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DEVELOPING DIDACTIC GAMES TO IMPROVE THE MATHEMATICAL SKILLS OF YOUNG CHILDREN

Research article

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Abstract

The aim of this study was to develop didactic games that enhance the mathematical skills of young children. The participants were 22 students aged 5-6 years, who were enrolled in a kindergarten class at Rajamangala Demonstration Kindergarten School in Thailand. This research used quantitative research method. The quasi-experiment was conducted over an 8-week period, 3 days per week, with each session lasting for 40 minutes. The research utilized various instruments, such as an experience activity plan, educational media, an early childhood mathematics skills observation form, and a satisfaction assessment form. Mean, standard deviation, and One-way ANOVA were used for data analysis. The findings indicated a significant improvement in the mathematical skills of the young children at a level of .01 significance, and the satisfaction of the teachers and educational personnel was high.

Keywords: didactic games, mathematical skills, young children

1. Introduction

The administration of early childhood education plays a crucial role in supporting children's holistic and balanced development, encompassing physical, emotional, mental, social, and intellectual aspects (NAEYC, 2009). This is achieved by adhering to the guiding philosophies and curriculum visions of early childhood education, which prioritize a comprehensive approach to child development. To effectively manage early childhood education, it is essential to have a fundamental knowledge and understanding of the principles and ideas underlying early childhood education management. Such knowledge is crucial to creating a conducive learning environment and promoting positive discipline that would foster the development of children into complete individuals, in line with Thai society's cultural context and the need for coexistence within a multicultural society (Office of the Education Council, 2012). The Ministry of Education in 2017 recognized the importance of creating a quality and positive learning environment for children's optimal development through effective early childhood education management (Ministry of Education, 2017).

Mathematics instruction in early childhood is essential as it provides children with a solid foundation for academic success and life. Research has shown that a child's math performance influences their expectations for future academic accomplishments, not only in mathematics but also in other areas of their lives (Rudd et al., 2008; Schoenfeld & Stipek, 2011; Clements et al., 2019). The mathematical concepts and skills taught in elementary school include counting, comparing, exploring, and comprehending shapes and spatial relations,

measurement, patterning, matching, grouping, problem-solving, sorting, graphing, and basic arithmetic operations such as adding and subtracting (Sarama & Clements, 2009).

Young children's education in mathematics should include experiences that are mathematically rich, relevant, of high quality, and challenging (NAEYC, 2010; Prachagool, 2021). Children develop mathematical abilities and concepts through their everyday experiences, making observations and investigations on the mathematical aspects of their environment. Through activities that explore amounts, patterns, measurement, sharing, spatial vocabulary, and problem-solving, children gain opportunities to address real-life problems. It is crucial that children are given the chance to participate in mathematically significant discoveries to promote their mathematical development (Guberman, 2004)

The current state of mathematics teaching and learning management for preschool children in Thailand faces several challenges. The predominant teaching style is based on exercises, and the content is often too complex for their age. Teachers also tend to use unsuitable teaching methods that do not align with early childhood education, such as choosing inappropriate teaching materials, complicated content, and teaching methods (Nuangchalerm, 2020). As a result, children often feel disheartened and bored with the subject, as they are required to focus more on memorizing rather than understanding. To overcome these challenges, different instructional methods should be utilized in early childhood education, including play-based learning that is more appropriate for children's development. According to Palmer and Björklund (2016), play-based learning should be prioritized in early childhood education to ensure that children learn through play and using their senses.

Engaging children in playful and interactive activities is a highly effective approach to teaching mathematics to preschoolers (Wickstrom et al., 2019). Traditional exercises that focus on memorization, reading, and writing often lead to disengagement and negative attitudes towards learning math, but foundational skills remain critical (Prachagool & Nuangchalerm, 2021). Instead, mathematics should be introduced to young children through experiential activities that tap into their natural curiosity and build on their prior learning and real-world experiences. Research has shown that children's mathematical understanding is enhanced when they are given opportunities to physically manipulate objects and engage in problem-solving activities (Sarama & Clements, 2009). Therefore, promoting a mathematically rich and stimulating environment that encourages children's computational thinking is vital for their intellectual development and overall learning.

It is crucial to create a relaxed and enjoyable atmosphere during math instruction in early childhood. Such an atmosphere can enhance a sense of accomplishment and promote positive attitudes towards learning math (Öçal & Halmatov, 2021). It is essential to consider the age of the children and avoid making lessons too serious, keeping in mind that children's worldview is often aligned with didactic games that correspond to their interests. An inappropriate choice of teaching methods for preschoolers can be a common cause of failure. At this age, playing is the primary form of activity for children. It helps them discover the world, develop their minds and effective operational abilities, satisfy their need to be physically active, establish pleasant emotional states, and reduce emotional stress (Klim-Klimaszewska & Jagiełło, 2012). Through play, children can develop cognitively, physically, socially, and emotionally while using their creativity, imagination, dexterity, and physical, cognitive, and emotional strength (Gasteiger, Obersteiner, & Reiss, 2015).

In the context of preschool education, didactic games have been found to be highly effective teaching strategies for young children. They provide active engagement in activities that promote the discovery of new knowledge elements through perception, assimilation, and exploration (Kadirov et.al., 2021). Teaching through educational games and activities integrates different components of comprehensive teaching, such as learning through

cognition, experience, and action. Didactic games can also enhance children's perceptual-motor skills, observation ability, imagination, focus, memory, and mental functions (Anna, 2018). Therefore, didactic games can offer a fun and interactive way for preschoolers to learn and develop important cognitive and motor skills.

Research has shown that children's motivation to learn increases when they engage in enjoyable educational games. Task-oriented motivation is more likely to develop in children who find the activities pleasurable, and this can be particularly useful for those who struggle with speech issues or experience anxiety in group settings (Anna, 2018). To address these issues, researchers have developed instructional materials aimed at enhancing the mathematical skills of young children through didactic games. By using these games, children can develop their cognitive, social, emotional, and physical skills, while also finding learning enjoyable and engaging. Therefore, it is important for teachers and administrators in early childhood education to incorporate media and didactic games into their teaching strategies to support children's development in various domains.

2. Methods

2.1 Participants

1. A sample of 22 students aged 5–6 years was selected from the second semester of Grade 3 in a kindergarten at Rajamangala Demonstration Kindergarten School, Faculty of Home Economics Technology, Rajamangala University of Technology, Thanyaburi, Thailand. One classroom was selected out of two for the study.

2. The educational personnel involved in this research were 30 teachers and early childhood education officers who taught at the kindergarten level in the second semester of the academic year 2016 at the Child Development Centre, which was under the supervision of Khlong Ha Subdistrict Administrative Organisation, Khlong Hok Subdistrict Administrative Organisation, and Thanyaburi Municipality.

2.2 Research instrument

Lesson plan

Study documents and research related to the early childhood education curriculum Ministry of Education, Strand 1 Numbers and Actions Standard 1.1 Understand the variety of number expressions. Use of numbers in real life and to study activities to promote mathematics skills in early childhood children from books, articles, and research journals. Then create a teaching plan for experiential activities to promote the mathematics skills of preschoolers (24 plans, 8 weeks per week, 3 days, 40 minutes per day), and then try the teaching plan to find flaws for further improvement.

Educational game

Study documents, concepts, theories, and research related to educational media for early childhood children. The researcher produces learning materials according to the basic concepts of designing and producing teaching materials. Focusing on the use of natural materials that can be found locally so that early childhood children can touch a variety of media such as paper, cloth, wood, etc.

Mathematics skill assessment form

A study of documents, concepts, theories, and research related to the mathematical skill assessment of preschool children Designing and creating a mathematical skills assessment form for preschool children. It is a 3-level estimation scale, i.e., 2, 1, or 0, depending on the scoring criteria.

Satisfaction assessment form

Satisfaction questionnaire are the 5-level scale, using the criteria: level 5 means highest satisfaction, level 4 means high satisfaction, level 3 means moderate satisfaction, level 2 means low satisfaction, and level 1 means satisfaction. least satisfied Then the researcher uses questionnaires to find flaws and improve. Analyse the data obtained from the questionnaire.

2.3 Data collection

To experiment the research, the researcher began by administering a mathematics skill assessment form to preschool children before organising any learning activities. Next, the researcher conducted educational game activities using the developed learning media for 24 plans, with each plan taught for 40 minutes on Monday to Wednesday. The mathematics skills of preschoolers were assessed on Thursdays and Fridays of every week. The results of the assessment of mathematics skills for early childhood children were analysed to draw conclusions.

To disseminate the research results to early childhood teachers or kindergarten educational personnel, the researcher publicised the project to recruit 30 teachers and educational personnel from the kindergarten level to participate in the project. An organiser of a workshop disseminated the research results to the participants in a one-day activity. Upon completion of the training, the researcher evaluated the trainees' satisfaction using a satisfaction assessment form for learning materials in educational game activities designed to promote mathematical skills in preschool children, which the researcher created.

2.4 Data analysis

The study examined the computation of the average and standard deviation of the math test scores of children, both prior to and following the experiment. The results of the experiment were subsequently compared to the early mathematics skill scores using a one-way ANOVA. The mean and standard deviation values can be utilised to evaluate the satisfaction of educators and teachers with the instructional materials designed to enhance the math abilities of young children. The mean score can be interpreted to determine the level of contentment.

3. Results and Discussion

Part 1 studies the effect of using educational media to promote the mathematics skills of preschool children.

The pre-school children had average mathematics skills that were consistent with pre-school children overall. However, there was a notable improvement observed in the period of using educational media, with an average score increasing from 10.68 to 23.82 out of a full score of 24, as shown in Table 1.

Table 1. *Mathematics skill scores classified by observation period.*

Mathematics skills	Observation time (week)							
	1	2	3	4	5	6	7	8
Mean	10.68	14.00	15.95	18.86	20.59	22.59	23.18	23.82
SD	1.86	1.72	2.38	2.21	1.53	0.73	0.39	0.39

Comparison of mathematics skills of early childhood children classified by observation period by repeated measure variance analysis. A comparison of mathematics skills of early childhood children classified by observation period found that early childhood children's mathematics skills differed statistically at the .01 level of statistical significance in all aspects ($F = 272.82$). At least 1 period has a different value and details can be shown in Table 2.

Table 2. *Comparison of mathematics skills of early childhood children*

Skills	Variance	SS	df	MS	F	Sig
Early childhood children's mathematics skills	During the week	3496.72	2.96	1182.42	272.82	.000**
	Tolerance	269.15	62.10	4.33		

The results of the analysis revealed that the mean scores of mathematics skills in each period of at least one period were different. Therefore, a comparison of the changes in mathematics skill scores in each experiment period was performed. By using the Least Significant Difference (LSD) test method (Table 3).

Table 3. *Comparison of the changes in mathematics skill scores in each experiment period*

Trial	Week 2		Week 3		Week 4		Week 5		Week 6		Week 7		Week 8	
	df	Sig	df	Sig	df	Sig	df	Sig	df	Sig	df	Sig	df	Sig
Week 1	3.32**	.00	5.27**	.00	8.18**	.00	9.91**	.00	11.91**	.00	12.50**	.00	13.14**	.00
Week 2			1.96**	.00	4.86**	.00	6.59**	.00	8.59**	.00	9.18**	.00	9.82**	.00
Week 3					2.91**	.00	4.64**	.00	6.64**	.00	7.23**	.00	7.86**	.00
Week 4							1.73**	.00	3.73**	.00	4.32**	.00	4.96**	.00
Week 5									2.00**	.00	2.59**	.00	3.23**	.00
Week 6											0.59**	.00	1.23**	.00
Week 7													0.64**	.00

** Statistical significance at 0.01 level

According to the findings of a study on the use of educational media to improve the mathematics skills of young children, it was found that young children had average mathematics skills in their age group. Throughout history, there has been an increase in the use of educational media. During the experiment, the mean scores ranged from 10.68 to 23.82 out of a possible 24, demonstrating that children in early childhood have more advanced mathematics skills. Because during the early years of life, children observed and investigated their environments quantitatively, for example, by comparing shapes, amounts, colors, etc.; discovering or creating patterns; sharing their toys and other objects; utilizing space; solving real-world problems; etc. Children have the possibility to learn from their own experiences through play. In addition, Seo & Ginsburg (2004) reported that while playing, youngsters spent 88% of their time creating patterns, building blocks, counting, and comparing items. Consequently, this study's findings were consistent with those discovered in the existing scientific literature. Therefore, the educational materials produced were based on the standard framework for early childhood mathematics skills as a guideline to produce educational materials and plans for educational game activities that were appropriate for the learning and development of 5-year-old early childhood children.

Children's mathematical education was enhanced with the implementation of didactic games. The provided statistics revealed that the children were satisfied and content, that the games captured their interest, and that they assisted children to overcome barriers and acquire new words. Competition or rivalry inherent to didactic games drives children to perform tasks accurately, focus on winning, and devote their entire efforts to obtaining success. Consequently, child development could be aided by a range of scenarios and media that inspire various actions targeted at exploring reality in various ways, engaging the child, and posing open-ended inquiries. In the study Matsuo & Nakawa (2019) designed mathematical measurement activities for five- to six-year-old children and discovered that children understood direct comparison through activities and play; however, it was challenging to establish an understanding of early numeracy skills, which are the strongest predictors of children's later mathematics achievement.

Part 2 disseminates research results to early childhood teachers or educational personnel in kindergartens.

Teachers and educational personnel had the highest overall satisfaction with educational materials to promote the mathematics skills of early childhood children. When considering each aspect, it was found that the satisfaction was at the highest level of 9 items and at high level, 1 item, the aspect that was most satisfied was educational media corresponded to the development of early childhood children and the aspect with the least satisfaction was educational materials allow children to make self-discovery (Table 4).

Table 4. *Level of satisfaction with educational materials*

No.	Item	Mean	SD	Interprets
1	Educational media is most consistent with early childhood development	4.80	0.40	Highest
2	Educational media promoting mathematics skills of early childhood children	4.73	0.44	Highest
3	educational materials enabling children to make self-discovery	4.47	0.81	Highest
4	Educational materials to stimulate children's interest	4.50	0.72	Highest
5	Educational materials promote creative interaction and two-way communication	4.77	0.42	Highest
6	Educational media are up-to-date	4.60	0.61	Highest
7	Educational materials are durable, strong, and safe	4.57	0.62	Highest
8	Educational materials have manuals for use	4.53	0.62	Highest
9	Educational media are in line with the needs of early childhood teachers	4.53	0.50	Highest
10	Educational materials are easy to store	4.63	0.48	Highest
	Overalls	4.62	0.18	Highest

The results of the dissemination of research results to early childhood teachers or educational personnel in kindergarten schools found that teachers and educational personnel had a high level of satisfaction with educational materials created by the researcher to promote the mathematical skills of early childhood children (Prachagool, 2006; Djonko-Moore, 2022). This finding was because early childhood teachers and educational personnel were shown the research results. When considering each component, it was discovered that the amount of satisfaction was maximum at 9 items, with 1 item reaching the high level of satisfaction. The part of educational media that corresponded to the growth of young children had the highest level of satisfaction from respondents, while the aspect of educational media that helped children become more aware of themselves received the lowest level of pleasure.

Early childhood educators need to receive training in the use of suitable activities and media to foster mathematical skill development in their students. These training exercises are aimed at assisting instructors in gaining an understanding of the fundamentals of mathematical activities, learning how to make proper use of various forms of media, and implementing the standard curriculum for teaching mathematics to preschoolers. Children's learning can be enhanced using activities like songs, rhymes, and riddles that are related to mathematical concepts. These kinds of activities can be used to interest children and keep their attention.

According to Heffernan and Newton (2019), including the term "math" in a riddle is one way to assist children in paying attention as well as remembering the content while they are having fun with it.

Researchers arranged for an event to take place and played a game to illustrate the usefulness of instructional materials in imparting mathematically related tasks in the early stages of development. Preschoolers were able to comprehend math-related activities that are suitable for early development since concrete materials instructional material was incorporated into the lesson plan. According to Arslan and Kartal (2022), the study examined the impact of coding education on the skill development of preschoolers between the ages of 60 and 72 months and showed a positive effect. Naturally, even the preliminary steps in teaching an abstract concept require the use of concrete materials. These components should be functional and straightforward in design. Additionally, it needs to be selected in accordance with the design of the study. Materials were made from natural wood and others. So, teachers must develop and deploy new techniques and resources to improve their students' mathematical abilities (Sun et. al., 2020).

Educational institutions should establish educational resources and strategies for gaming activities to stimulate the growth of young children's mathematics skills and other abilities. This will help young children become more well-rounded. The findings of additional studies can be used by educators in the form of conclusions and the creation of educational resources for the purpose of fostering the growth of a variety of skills in young children.

4. Conclusion

Mathematics skills of early childhood increased over the 8-week period, and each week the early childhood mathematics skills. There is a statistically significant difference at the .01 level. There were 9 items of teachers' and educators' satisfaction are at the highest level and 1 at the highest level. The aspect with the most satisfaction was educational materials are consistent with early childhood development and the aspect with the least satisfaction is educational materials enabling children to make self-discovery.

5. Recommendation

Studying the development of other early childhood skills such as language skills, listening, speaking, reading, and writing using educational materials is also essential. Early childhood teachers should follow up on the production and promotion of mathematics skills in young children by using this knowledge base to expand their results. By integrating various educational materials, teachers can encourage the holistic development of young children. For instance, literacy-based activities that incorporate math concepts have been found to enhance children's mathematics skills while also promoting language and literacy development. Further research in this area can contribute to the creation of more comprehensive educational resources that support the development of various skills in young children.

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