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MATHEMATIC FINGER GAME OPERATION OF COUNTING MULTIPLICATION WITH OPEN-ENDED APPROACH FOR ELEMENTARY SCHOOL STUDENTS

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Abstrak: Penelitian ini bertujuan memberikan solusi alternatif melalui pembelajaran interaktif bagi siswa sekolah dasar untuk meningkatkan kemampuan operasi hitung perkalian menggunakan *mathematic finger game*. Siswa kelas tinggi sekolah dasar (kelas 4, 5 dan 6) sebagai subjek penelitian. Metode pengembangan melalui tahapan identifikasi tujuan, analisis kebutuhan, identifikasi perilaku siswa, merumuskan tujuan, pengembangan test acuan kriteria, pengembangan strategi pembelajaran, pengembangan dalam memilih media pembelajaran, dan evaluasi. Perpaduan tiga permainan jari yaitu Hompok, suit Indonesia dan suit Jepang menjadi *Mathematic finger game* yang dikaitkan dengan operasi hitung perkalian. Permainan dikemas menjadi pembelajaran interaktif berpendekatan open-ended dengan melibatkan kemampuan berpikir kreatif dalam menjawab sesuai kebebasan berpikir terarah serta kemampuan berpikir kritis dalam memberi dan menerima masukan atas jawaban penyelesaian masalah yang dapat diterima secara logis.

Kata kunci: *Mathematic finger game*, *Open-ended*, Kreatif dan Kritis

Abstract: This study aims to provide an alternative solution through interactive learning for elementary school students to improve multiplication arithmetic operations using mathematical finger games. Elementary school high grade students (grades 4, 5 and 6) as research subjects. The development method is through the stages of identifying goals, analyzing needs, identifying student behavior, formulating goals, developing criteria reference tests, developing learning strategies, developing in selecting learning media, and evaluating. The combination of three finger games, namely Hompok, Indonesian suits and Japanese suits, becomes a Mathematical finger game associated with multiplication counting operations. The game is packaged into interactive learning with an open-ended approach by involving the ability to think creatively in answering according to the freedom of directed thinking and the ability to think critically in giving and receiving input on logically acceptable problem solving answers.

Keywords: *Mathematic finger game*, *Open-ended*, Creative and Critical

Preliminary

Mathematics is a structured deductive logical science by inductively teaching elementary school students. Starting from a simple concept to a complex concept into a structured part of mathematics. The basic concept must be accepted and understood the earliest by students (numbers, basic arithmetic operations), developing concepts train students to think to solve in other ways and do not conflict with basic concepts (commutative, associative, distributive),

and the concept of trying to solve math problems related to with activities in life (Mursidik & Ambarwati, 2021).

The development of communication tools, especially gadgets, has a positive and negative impact on student development. On the positive side, it is easy to interact for discussions between students at a distance, but the negative is the high frequency of using gadgets to play games. This has an impact on student learning progress, so that high-class students find it difficult to do the

multiplication count process and only use individual memorization. Some teachers also assign students to memorize multiplication count operations which make students overwhelmed and think of mathematics as rote (Mursidik & Ambarwati, 2021).

The use of non-interactive learning methods needs to be balanced with interactive learning. Although this method is useful and makes it easier to understand the multiplication count operation, there is no discussion interaction between friends in learning activities who provide input with criticism and train creative thinking in providing a solution. This means that the learning method only makes it easier for himself (Mursidik & Ambarwati, 2021).

Open problem solving is a must in mathematics education. Every time mathematics raises an open problem so the introduction of the type of mathematical problem brought to the classroom brings it closer to real mathematics (Cifarelli & Cai, 2005). Several mathematicians have made extensive use of the open-ended approach, besides that students are able to try to develop their potential in providing solutions. Creative and critical problem solving should not be ignored starting from basic education or higher education so that students must have the opportunity to solve mathematical problems creatively, but in fact they often do not have the opportunity to try. (Yaftian, 2015). Collaborative learning is proven to be one way to improve students' social skills, problem-solving abilities and individual learning performance (Cheng et al., 2019).

In thinking there are activities of ascertaining, designing, calculating, measuring, comparing, classifying, distinguishing, relating, interpreting, predicting, evaluating, analyzing, synthesizing, reasoning, weighing, and

deciding. Thinking means trying mentally to understand something that is experienced or looking for solutions to the problems at hand (Mursidik et al., 2015). The creative thinking competence of students is still directed divergently but requires investigative activities in solving mathematical problems from various different perspectives with the same goal. In contrast to the basic skills of learning mathematics which are usually formed through convergent activities. Elementary mathematics lessons require that reasoning (reasoning), problem solving (problem solving) and communication (communication) are competencies that must be mastered by students (Mursidik et al., 2015). Simply put, thinking is the process of generating ideas internally in the mind that involves some knowledge in the cognitive system that can be observed, directed and produces behavior that attempts to generate solutions.

This study discusses the usefulness of interactive mathematical finger game learning with an open-ended approach to the multiplication arithmetic ability. Familiar game collaboration helps understand the basic arithmetic operations needed as a group, especially to overcome student learning difficulties.

Finger game

Perceptual support and parental guidance on children's numeracy skills after playing games together. The joy and excitement of children about numeracy operations can easily be put in the context of daily routine activities. So that parents only receive reports of learning progress every time there is a change in numeracy skills after the children play together. Children's math performance during game matches can show enthusiasm for learning and winning (Vandermaas-Peeler et al., 2012).

Problem construction and learning objectives are built by children related to



different understanding abilities to achieve them together, so it is necessary to have rules so that children play in a similar and mixed configuration of abilities. (Guberman & Saxe, 2000). The diversity of students' initial abilities in learning to count provides interesting dynamics during the game so that high-ability students will give correct answers quickly compared to students with moderate and low abilities.

The rules in a game provide the order that will be used to take the form of children's play and divide the roles of players so that the game can be played according to learning objectives (Guberman & Saxe, 2000). Purpose of rules are used to determine who does the first activity and continues with the next activity with the same or a different child.

Open-ended approach

The learning process in finding the right answers to problems in learning must be the main to provide new experiences in an effort to find answers. The process is carried out through various combinations of knowledge, skills and ways of thinking that have been previously learned. Learning with an open-ended approach is an open problem to be solved by students with different knowledge, ways, and methods in answering the problems given (Mursidik et al., 2015). The conceptual progress of open-ended problem solving is continuously shaping and reformulating in order to develop solutions. Intellectual freedom in the open problems experienced is a temporary solution to see the problem solving directly which is directed to see and consider new ideas and approaches that can lead to solutions (Cifarelli & Cai, 2005). The open-ended approach is believed to be able to encourage students to carry out creativity and innovation in students' mathematical thinking in a more varied manner (Rudyanto et al., 2019).

The learning process with an open-

ended approach is able to provide encouragement to students to think openly, critically, cooperate, and competently solve problems as well as communicate logically and argumentatively. The open-ended approach is done by presenting the problem with the correct answer in more than one way to get the right answer, so that students freely use their ideas, abilities, and skills. In addition, the open-ended problem solving approach is able to train students to reason and communicate their ideas in clarifying the reasons related to the answer.

Mathematics in Primary Schools

Mathematics is a universal discipline that continues to develop as well as basic science in various disciplines to advance human thinking in life. Learning mathematics requires basic mastery of the ability to think systematically, critically, analytically, logically, and creatively and fosters the ability to work together towards the dynamics of competitive life according to the times. BSNP (2007: 11) explained that the objectives of mathematics lessons are: (1) understanding concepts and explaining the relationship between concepts and applying concepts or algorithms, in a flexible, accurate, efficient and precise manner, in problem solving; (2) using reasoning patterns and properties, manipulating in making generalizations, compiling evidence of mathematical statements; (3) the ability to understand problem solving, design and solve models and interpret solutions; (4) communicating ideas with symbols, tables, diagrams, or other media to clarify the situation or problem; (5) Having an attitude of appreciating the usefulness of mathematics in life by having curiosity, attention, and interest in learning mathematics, as well as being resilient and confident in problem solving.

The general objective of mathematics focuses on the structuring of reasoning and the formation of mathematical attitudes and application skills. Furthermore, the specific objectives of elementary school mathematics are: (1) growing and developing numeracy skills in everyday life, (2) fostering student abilities that can be transferred through mathematical activities, (3) developing basic mathematical skills as a provision for further learning, (4) forming a logical, critical, careful, creative and disciplined attitude (Wandini & Banurea, 2019).

Numeration is not only the ability to count, but the ability to apply abstract or real numeracy concepts, because these are two important fundamental areas in all subjects that can only achieve real learning if you can understand the logic of literacy and numeracy. (Putranto & Daniswar, 2019). Numerical literacy is a part of mathematics. The numeracy literacy component is taken from the scope of mathematics in the 2013 Curriculum. (table 1)

Table 1. Numeration Literacy Components in the Scope of Mathematics Curriculum 2013

Components of Numeration Literacy	Mathematics Curriculum 2013
Estimating and counting with integers	Number
Use fractions, decimals, percentages, and comparisons	Number
Recognizing and using patterns and relationships	Numbers and Algebra
Using spatial reasoning	Geometry and Measurement
Using measurement	Geometry and Measurement
Interpret statistical information	Data processing

(Han et al., 2017)

Mathematical literacy is the ability to understand and use mathematics in solving life problems through problem posing, problem solving, and mathematical investigations based on problem solving (problem solving), real learning (realistic mathematics education) or contextual (contextual). teaching-learning), as well as using an open-ended approach (Abdussakir, 2018).

Illustration of learning mathematics in elementary schools is strived concretely and contextually with an open-ended approach so that it can make interactive learning between students that can be implemented in the family, school and community environment.

Subjects and Research Methods

The research subjects were high grade elementary school students. The research stages include: (1) Identification of learning objectives by determining student expectations of improving multiplication arithmetic operations; (2) Needs analysis by identifying students' needs in facilitating learning multiplication arithmetic operations; (3) Identification of the actions of high-class students towards activities inside and outside the classroom; (4) Formulating learning objectives according to the analysis of student needs and activities; (5) Developing criteria reference tests by making mathematic finger game guides; (6) Development of learning strategies according to needs analysis and identification of actions to carry out learning in other ways; (7) Developing and selecting learning media tailored to the learning strategy; (8) Designing and conducting evaluations to obtain information on increasing the multiplication arithmetic ability.

Results and Discussion

The results of the study are basically the answers to the problems formulated,

namely the benefits of interactive learning using mathematical finger games on mathematics learning outcomes in multiplication arithmetic operations. The research results are as follows:

1) Identification of the initial objectives of learning obtained information about the expectation of learning achievement in mathematics in mastering the multiplication arithmetic operation ability to provide support for students' understanding of numeracy competences that must be mastered by elementary school students.

2) The results of the instructional analysis of learning show that in mathematics learning, elementary school students are required to be able to understand, understand and perform multiplication count operations to facilitate the process of understanding related mathematics material and even have to be applied in real life.

3) The findings of behavioral identification and initial characteristics show that elementary school students learn to master multiplication count operations using various methods independently by memorizing / memorizing but there has been no interactive learning with their friends. This is done because it requires the competence attainment of calculating ability, especially in the multiplication operation.

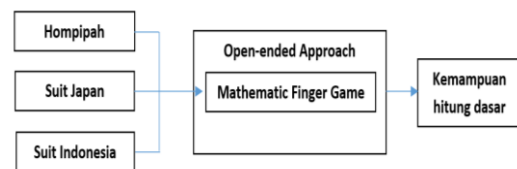
4) Based on the results of instructional analysis and information on initial behavior, it is formulated that to improve the multiplication arithmetic operation skills, an interactive way of learning is needed. Interactive learning by combining hompipah games, Indonesian suits (elephant, people, ants) and Japanese suits (scissors, rocks, paper) which are modified for math games. The game is expected to help students learn multiplication arithmetic operations interactively;

5) The benchmark reference test is designed in the form of a mathematic finger game guide (table 2). In this game, there is a test to measure the multiplication count ability that must be achieved by students. In this game, students will interact and compete to become winners so that the winners have higher calculation skills than the losers, while the students who lose will try to reflect on their weaknesses to try to improve their ability to become winners.

Table. 2. Reference numbers in mathematic finger game on multiplication operations

Class	Number	Information
4	Natural	2 student
5	Natural	2 more students
	Whole	2 student
6	Whole	2 more students
	Integers	2 student

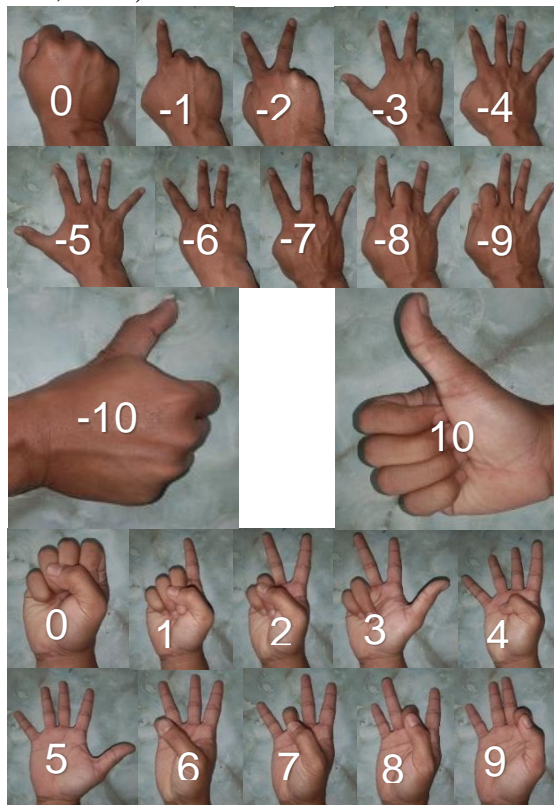
6) Develop learning strategies. The learning strategy with mathematic finger game is based on the needs and demands of students to master multiplication counting operations. This strategy is adapted to the habit of elementary school students playing with their friends outside of class hours or free hours. With this game, students can take advantage of time outside of class hours to learn basic arithmetic operations. This game was tried out on elementary school students in the research environment and the results were obtained that students can practice and attract attention to continue trying to be a winner.



Picture 1. Development thinking framework

7) Developing and selecting learning materials. Developing material on

numbers and arithmetic operations that can be played in this game and adapted to the level of student ability. Material numbers and arithmetic operations in this game are grouped according to learning outcomes based on class levels. This game uses number symbols from sign language which is a medium of communication to make the brain more active and also help develop interaction, social maturity, and cognitive development. Language is a human ability that is used to communicate with other humans with signs, either signs or movements (Krisnan, 2017 ; Basuki, et. al, 2016)



Picture. 2. Numeral symbols using fingers

Research Results and Discussion

Mathematic finger game is a combination of three familiar traditional games, namely "Hompipah, Suit Indonesia and Suit ala Japan". The game requires at least two direct interactions with individuals. Hompipah is a hand game that uses the front and back sides of the palm to determine the winner. Indonesian

or Japanese suit is a finger game by two people to determine the winner using their fingers. can be played by all ages. The Indonesian-style suit consists of three choices, namely elephant (thumb), human (index finger) and ant (little finger), while the Indonesian style suit consists of scissors (index finger and middle finger), stone (all fingers clenched) and paper (all fingers open).

The game modification (Mathematic finger game) functions as a learning activity that needs to be improved and updated its rules if used in mathematics learning activities. Games can be an interactive activity between students who give and receive criticism. This game is expected to be able to form an attitude of mutual respect for the opinions of others and to train students' creative thinking skills in answering questions directly using their own way.

The number system is a language that contains a set of symbolic messages in the form of numbers with the limitation of addition, multiplication and other arithmetic operations (Wuriyaningsih, 2014). The basic principles in the game according to the number system are: (1) the set of numbers being discussed; (2) counting operations performed and (3) answers to the results that must be searched and found. The revised rules are: (1) The game uses a number symbol of 5 fingers (thumb, forefinger, middle finger, ring finger and little finger); (2) There are at least 2 players and can be played in groups; (3) The game is associated with the multiplication count operation; (4) Win or lose in this game is determined by the speed of answering and the number of answers. Even though the player can answer the first time but the answer is wrong, the player loses and is followed by the next player to get the answer right.

Conclusion

The results of developing a mathematical finger game with a combination of three different finger games provide positive benefits to students' interest in trying to be a winner so that this game can be used to improve multiplication counting skills. This game can be adapted to the competence of the high class about natural and counted numbers, and can use integers as an introduction to deepening stage. The thing of concern is that learning the multiplication arithmetic operation does not have to be done in the classroom during class hours but can be done in a fun way for students. This activity can be done by students, teachers or parents wherever and whenever the time.

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