



Early Childhood Arithmetic Learning Assisted by Marble Game Media

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Abstract. Arithmetic is the ability of every child in mathematics, such as activities to order numbers, count, and recognize numbers, to develop skills necessary for everyday life. This ability is the basis for developing mathematical skills and readiness to attend basic education. This research was conducted at the kindergarten level because many young children were not fluent in numbers and counting, especially in Group A. Most children were affected by the pandemic, so they had to study at home and not enter the playgroup beforehand. Marble Game is a media application that makes it easier for children to learn to count effectively in kindergarten. This study aims to determine children's arithmetic skills in kindergarten and children's arithmetic skills before and after using the Marble Game application media. The research method was factual and accurate, and systematically arranged. Data was collected qualitatively by observing the school principal to find learning media to identify the ability to count and recognize numbers in Group A and B children. Interviews were conducted with group B class teachers to determine the ability to count in group B children and how the children were prepared to continue to the basic level. Classroom practice was conducted for two weeks to determine the difference in the ability to count in group A and group B children before and after using the Marble Game application. Documentation was done during practical activities in class. The Marble Game application is considered effective because it has several levels according to the children's abilities and age, so it is more fun and attracts the children's attention and focuses when learning to recognize numbers and count. Marble Games Games in learning are considered effective in improving children's arithmetic skills, shown by the increase in the ability of Group A children to write numbers correctly.

Keywords: arithmetic · early childhood · marble game

1 Introduction

Early childhood is a group of children between the ages of 0 and 8 years, according to the National Association of Education for Young Children (NAEYC) classification, an organization that focuses on child development in the United States. At this time, parents or families must pay attention to every child's development by always providing stimulation to increase their potential. Early childhood experiences a very rapid and fundamental phase of growth and development to obtain education [1].

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Early Childhood Education (ECE) is the level of education for children aged 2 - 6 years. This program aims to stimulate children's physical and psychological development. ECE is an important educational stage because children are at a golden age in starting their brain or motor development to prepare for further education [2].

One aspect of ability that needs to be developed in ECE is the cognitive aspect. Cognitive is a person's thinking ability to solve problems appropriately and wisely. This ability can be cultivated in children so they can think logically when faced with a problem case. Cognitive development efforts in children can be made by introducing and understanding the number shapes, numerals, and symbols. A child's cognitive ability or analytical power includes several aspects: audio, visual, kinesthetic, science, and arithmetic. Arithmetic is an aspect of cognitive development introduced and honed in educational institutions through arithmetic programs [3]. Basic arithmetic learning aims to introduce children to number shapes. Children learn arithmetic components at the ECE level, including knowing and saying numbers and basic arithmetic operations such as adding and subtracting real objects [4]. The achievement of basic arithmetic is the ability to sort numbers 1 to 10 for four years old children and sort numbers 1 to 20 for 5-6 years old children [5, 6].

The 2013 ECE curriculum targets several aspects of arithmetic that must be mastered by early childhood, such as the ability to say numbers 1 to 10 and determine number names from symbols or vice versa. The arithmetic stage begins with introducing numbers through the number of objects in the surrounding environment. The learning process is also fun. The next stage is basic operations with abstract numbers. When the child ages six years, the concept of addition and subtraction begins to develop [7].

Arithmetic learning provides benefits for early childhood, including introducing the basic concepts of mathematics with fun methods according to the environmental conditions around the children. These conditions allow children to learn naturally to feel more prepared and accustomed to arithmetic. The higher the child's analytical ability, the wiser they are in solving a problem. Introducing arithmetic to children will provide capital for children in the form of basic math skills to solve everyday problems and become the first step to studying mathematical concepts in more depth at the next level of education [8].

The initial arithmetic concept is carried out using a simple and fun method so that it is easily accepted and understood by children. Fun conditions can be created by inserting a game concept [9]. Children play as a form of exploration of the surrounding environment, learn alternative ways of playing, and train their motor skills to be faster and more responsive when faced with a challenge. Combining learning and playing is effective and does not make children feel bored [10]. The learning process combining play and learning has been widely applied at the ECE level because it has increased children's understanding and activeness [11].

The problem with the learning process is that children are less interested in and understand the arithmetic activities taught by the teacher. The reasons can be various, including children feeling bored and less interested in the material from the teacher [12], families who are too busy and allow children to play without good assistance, and a lack of teaching aids or media [3]. Learning media is a tool or method teachers use to facilitate material delivery to students [13] to achieve learning objectives correctly.

Interesting and creative learning media can foster interest in learning so students are enthusiastic and do not get bored quickly [14].

The use of learning media is proven to affect students' understanding significantly. It is shown in the effect of using a game of arranging blocks on increasing the arithmetic skills of group B students at TK Al Hikam Bekasi. The results showed that arranging blocks improves the ability of 30% of students in pre-cycle testing. The abilities that were successfully improved include recognizing quantities, grouping objects, and counting them with number symbols [6].

Interesting learning media is closely related to science, technology, engineering, and mathematics (STEM) principles for early childhood education [15]. One of the implementations of STEM is using technology, such as gadgets. The use of gadgets has various impacts, both positive and negative. The positive impact is facilitating access to communication and supporting the development of globalization, which provides many advantages in all aspects of life. The negative impact is that much time is consumed, interfering with learning activities [16]. The negative impact on early childhood is using games, which decreases the quality of their education [12]. The negative impact on early childhood is using games, which decreases the quality of their education [17].

As learning media using technology, gadget innovations can be introduced to early childhood in kindergartens and playgroups [18]. Gadgets can be used as media in presenting learning material, for example, using a cellphone or laptop. Using gadgets, the learning material delivered can be adapted from educational games [19], creating new and fun learning experiences [20]. Implementing gadget media by adapting educational games can take advantage of digital game applications. This game is interactive and interesting to children because the visualization is interesting, so they do not get bored easily [21]. Educational games in digital form provide game services with specific themes. The existence of a theme can increase understanding and deepen children's concepts of aspects of knowledge or socio-cultural values conveyed. A game also provides skills for children when playing. Knowledge and skills can shape a child's character and be applied in everyday life [22]. Educational games can also increase children's pedagogical abilities in understanding events in life through the digital environment. This game can reflect real life virtually to form characters and become deep memories for children because the learning process is carried out simultaneously with playing [23]. Based on this background, the researchers intend to apply one digital educational game, namely the marble game, for early childhood and examine its effect as arithmetic learning media.

2 Method

This study used a descriptive qualitative research method. The descriptive method describes and explains the research object based on direct observation or observation results. The research results are factual data according to the conditions during observation [24]. The results of observations of an object are intact and authentic because the observation process is carried out in a comprehensive and structured manner. The method used was interactive descriptive, making it possible to seek in-depth information from the observed source or the intended source in a case study [25]. Case studies focus on observing one particular case. The research results are specifically describing

a centralized state. Conclusions can only conclude the state of the case without representing other cases. Several data collection techniques in the qualitative method, such as interviews, observation, or documentation studies, are focused on getting unity and conclusions.

This research design was an ethnographic study, introducing technology using the media of learning games to learn arithmetic in early childhood (Ethnographic Study: Children at TK Wonokarto 2 Wonogiri). This research was conducted at TK Wonokarto 2, Wonogiri, Central Java Province. Many children at school aged 0–6 years are likely not familiar with digital marble games. The study ran for two weeks on Friday and Saturday.

The research object was a group of objects or people used as research objects [26] or problems under study to obtain directed and focused results or conclusions [27]. The objects of this research included school principals and class teachers, how the teacher applies learning using marble games, and the ability of children to understand learning games. The research subjects in this study were students at TK Wonokarto 2, Wonogiri.

Data was all information that was factual and related or relevant to the topic or matter that is the focus of the research. Qualitative data are grouped into primary data and secondary data. Primary data are obtained from the results of observations or the results of direct interviews or the first informant. Primary data has a close direct relationship with research. Secondary data are obtained from additional sources, such as information from books or other important documents. The results of the research do not describe a close relationship.

Data sources can be sources, informants, participants, friends, and teachers in research. Data sources are grouped into primary and secondary data sources [28]. Primary data sources are the main sources that can provide information, facts, and descriptions of events desired in research. Data sources in this study were taken directly from observations and interviews with school principals and students of 2 children at TK Wonokarto 2, Wonogiri. Secondary data sources were all documents in written form and photographs. This study used additional data to document activities when children carried out arithmetic activities using marble game media.

Collecting data is an important and decisive research work [28]. Using appropriate data collection techniques in research allows for objective data and results to be obtained. Data collection techniques in this study were observation, interviews, and documentation. Observation is a daily human activity using the eyes as the main tool and other senses such as ears, nose, mouth, and skin [28]. Observations in this study were conducted to determine the teacher's ability to convey learning using marble game media and the children's ability to accept new learning media such as the marble game media.

This study used unstructured interviews. The unstructured interview is free. Researchers did not use systematic, structured, complete interview guidelines for data collection [28]. Interviews were conducted to obtain information and data from school principals and class teachers regarding the arithmetic skills of early childhood before using Marble Game media. The interview method strengthens and clarifies the data obtained from observation and documentation methods.

Documents are written records whose contents are in the form of written statements compiled by a person or institution to examine an event and are helpful as natural sources

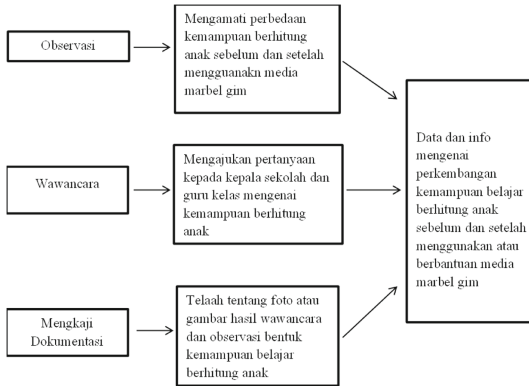


Fig. 1. Triangulation of Technique or Data Collection Method

of data, evidence, and information which are difficult to obtain, difficult to find, and open up opportunities to expand further knowledge of something being investigated. The documentation in this study was photos of children's activities during playing activities while learning using marble game media in the classroom. This study used two triangulations: triangulation of data sources in the form of information from several informants or sources and triangulation of techniques or data collection methods derived from the results of documentation, direct observation, and interviews.

Triangulation of data sources is used to test the credibility of the data by checking the data obtained through several sources [29]. The triangulation of data sources in this study came from teaching staff at TK Wonokarto 2 as informants, as shown in Fig. 1.

3 Results and Discussion

Group A had nine students who were generally only able to count up to 5. However, when data was collected, only four children attended school. One could memorize and write up to 20 because he previously joined the playgroup. However, three other children could only count to 5 and 7. The children's enthusiasm was very high when the Marble Game digital counting application opened. Then, the researcher gave a counting game with the help of pictures, such as one shirt plus two clothes, and then asked for the number of clothes. The illustration is presented in Fig. 2.

Although some could count to the tens, the other three children could not write the numbers correctly. Some children wrote numbers upside down and forgot the shape. Therefore, they must be given directions; for example, the number eight is two eggs stacked on each other. After using the Marble Game media, the children could write the numbers correctly. The illustration is presented in Fig. 3.

This media is beneficial for Group A children to answer quickly and precisely. However, some are still confused because of the pandemic's effects, so they rarely learn to count. Children who did not join playgroups before are particularly not fluent in numbers.



Fig. 2. The Use of Marble Game Media in Group A Children

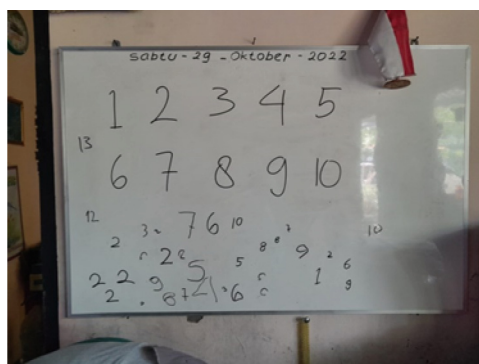


Fig. 3. Number Writing by Group A Children

From the results of using this application media, children can learn arithmetic in a fun way without feeling bored and without realizing that they are learning while playing. Children wanted to learn again with different games in the application. This digital game can help children memorize addition even without an object analogy. Children begin to master even with small numbers.

There were ten children from Group B as research subjects. Based on information from the homeroom teacher, all children could only memorize up to 30 numbers on average. However, they still did not master the writing, just like Group A. Only five or half of the children in group B attended during data collection. All of them can count and recognize different numbers. Initially, the researcher gave questions about

simple addition without using arithmetic application media, but the children were still confused. Then the researcher tries to use parables of objects, such as eggs, candy, and other objects. Finally, the children were able to answer one by one. The illustration is presented in Fig. 4.

The use of early childhood arithmetic application media has several levels, from easy to difficult, according to children's abilities. Through this digital game, children do not only count in the form of presenting numbers but also in the form of interesting games so that they learn while playing without realizing it. The children try to level one or the lowest level in the first step. The children answered quickly because it was easy, like adding one. At the next level, the children also answered quickly, but some answered by imitating their friends' answers without counting. At the next level, the researcher uses a tool or media of ice cream sticks to make it easier for children to count. At that level, there are no pictures of objects and only numbers, but it still corresponds to the level of Group B. Ice cream sticks also help children count. In addition, the children also tried matching the number of objects with numbers. However, two children still did not understand it, so the researcher explained it first, and they followed it well.

Research is not only carried out by direct observation of students but also by interviews. Interviews were conducted with one of the TK B teachers regarding the implementation of teaching and learning. Based on the results of the interviews, before carrying out the learning process, the teacher first prepares learning tools in the form of lesson plans to help teaching and learning activities to be directed and structured. Teachers still play a role in making the classroom atmosphere conducive and balanced with their role in understanding the social conditions of children every day. In each teaching and learning activity, the teacher uses media and teaching aids to support the learning process in



Fig. 4. The Use of Marble Game Media in Group B Children

class according to the conditions. In carrying out interesting learning, teachers always provide opportunities for children to choose learning activities. If children do not obey the rules at school, the teacher approaches and directs them to obey the rules that apply.

The teacher chooses learning media to develop learning materials in class following the learning objectives. The reference used by the teacher in determining learning materials is selecting sources of teaching materials and determining teaching materials that are under basic competency standards. The teacher's preparation of teaching materials pays attention to competency standards, basic competencies, indicators, and learning objectives. Teachers also have criteria for using teaching materials in learning, such as materials that must be economical, practical, easy to obtain, and flexible. Regarding learning resources, teachers use messages or information obtained, stories, community leaders, books, and natural materials. There are two ways the teacher gives material to children. For four years old children, the teacher pronounces the material; for five years old children, the teacher counts using objects and learning media in the form of objects, pictures, cards, and its like.

The researchers made observations using observation instrument sheets for teachers. The observation sheet concludes that teachers at TK Wonokarto 2 use learning media that make students active according to their age level in effective and efficient learning activities. The teacher also implements learning scenarios following students' development and learning materials and the basic competencies to be achieved. The teacher applies learning that is oriented to student activities. The teacher pays attention to student involvement in using learning media. The teacher delivers learning material using excellent and correct spoken language and monitors students' progress in each learning activity.

4 Conclusion

Based on the research and discussion results, it can be concluded that most Group A children have not been able to understand numbers, while some children from Group B have been able to understand numbers and are starting to be good at arithmetic. Marble Games in learning are considered effective in improving children's arithmetic skills and are considered an interesting feature because they are related to everyday life, such as counting the number of clothes, fruit, and animals. There is a significant difference in the ability to write numbers in group A before and after using the Marble Game application. This difference is shown by the children's ability to write and add up numbers correctly after using Marble Game media.

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