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Development of "hand magic" educational media to introduce the concept of numbers for young learners

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Abstract

Introducing the concept of numbers is important from an early age because it is the basis of mathematics, which consists of counting, mentioning objects with numbers, connecting objects with numbers, comparing, recognizing, and writing numbers. This research aims to develop educational game tools to introduce the concept of numbers in children aged 4-5 years. This type of research and development (R&D) uses the 4-D development model, which consists of defining, designing, developing, and disseminating. Data was collected by using observation and questionnaires. Data were analyzed from the results of questionnaires distributed to expert validators to assess the media developed, as well as the results of observations of children's number concept abilities during the field test. The results showed that the educational media developed and named "hand magic" had very feasible criteria for use with the acquisition of a media design validation score of 3.8%, early childhood expert validation of 3.9%, and validation from early childhood teachers of 3.9%. The results of trial observations for small groups were 44% with Developing as Expected (DE) criteria, 56% with Developing Very Well (DW) criteria, and for large groups obtained a value of 18.6% with Starting to Develop (SD) criteria, 47.9% with DE criteria, and 29.3% with DW criteria. Therefore, hand magic media has contributed to helping young learner teachers introduce number concepts in early childhood. More research topics are suggested, along with some challenges of utilizing a play method with the hand magic educational game in the classroom.

Keywords: *hand magic educational media; number concept; math for children; young learners.*

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A. INTRODUCTION

Early childhood education basically includes all efforts and actions taken by educators and parents in the process of caring, nurturing, and educating children by creating an aura and environment where children can explore experiences that provide opportunities for them to know and understand learning experiences obtained from the environment, through observing, imitating and experimenting that take place repeatedly and involve all the potential and intelligence of children (Usnah & Supriadi, 2023). Therefore, early childhood education is education that can facilitate growth and development as a whole, so media development should have conditions for children to develop skills that are appropriate to their age; creatively, teachers can utilize used materials around them (Miftah, 2023).

With the development of science, it is increasingly encouraging efforts to utilize used goods, natural resources, or materials that can be recycled and modified to be used as learning media that can help the learning process (Ayuni & Setiawati, 2019; Rais et al., 2018). From this, the role of the teacher is needed in the generation of the use of APE in the learning process of children. Early childhood education has the main function of developing all aspects of child development optimally and thoroughly. Aspects of child development include religious and moral development, socio-emotional, cognitive, language, physical motor, and art. These six aspects of development cannot develop only by themselves; they are interrelated with one another (Dewi et al., 2023).

Knowing the concept of numbers is included in cognitive development, which aims to develop children's thinking skills. Recognizing the concept of number involves thinking about some number of objects or some number of objects (Mix et al., 2005; Sarnecka & Lee, 2009). Cognitive development is a thinking process in the form of the ability to connect, assess, and consider an event (Rozana, 2020; Saudia & Wardani, 2022). Learning media is anything that can be used to channel messages (learning materials) and stimulate children's thoughts, feelings, attention, and abilities so as to encourage children's learning process (Rusman, 2016). To support the learning process, teachers are responsible for the learning design that will be used to direct children to achieve competency. In directing children to achieve learning competency, the teacher must make an effort (Sufa & Widyahening, 2023). Engage the child in hands-on mathematics activities that incorporate concrete things and the five senses, teaching the concept of numbers to them so they may learn through their interactions with the world around them (Sari, 2013). Play and math go hand in hand extremely well. Math can be a quiet, solitary pursuit as well as a social and cooperative one, and we need to show kids that it is fun and beneficial if we want them to grow up to be effective mathematicians. Play is more than just a means of presenting basic concepts. Therefore, we must be careful to keep it in mind. When we give children more authority over their education than when we leave it to the adults, they will frequently set themselves far more difficult problems (Özdoğan, 2011). The foundation for mathematical learning is provided by mathematical play, which gives children the freedom to formulate their theories without fear of rejection (De Holton et al., 2001).

In early childhood education, there are three kinds of mathematical play. These

include play with mathematics integrated into it, play centered around it, and play utilizing the mathematics that has been taught (Ginsburg, 2006). A learning strategy that works well for teaching the notion of a number sign to children between the ages of four and five is playing games involving math. Children's participation aids early children in math play activities (Zippert et al., 2019). Children apply what they already know when they play mathematical games, and while they play, mathematical play creates connections between their existing schemas. Playing with math strengthens what is already known and helps with subsequent math and problem-solving exercises. As youngsters engage in mathematics play activities, they encounter various everyday situations and impromptu come up with multiple solutions. As a result, mathematical plays foster logical reasoning and produce effective learning (Holton et al., 2001). The Course Review Horay learning paradigm could help young children better grasp the concepts of numbers 1-10 (Rangkuti & Rangkuti, 2019). From this research, children can improve their concept of numbers with fun learning.

Based on observations at Pembina Tanah Luas Kindergarten, the average child is not able to recognize the concept of numbers. It is known because some children still do not understand numbers. When the teacher asked the children to mention the numbers 1-10, the children were able to mention them, but when the teacher told the children to mention them individually, some could and some could not, and when the teacher showed the concept of numbers with fingers, many of the children were wrong in mentioning it. Moreover, when the teacher asks the child to take a number card that matches the number concept on the fingers that the teacher shows, the child feels confused in choosing a card to match; apart from that, the child also still finds it difficult to compare a small number with a large number, one example is on the child's worksheet there is a task of connecting number symbols and objects, there is one column that has three watermelons and five apples when doing the work the child connects the number 5 to the picture with three objects on the grounds that the watermelon is bigger than the apple.

From this fact, it is necessary to develop a learning media that can explain clearly and easily so that with the help of media, students understand it more easily. Learning mathematics is supported by everyday activities. Teachers must be aware of children's mathematics beginnings and progression (Clements & Sarama, 2016). Math learning is influenced by playing activities. Through play, kids can combine their knowledge and experiences, explore and infer meanings connected to mathematical ideas, and make use of their experiences (Syafdaningsih & Utami, 2021). Teachers could design a game-based learning program that is easily customized to meet the needs of kindergarten students, improving their learning and fostering good attitudes toward mathematics in the process (Alomyan et al., 2020).

Several previous studies about introducing the concept of numbers to children have already been conducted with different kinds of media development, such as loose parts (Utami & Eliza, 2022), giant snake and ladder (Syarfina et al., 2022), abacus game (Susanti, 2020), and the like. However, this research aims to develop mathematics educational games to introduce the concept of numbers in early childhood. The researcher named it Hand

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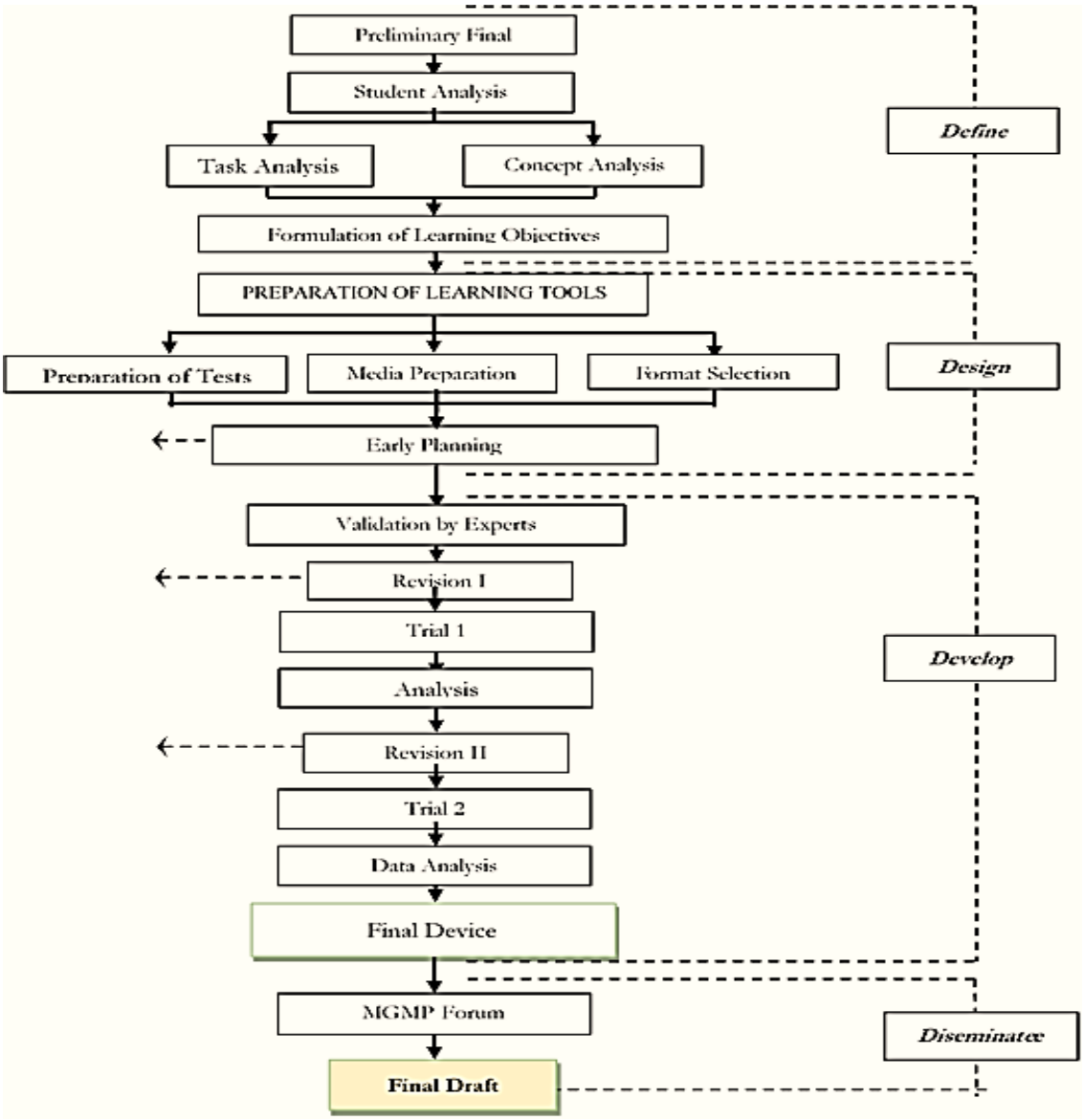
Magic, which is a hand-shaped media created with a magician's hat; this media is called Hand Magic because the hand can move and show the number symbol. Through this, the child can understand and easily understand the number and also the symbol, and the child can understand the number and its symbol from the fingers; apart from that, the researcher wants to make this media interesting media, by associating the media with magic elements, where later the hand will move in the magician's hat and the hat there will also be several media that can be used to train the development of the concept of number in children.

B. METHOD

The research method that researchers use in this study is research and development (R & D). This research will produce a certain product and test its feasibility. The development procedure in this study is the 4-D development model (Four D Model) proposed by Thiagarajan and Semmel, which has been modified and consists of four stages. The four stages are defining, designing, developing, and disseminating (Trianto, 2011).



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Picture 1.
Steps Using 4-D model by
S. Thiagarajan, Dorotthy S. Semmel, and Melvyn I. Semmel

The defining stage is useful for determining and defining the needs in the learning process and collecting various information related to the product to be developed. After getting problems from the defining stage, the design stage is then carried out. This design stage aims to design an educational game tool that can be used for early childhood learning media. After the design stage, proceed to the development stage. The purpose of the development stage is to produce a good final draft. In draft 1, the learning tools and research instruments were validated by experts. After the trials and instruments have been revised, the next stage is the dissemination stage. The purpose of this stage is to disseminate the educational media.

The participants in this study were students at Pembina Tanah Luas Kindergarten aged 4-5 years old. In this study, data collection techniques were carried out by observation, interviews, and validation questionnaires for media experts and pre-school experts. The purpose of the observation was to describe the implementation of the use of hand magic game tools in kindergarten. A tape recorder was used as a tool to facilitate the interview. The interview aimed to find out the needs and shortcomings of learning media used to improve the introduction of number concepts. Questionnaires were used to find out the responses and assessments given by the students.

The data obtained from the media evaluation questionnaire results on material experts and media experts are then analyzed for media evaluation purposes. Classifying data based on variables and types of respondents, tabulating data, presenting data from each variable, and using calculations to answer problem formulations are data analysis activities. The data analysis technique in this research is to describe all opinions, suggestions, and responses from validators contained in the comment sheet. At the trial stage, data was collected using an open assessment questionnaire to provide criticism, suggestions, input, and improvements. The results of this descriptive analysis are used to determine the results of the development of educational media. Quantitative data processing uses a Likert scale with a score of 1-4. Start from No Develop (ND), Starting to Develop (SD), Developing as Expected (DE), Developing very Well (DW).

C. RESULT AND DISCUSSION

1. Result

The result from 4 steps is described as follows:

Define. At this stage, the researcher analyses and collects information at an early stage to make an educational game tool, initial analysis, child analysis, concept analysis, and learning objectives. The researcher looked at the problems found in the field when observing class A at Pembina Tanah Luas Kindergarten. The problem was obstacles for children in recognizing the concept of numbers. Researchers collected information on

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what caused the obstacles for children in recognizing the concept of numbers, and the information that researchers got is the lack of supporting media that can be used in the learning process of introducing the concept of numbers to children, the media used in the process of recognizing the concept of number using number cards and some sticky pictures on the wall that have a function to introduce the concept of number to children. No game tool can be played by children both individually and in groups in terms of introducing the concept of numbers. From this information, the researcher took the initiative to design an educational game to introduce the concept of numbers to children; the name of the media is Hand Magic.

Design. At this stage, the researcher arranges the steps in making learning media, which consists of selecting materials for design and setting criteria. From the problems that researchers have found, they then discussed and looked for solutions to what kind of media to solve existing problems. In designing a Hand Magic media, starting from looking for ideas on how to design media, what games are contained in the Hand Magic game tool, and how to play it, all the games in Hand Magic collaborate in one game tool, which has the purpose and function to be an intermediary tool in introducing the concept of number to children aged 4-5 years.

Develop. At this stage, the researcher develops Hand Magic media based on the design note. Then, it goes to the process of submitting it to the media expert validation. To support perfection in media development, the researcher improved educational media according to the direction and input from expert validation.

Picture 2.
The various games contained in Hand Magic media

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Picture 3.
puzzles before revision

Picture 4.
puzzles after revision

After Hand Magic media was ready, expert validators and kindergarten teachers validated the media, and teaching materials, small group trials, and large group trials were revised. Validator assessment results are shown in Table 1.

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Table 1. Validator Assessment Results of Experts

No	Indicators	Research Results		Average
		Assessment I	Assessment II	
1.	Media design is attractive and increase the children's appeal	4	4	4,0
2.	The color selection is accurate and attractive	4	4	4,0
3.	Media is designed according to the age range of children 4-5 years in the knowledge of the number concept	4	4	4,0
4.	Media is designed to help the development of number concepts in children	4	4	4,0
5.	Media is designed to train children to recognize the concept of grouping.	4	4	4,0
6.	Media is designed to train children to recognize numbers and symbols.	4	4	4,0
7.	Media is designed to train children to know the ratio	3	4	3.5
8.	Media does not injure children, neither pointed nor sharp	2	4	3,0
9.	Media is not harmful to the child, does not contain chemical	3	4	3,5
10.	Media design is collaborative; there are several models of games that can be played.	3	4	3,5
11.	Media is easily used and played.	4	4	4,0
12.	Media is designed to train children to recognize the concept of grouping.	4	4	4.0
13.	Media can be played individually	4	4	4,0
14.	Media can be played in groups	4	4	4,0
15.	Media in accordance with the achievement of child development indicators	4	4	4.0
	Average			3.8

The results of the validation of the Hand Magic game to train number concepts in early childhood given by the media design validator are 3.8, which is a very feasible category; from the average assessment, it can be concluded that the design of the Hand Magic media that has been developed is feasible to use and field tested. Furthermore, the assessment results from ECD teachers are illustrated in Table 2.

Table 2. Validator Assessment Results of ECE Teachers

No	Indicators	Research Results		Average
		Assessment I	Assessment II	
1.	Media train cognitive development in children	4	4	4,0
2.	The color selection is captivates the child's appeal	4	4	4,0
3.	Media is designed according to the age range of children 4-5 years in knowledge of the concept of numbers	4	4	4,0
4.	Media help the development of the concept of numbers in children	4	4	4,0

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5.	Media is designed to train children to recognize the concept of grouping	2	4	3,0
6.	Media is designed to train children to recognize numbers and symbols	4	4	4,0
7.	Media is designed to train children to know the ratio	4	4	4.0
8.	Through the game hand Magic teacher can introduce the concept of numbers 1-10 to children aged 4-5 years	4	4	4,0
9.	Media help teacher to introduce the concept of numbers 1-10 to children aged 4-5 years	4	4	4,0
10.	Media is designed in accordance with the child's ability level	4	4	4.0
11.	Media designed in accordance with the competence to be developed	4	4	4.0
	Average			3.9

The results of the validation of the Hand Magic game tool to train the concept of numbers in early childhood given by the ECE Expert validator are 3.9, which is a very feasible category. From the average assessment, it can be concluded that the Hand Magic game tool that researchers have developed is suitable for use and field trials. Next, a field test was conducted, and the results are in Tables 3 and 4.

Table 3. Respondents' Results on the Small Group Trial

No	Indicators	Response				Percentage%			
		ND	SD	DE	DW	ND	SD	DE	DW
1.	Children are able to count and recognize the symbol of numbers 1-10	0	0	2	3	0	0	40	60
2.	Children are able to mention the numbers 1-10 and the numbers that correspond to the number symbols	0	0	3	2	0	0	60	40
3.	Children are able to match the symbols of numbers with numbers	0	0	3	2	0	0	60	40
4.	Children are able to compare the concept of numbers such as between large and small or many and little	0	0	1	4	0	0	20	80
5	children are able to group objects by count of numbers or objects of an appropriate type	0	0	2	3	0	0	40	60
	Total							220	280
	Average							44%	56%

The results obtained are 56%, meaning that almost all indicators, which means that the indicators assessed by the researcher already have good enough results while being assessed by the researcher have been able to be mastered by the child. After the small group trial is carried out, the Hand Magic game tool will be given to a large group trial of 15 children.

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Table 4. Respondents' Results on the Big Group Trial

No	Indicators	Response				Percentage%			
		ND	SD	DE	DW	ND	SD	DE	DW
1.	Children are able to count and recognize the symbol of numbers 1-10	0	0	5	10	0	0	33,3	66,7
2.	Children are able to mention the numbers 1-10 and the numbers that correspond to the number symbols	0	0	10	5	0	0	66,7	33,3
3.	Children are able to match the symbols of numbers with numbers	0	3	12	0	0	20	80	0
4.	Children are able to compare the concept of numbers such as between large and small or many and little	0	3	7	5	0	20	46,7	33,3
5	children are able to group objects by count of numbers or objects of an appropriate type	0	3	10	2	0	20	66,7	13,3
	Total						60	293,4	146,6
	Average						12%	58,7%	29,3 %

The average assessment showed that 29.3% of children got the score, meaning that of the 15 samples taken, only a few children were able to master the concept of numbers almost perfectly.

Disseminate. The end of this development stage is the Hand Magic game tool media for recognizing a number of concepts in children aged 4-5 years, which is then disseminated to teachers of Pembina Tanah Luas Kindergarten. This dissemination stage was carried out during the trial due to material limitations. Media can be used to ECE institutions and the wider community that contributes to early childhood development.

2. Discussion

In this study, researchers developed a "Hand Magic" educational media that has the purpose and intention of facilitating the introduction of a number of concepts in children aged 4-5 years. The concept of numbers is mathematical, which consists of counting, mentioning objects with numbers, connecting objects with numbers, comparing, recognizing, and writing numbers (Gifford, 1995; Linder et al., 2011). The feasibility of learning is the link between the objectives and results of learning, and the completeness of learning outcomes indicates the achievement of planned learning objectives so that learning is said to be effective. Learning media must be designed to attract children in the learning process, especially in the process of learning to recognize number concepts (Iqbal et al., 2023). Based on the results of the study, the researchers obtained the feasibility value of the Hand Magic media as a tool to introduce the concept of numbers in children aged 4-5 years.

Hand Magic media obtained in the trial on the respondents consisted of two tests: a small group trial of 5 and a large group trial of 15 respondents. The hand Magic game

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tool was able to increase children's understanding of the learning process and increase their interest. Early childhood education learning media is very important to support the learning process in order to stimulate aspects of child development (Hayati & Syaikhu, 2020; Nainggolan et al., 2019). The media used must be in accordance with the characteristics of the child so that through the use of media can motivate and facilitate children's understanding. The concept of number is a mathematical concept that is very important for children to master which consists of; children are able to count, children can mention the number of objects with numbers, children are able to connect or pair objects with numbers, children are able to compare, and children can recognize and write numbers (Novita, 2018).

Researchers developed a Hand Magic media that has the purpose to apply concrete and efficient learning media. The object in question can be in the form of real, miniature, model, or the form of images that can be presented audio-visually and audibly. If early childhood cannot be brought to the direct object being studied, then the object is brought to early childhood (Nasution et al., 2022; Rasmani et al., 2023). The positive impacts of using learning media are making learning more standardized, more interesting, more interactive, time shorter, the quality of learning can be improved, the learning process can take place anytime and anywhere, positive attitudes of students towards learning materials and the learning process can be increased, the role of the teacher changes towards a positive direction (Maghfiroh Shofia & Suryana, 2021; Zaini & Dewi, 2017). Learning media can improve early childhood cognitive development. It is in line with research from Ayu, who found that alphabet learning media using interactive multimedia on cognitive development is feasible to use and develop for early childhood (Ayu & Manuaba, 2021). The use of eco-bricks for learning media in the form of educational game tools needs to be tried. The researchers suggest that this activity can be socialized to parents and children at school. Besides being fun, this activity also has various benefits, especially contributing to the reduction of plastic waste, and is expected to stimulate many aspects of child development, such as physical development, especially fine motor development, cognitive, social emotions, creativity, and art (Palupi et al., 2020). Based on the results of the description above, it can be concluded that the Hand Magic game tool is very feasible and has no obstacles; this can be seen from the child's understanding of the concept of numbers, understanding of the concept of number can also be learned by playing individually or in groups.

In this research of development Hand Magic Educational Games, children learn mathematics through playing. Children naturally pick up mathematical concepts through play, enjoyment, and life (PekİnceDağlioğlu, 2012). Hand magic media has some game content, such as (1) Counting fingers. In this game, the child counts the fingers in the Hand Magic game and counts the number of fingers that correspond to different finger patterns; (2) Playing patterns. In this game, the child observes the finger patterns shown in the Hand Magic game and then recognizes the numbers that match the finger patterns and takes the numbers that match the hand patterns. Then, the child puts it into the bag available in the hand magic game; (3.) Puzzle. This game trains the concept of numbers

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by sorting or pairing until it becomes a perfect shape. The type of puzzle here is a flat shape that is connected and then becomes a building, and the child will sort according to the numbers 1-10; (4) Number case. This game aims to train children's number concepts in the matching section. The form of this game is a case in which each part has a needle, and for each number at the end, the needle, if rotated, will show the color at the bottom. In this game, children group colors based on the number and color indicated by the case needle; (5) Seize me. This game aims to train the concept of numbers and concentration in children. The form of this game is a group game by the way the teacher provides flat shapes such as circles, triangles, squares, and rectangles. Then, the teacher arranges the flat shapes in the middle of a row of children sitting facing each other. In the initial step, the teacher gives ice breaking to the child, then quickly gives instructions, and the child chooses the flat shape according to the instructions quickly, and whoever quickly gets the flat shape according to the instructions becomes the winner (6) Magic jar. This game trains children to guess. The form of the game is a picture of a jar that, if seen with the naked eye the jar is empty with nothing in it, but if we look using a flashlight, then inside the jar, there are objects with different numbers and shapes. The results of this study are in line with previous research which stated that playing with number-related toys (cards with numbers on them and matching numbers of pictures on them) intentionally helped preschoolers anticipate their numeracy skills five months later (Fisher et al., 2012).

Thus, one way to encourage children's enthusiasm in learning mathematics is through play-based learning. Play provides children with possibilities for learning as they spend time and energy playing (Chin & Effandi Zakaria, 2015). However, it recognizes the wide variety of dynamic and diverse educational media that are available, emphasizes the value of individualized learning experiences, supports all-encompassing learning settings, and investigates the cognitive effects of teaching number concepts to young learners using a variety of media (Ilham et al., 2022). This forward-thinking strategy has the potential to enhance early maths teaching and child development and is well-positioned to make a substantial contribution to the changing field of educational research and practice (Björklund et al., 2020; Kermani & Aldemir, 2015). With this media, children can employ mathematical play at different age stages. All infants begin to observe mathematics from birth. Young children utilize their hands to grasp mathematical concepts and abilities in both play and real-life scenarios.

D. CONCLUSION

Several game contents in hand magic media can introduce the concept of numbers to children. The game content stimulates the ability to count, mention objects with numbers, connect objects with numbers, compare, recognize, connect patterns, and write number symbols. The development of Hand Magic educational media is adapted to the achievements of children aged 4-5 years after prior analysis. Then, the steps in making the media were arranged, and the media design and some of the games contained in Hand Magic were determined. The next stage is to develop the media design in such a way that it is submitted to expert validation to support the perfection of the media design in accordance with the

input and suggestions from the validator. After small and large field trials, the results were very significant in introducing the concept of numbers to children. The distribution of Hand Magic media is still limited to ECE institutions so that the wider community can contribute to the development of early childhood and Hand Magic game tools to train a number of concepts in children aged 4-5 years that are effectively used in early childhood learning.

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