skills and creating designs.

Previous research stated that the learning media that students need is multiplication bots. Tolkama learning media is an interactive learning media that can be useful for increasing understanding of the basic concepts of multiplication in grade 2 elementary school students. Tolkama learning media itself is made from used goods, namely used drinking bottles and used cardboard. Apart from that, decorative paper or colored markers can be used to beautify the shape of the tolkama media (Attalina & Irfana, 2020). Development research in the develop stage is carried out by creating media adapted to existing material according to the lessons learned. The first stage in making is making a circle or circle which is the basis for the multiplication medium. After that, write the existing multiplication material onto the multiplication circle media which has been formed into a circle and then color the media (Tarigan, 2020).

Previous research stated that to answer the problem analysis by developing Multiplication Bottle Learning Media (Bolian) to improve Mathematics learning outcomes. Therefore, it is necessary to use learning media in the form of Multiplication Bottle Media (Bolian) so that it can make students more enthusiastic and make it easier for students to understand the material. Students also do not feel bored because they learn while playing, so they can improve students' skills in solving problems because students are directly involved in solving the problem (Nosa et al., 2022). Other research found that media development was done by creating Multiplication Bottle Learning media (Bolian). Multiplication Bottle Learning Media (Bolian) is a learning media that uses used bottles and plywood as the main materials. Multiplication bottle learning media is an interactive learning media that can be useful for improving the basic concept of multiplication in class III elementary school students (Zumrotun & Attalina, 2020).

In the development stage, an assessment of the multiplication round media was carried out through 3 stages, namely media and material experts, as well as one to one and small group field tests. This research at the media expert validation stage resulted in the total score reaching 3.58, so that based on the media expert validation score table it was categorized as valid (very good). Apart from that, material expert validation obtained a result of 91.6% with a valid predicate, so the development of contextual-based multiplication bottle learning media to improve students' multiplication abilities is suitable for use in the mathematics learning process, especially on the theme of multiplication. Previous research on media development found that testing the validity of the Multiplication Bottle (Bolian) game media was included in very good, which means it was valid in the validation of the three validators for the media. average 0.83 (Nosa et al., 2022).

The results of the questionnaire regarding responses to the development of contextual-based multiplication bottle learning media based on teacher responses showed that the number of positive responses was 36 out of 40 points, which means the percentage was 90% in the very feasible category. Meanwhile, student responses showed positive responses obtained with a total score of 44 out of 50 so that the percentage of positive responses was 88% with a very feasible category. This is supported by previous research that the results of the questionnaire submitted to students received positive answers where students enjoyed learning while playing using the Multiplication Bottle (Bolian) media and students more easily understood or comprehended the material presented by proving the results of the student response questionnaire. The results obtained from the teacher practicality score were 95.67%, while the average results from teacher and student practicality were 95.45% (Nosa et al., 2022).

Previous research found that validation tests were carried out at the development stage. The aim of this assessment is to determine the suitability of the media that has been created. Media is said to be worthy if the validator has rated the media as worthy or unworthy. At the assessment stage carried out by experts and field tests using instruments in the form of questionnaires and interviews. The suggestions given will be used as improvements for the multiplication round media. The overall validation of the multiplication stacking media got 4.1 out of 5, which means it is included in the appropriate criteria and then after it has been corrected based on validation of the media and material, it is then entered into one to one and small group field tests until it gets an appropriate (preferred) score. The results of student questionnaire responses showed good responses to the media that was developed and suitable for use. Judging from the results of student responses, the average shows that students are happy to use learning media in the learning process so that they do not require revision, which then requires learning media at the field test stage (Tarigan, 2020).

The results of the limited trial research obtained an average pretest score for the control class of 5.1, the highest score was 6, the lowest score was 4. Meanwhile, in the experimental class the average was 5.8 with the highest score being 7 and the lowest score being 4. The *posttest* score for the control class got an average score of 5.2 with the highest score being 6, the lowest score being 3. Meanwhile, the experimental class got an average score of 7.2 with the highest score being 9 and the lowest score being 7. The results of the analysis got a Sig. (2-tailed) of $0.000 < 0.05$. The decision is that H_0 is rejected and H_a is accepted because of Sig. (2-tailed) < 0.05 and $t_{\text{count}} > t_{\text{table}}$. This means that there is a significant increase in students' multiplication abilities after using contextual-based multiplication bottle learning media. This is supported by previous research which found an increase in scores before and after the application of the media. The increase occurred by 20% from 33 students. This shows that the multiplication stacking media that researchers have developed can have a potential effect on learning outcomes for students' reading comprehension abilities (Tarigan, 2020).

The results of extensive testing showed an increase in the average pre-test and post-test scores. The average pretest score was 5.17 and the average posttest score was 8.7. The results of the analysis obtained a sig value of $0.000 (< 0.05)$, so H_0 was rejected and H_a was accepted, namely the development of contextually based multiplication bottle learning media is effective for improving students' multiplication abilities. Previous research found that the results of evaluating learning to calculate multiplication in mathematics lessons using nearby objects as a medium increased learning activities, increased interaction between students and group cooperation, and increased students' understanding of multiplication and division so that students' calculation abilities were higher (Wati & Purwanti, 2022). Another study found that the level of effectiveness of the Multiplication Bottle (Bolian) media certainly had a positive answer determined from the pretest and posttest scores or results with an average score of 79%. These results indicate that the development of Bolian media is effective in improving students' abilities (Nosa et al., 2022).

Similar research also found that the use of learning models assisted by learning media can be effective in increasing understanding of basic mathematical concepts in elementary school level students. When using learning models and media, you must of course pay attention to the characteristics of the students who will be taught, and of course they must be appropriate to the material being taught so as not to make things difficult for students. For this reason, we hope that the use of the PBL learning model assisted by TOLKAMA media can increase understanding of the basic concepts of multiplication for grade 2 elementary school students (Attalina & Irfana, 2020). Zumrotun and Attalina's research on the use of smart mathematics bottle cap learning media to improve mathematics learning outcomes has reported that bottle caps are an effective medium for teaching number operations material, including multiplication (Zumrotun & Attalina, 2020).

Learning using a scientific approach means that learning is carried out scientifically, in a scientific approach it can be believed to be a point of development and development of students' attitudes, skills and knowledge. The scientific learning approach is part of the pedagogical approach to implementing learning in the classroom which underlies the application of the scientific method. Learning mathematics using nearby objects stimulates students' courage so that feelings of inferiority and fear for certain students will disappear, motivating students to be more active in learning, so that learning becomes more alive, and giving students the freedom to be creative in completing assignments (Tarigan, 2020). Other research states that teaching aids (pebbles) are effective in helping students in mathematics lessons, especially multiplication operations (Sugita, 2018).

4. Conclusion

The development of this learning media is adapted to the analysis of core competencies and basic competencies of elementary school students in learning multiplication. Activities at this stage can be carried out after finding *the behavior objectives* for the learning tools. The choice of media and format for materials and the production of initial versions underlie the main aspects at the design stage. The learning tools referred to in this research are limited to the Learning Implementation Plan (RPP), used bottles and evaluation questions. The next stage is creating a theme, namely calculating operations, determining goals to improve multiplication skills and creating designs. In the media expert validation stage, the result was that the total score had reached 3.58, so that based on the media expert validation score table it was categorized as valid (very good). The results of the response questionnaire for the development of contextual-based multiplication bottle learning media based on teacher responses showed that the number of positive responses was 36 out of 40 points, which means the percentage was 90% in the very feasible category. Meanwhile, student responses showed positive responses obtained with a total score of 44 out of 50 so that the percentage of positive responses was 88% with a very feasible category. The results of the limited trial were that *the pretest score* for the control class averaged 5.1, while the experimental class averaged 5.8. The control class *posttest* score averaged 5.2, the experimental class got an average score of 7.2. The results of the analysis get a Sig value. (2-tailed) of $0.000 < 0.05$. The decision is that H_0 is rejected and H_a is accepted because of Sig. (2-tailed) < 0.05 and $t_{\text{count}} > t_{\text{table}}$. This means that there is a significant increase in students' multiplication abilities after using contextual-based multiplication bottle learning media. The results of extensive trials showed an increase in the average *pre-test* and *post-test scores*. The average *pretest score* was 5.17 and the average *posttest score* was 8.7. The results of the analysis obtained a sig value of $0.000 (< 0.05)$, so H_0 was rejected and H_a was accepted, namely the development of contextually based multiplication bottle learning media is effective for improving students' multiplication abilities. The recommendation of this research is that the application of contextually based multiplication bottle learning media can be one solution among alternatives in mathematics learning

to improve students' multiplication abilities. The teacher's creativity in presenting mathematics learning by applying more interesting, contextually based multiplication bottle learning media will not cause boredom for students during the learning process. Teachers should provide clear directions to students so that there is no confusion during learning by using contextual-based multiplication bottle learning media and monitoring student activities during learning.

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Conflict of Interest

The authors declare no conflicts of interest

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