

LEARNING MATHEMATICS THROUGH CARD GAME: ENHANCING CHILDREN'S NUMERACY SKILLS

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ABSTRACT: Numeracy knowledge has recently received a great deal of attention from both researchers and policy makers. Children with poor numeracy knowledge will affect their future in life since numeracy is beyond numbers. Based on previous studies, game-based learning is an effective way of learning numeracy among young children. This study was carried out to determine the effectiveness of game cards in learning numbers and children's perception of the usage of game cards in learning numeracy. This research employed a quantitative approach and qualitative approaches. A group of 70 children was selected as respondents. A set of tests was designed to gain respondents' performance (before-after play card game) and a questionnaire to gather children's perception towards the game card approach. A record observation also used to determine children's motivation, efficacy, and engagement during playing the game card. The major finding found that there was a significant improvement in children's performance in numeracy after playing the game card. The finding also indicated that the game card was promoting a positive perception of learning numbers among children. Through the observation, it was found that game cards could enhance children's motivation, efficacy, and engagement in learning. The game cards should be integrated into the teaching and learning by the teacher in order to make the teaching method fun, interactive, and to remain children's engagement in learning.

Keywords: Numeracy skills, Engagement, game card, motivation, perception.

1. INTRODUCTION

An engaging and encouraging climate for children's early encounters with mathematics develops their confidence in their ability to understand and use mathematics in the future. These positive experiences help children to develop dispositions such as curiosity, imagination, flexibility, inventiveness, and persistence, which contribute to their future success in and out of school. Children show an informal understanding of many numeracy concepts before they start learning mathematics at school as such their capacity to compare, share, order, estimate, and calculate different quantities. Hence, it shows that the importance and development of pre-schoolers' numeracy skills are fundamental for those involved in early years education so they can help the children to develop their skills in early learning contexts and provide appropriate school-entry teaching and learning [1, 2]. Poor numeracy achievement will affect everyone's ability to succeed in future since numeracy is not limited to the ability to use numbers, to add, subtract, multiply and divide but it encompasses the ability to use mathematical understanding and skills to solve problems in daily life and also in the workplace [3]. In order to have this ability, children need to be able to think and communicate quantitatively, i) number sense, ii) a spatial awareness, iii) understand patterns sequences, and to recognize situations where mathematical reasoning can be applied to solve complex problems.

In Malaysia, students who are incompetent in mastering numeracy concepts remain as a national issue in primary education level. As reported by Bidang Keberhasilan Utama Nasional (NKRA), the percentage of standard 1 pupils did not master numeracy is 24% (117024) in 2008. For 2012, Daily School Management Department reported that 9.3% percentage of standard 1 pupils could not master numeracy. This issue became a major concern to the Ministry of Education (MoE) when the target could not be achieved.

In 2012, 100% of children mastered numeracy. This is because if a child who begins with relatively low levels of math knowledge tends to progress more slowly and fall behind in schools. If the children started with low achievement at an early age, it will contribute to excel in math in later years, especially in secondary and tertiary levels. Hence, it is very important to improve the math achievement of young children starting by identifying numbers and operations as the primary early math content area [4].

Starting the year 2019, MoE stated that preschools and early primary schools should nurture the potential of children in all aspects of development, master basic skills, and foster positive attitudes in preparing them for later education. The concept used is "Learning while Playing" by emphasizing the "Themed Learning". Besides that, fun learning concepts is suitable for nowadays young children are known as Gen Z (who were born from 1995 - 2012) and Gen Alpha (who were born from 2013 to 2025). Based on recent studies, Gen Z and Gen Alpha are preferred to learn through interactive mediums, collaborative projects, and challenges rather than long explanatory lessons.

Even though there were many people who believe play is a waste of time in school. Many teachers and parents are anxious that if children are 'playing' games, then they cannot be learning much [5]. Consequently, playtime has decreased and has been replaced with academically-focused activities and lessons. Teachers from preschool reported that in preschool center's classes, they still apply teacher-centered, seems not to use play as a method in teaching preschool children, not involving collaborative learning [6]. However, recent researches show that children who engage in complex forms of socio-dramatic play have greater language skills, social skills, more empathy, more imagination, and more subtle capacity to know what other means than nonplayers [7].

In [7], it is stated that young children work hard at play. They suggested introducing play-based learning among young children have a strong foundation in numeracy among kindergarten and 1st grade particularly. The educators will play an important role which they will attune to the children's play themes and builds on them while introducing new content and play materials to stimulate their minds [7, 8].

Why play is important for learning and development for early childhood? As reported by [9], 1) play is meaningful – children play to make sense of the world around them, find meaning in an experience, 2) play is joyful – they often smiling and laughing, 3) play is actively engaging – they will actively involve, 4) play is iterative – play and learning are not static 5) play is socially interactive – allows children to communicate ideas. This is supported by previous studies the advantages of learning while playing which are children have fun and enjoy [10, 11, 12], no pressure and fear of failure [5, 13, 14], trying to win [10, 11], (Nisbet & Williams, 2009)), can memorize fact indirectly [11, 10], will actively involve in games [11, 10, 15].

In addition, learning through games can stimulate the learning environment since it can provide positive educational experiences and opportunities which will help children to develop mathematical knowledge and skills [11]. Playing a number of games with a specialist teacher could enhance children's numeracy learning [16]. Besides that, playing games in learning numeracy will allow the children to talk and explore ideas together helps children to clarify their thinking and understanding of key concepts [8, 17, 12, 15, 16, 18], develop mathematical knowledge and skills [19, 17, 20], mental computational [11], improve children's broader knowledge of numerical magnitude [17, 18].

There were many studies that showed that attitudes are integrally linked to learning and achievement, including mathematics learning and achievement. As children involved in games in learning, there is an improvement in students' attitudes to chance, namely, greater enjoyment and motivation [16, 13, 15], increased perception of the usefulness of chance, and less anxiety, [13, 14], remain the children's engagement in learning [21, 17, 20], and risk-taking [13]. This study focused on the usage of numeracy game cards to enhance children's understanding of numeracy. The aim of this study is to investigate the effectiveness of game cards in enhancing children's performance in learning numeracy. Specifically, the questions addressed are:

- Is there any significant difference in children's performance in learning numeracy before and after playing the card game?
- What is the children's perception of learning numeracy through game card?
- How is the children's motivation, efficacy, and engagement in learning numeracy through game card?

2. METHODOLOGY

This study was conducted using mixed approaches which are both quantitative and qualitative. A quasi-experimental research design was utilized to determine the effectiveness of

the card game in improving children's numeracy. The descriptive research design is used to determine children's perception of the usage of the card game in learning numeracy. The qualitative method used to observe the children's motivation, efficacy, and engagement in learning numbers using the game card.

A. Subjects

A simple random sampling technique was employed to identify the schools as this technique could give each and every sample an equal and fair chance of being selected. A total of 70 children with 30 boys and 40 girls from several schools.

B. Instrumentations

Three instruments were developed which are numeracy test (pre-test and post-test), questionnaire, and observations' checklist. The pre-test is distributed before playing the game card. The post-test and questionnaire are distributed over six weeks of learning and playing numbers through the game card. The Likert scale used in this questionnaire from 1 to 5 using smiley symbols which easier for children to respond. Observation's checklist was used to observe children's motivation, efficacy, and engagement in learning numbers through the game card.

3. FINDINGS

A. *Is there any significant difference in children's performance in numeracy before and after playing the card game?*

As shown in Table 1, the mean score of the post-test ($M=26.83$, $SD=5.06$) is higher than the mean score in the pre-test ($M=20.43$, $SD=5.42$). To determine if the scores are significantly different, a paired sample t-test was conducted.

Table 1: Descriptive of Children Performance Before And After Played The Game Card

Type of test	Mean	N	Std. Deviation
Pre-test	20.43	70	5.42
Post-test	26.83	70	5.06

Note: Full mark=40

Table 2: Paired-Sample T-Test Between Pre-Test And Post-Test

Pair	Paired Differences		t	df	Sig. (2-tailed)
	Mean	Std. Deviation			
Pre-post test	-6.40	3.97602	-13.47	69	0.00

The independent sample t-test in Table 2 revealed that there was a significant difference in the mean scores of pre-test and post-test achievement in the numeracy test. Therefore, this finding indicates that there is an improvement in children's numeracy before and after playing the card.

B. *What is children's perception of learning numbers through game card?*

This section details children's perceptions of learning numbers using a game card. The overall results (mean = 4.75; $SD = 0.32$) in Table 3 indicates a high level of agreement towards learning number using a game card is beneficial and interesting among children.

Table 3: Children's perception of learning number using the game card (n = 70)

Item	Part C: Items	Mean	SD
1	I enjoy learning numbers through this game.	4.25	0.61
2	I feel confident to answer questions while playing this game.	4.85	0.12
3	I understand more about numbers through this game.	4.65	0.13
4	I keep trying until I get the right answer.	4.90	0.35
5	I feel this game is fun and knowledgeable.	4.25	0.09
6	I feel easy to learn numbers through the game card.	4.75	0.72
7	I know the relationship between the numbers after playing the game card.	4.53	0.53
8	I can answer questions about numbers after playing the game.	4.63	0.14
9	I feel a more relaxed learning number through the game.	4.03	0.86
10	The game card is really helpful for me in learning numbers.	4.92	0.55
Overall Mean		4.75	0.32

Note: 1 to 5 (1 Strongly Disagree, 5 = Strongly Agree)

Item 1, 'I enjoy learning number through this game' was positively and favorably rated at a mean score of 4.25; SD (0.61). This implies that most of the children were enjoyed learning numbers through the game card. The children also positively rated Item 2, 'I feel confident to answer questions related in numbers while playing this game' at a mean score 4.85; SD (0.12) which expressed that the children were gaining their confidence to answer questions while playing game card. This would promote motivation to the children to answer the question related to the numbers. Item 3, 'I understand more about number through this game' yielded a favorable response from the children with a mean score of 4.65; SD (0.13). It shows that the game card has enhanced children's meaningful about the numbers. Item 4, 'I keep trying until I get the right answer' also received a high level of agreement among the children with a mean score of 4.90; SD (0.35). This implied that the game card has encouraged children to effort in learning numbers. The children also favorably rated Item 5, 'I feel this game is fun and knowledgeable' at a mean score of 4.25; SD (0.09) which shows that the children have agreed that learning numbers through the game were very fun and meaningful to them. Item 6, 'I feel easy to learn number through the game card.' yielded a highly favorable response from the children with a mean score of 4.75; SD (0.72). It expressed that the game card has made the children understand faster and easier compared with the traditional method. The next item which is Item 7, 'I know the relationship between the numbers after playing the game card.' gives a mean score of 4.53; SD (0.53). This implied that most children expressed that they

have relied on the interconnection between the numbers after playing the game card. In other words, the children's felt that their number sense has increased after playing the game card. A positively mean score of 4.63; SD (0.14) was rated for Item 8, 'I can answer questions about number after playing the game'. It seemed that the children are believed that they are more competent in numeracy and able to solve numeracy problems in the future. Item 9, 'I feel more relaxed learning number through the game' had been rated at a mean score of 4.03; SD (0.86) which means children agreed that they were feeling more comfortable and calm when learning numbers using the game card. Finally, Item 10, 'Game card is really helpful for me in learning numbers' was rated at the highest level of agreement with a mean score of 4.92; SD (0.55). The majority of the children felt that the game card was considered as an effective teaching aid and tools in learning numbers.

C. Children's motivation and engagement in learning numbers through game card

There are three aspects that have been observed which are children's motivation, efficacy, and engagement during play the game card. Based on observation, it is discovered that the children show highly motivated and enjoyed when playing the game card (Figure 1). It was proven when the children seem excited when the teacher introduced the game card in class. They insist to know the instruction of playing the game. Children are observed (Figure 2) to be very energetic and actively participate when playing the game card. It was observed that the children are very careful when taking out their cards to ensure that the card has the same numbers between an opened card on the desk (since each player cannot see their own card). The children are excited to say "attack" (win) loudly without realizing that the card is not similar (loss). It is showed that games could develop children's confidence and trying so hard to win a level in learning. Besides that, communication and discussion happened among children regarding the correct answer assisted by the teacher. The game card provoked each child to communicate to defend their answer and to share ideas together to clarify their thinking.

Figure 2 and Figure 3 describe the children's emotions and efficacy while playing the game card. It was observed that the children expressed their satisfaction playing game cards through verbally (speak loudly) and non-verbally (facial expression). They shouted, "yes, I win" and "yahoo" that signed as enjoy and contented. Besides, they also tend to speak loudly when they manage to see the similarities of numbers between the cards (without any fear and anxiety). At the beginning of the playing, the children are not able to see the similarities quickly or take time in determining the similarities of numbers, they looked frustrated. However, after several rounds played the game card, these children can identify the similarities between the numbers and become more competent to determine the characteristics of numbers quickly. Consequently, children remained engaged in the gameplay even after multiple sessions. This proved that the game card promotes enhancing children's motivation in learning number indirectly.



Figure 1. Children look excited playing Numeranto Game card



Figure 2. Children show satisfaction when he/she wins



Figure 3. Children show frustration when he/she loses.

4. DISCUSSION AND CONCLUSION

This study investigated the effectiveness of the game card in improving children's numeracy. This has proved that a game card is a powerful tool in enhancing children's numeracy in the future. The finding indicated that there is a significant difference in children's performance in numeracy before and after the treatment of playing the game card. The children's performance after six weeks (post-test, $M=26.83$, $SD=5.06$) is higher as compared with their performance before playing the game card (pre-test, $M=20.43$, $SD=5.42$). This finding was supported by [22] that suggested that game-based learning could enhance children's performance in learning numeracy. Therefore, it is proved that educational games could be an alternative approach in teaching and learning numeracy among children. It is to grant the MoE wish to integrate "Learning while Playing" concepts in the classroom to overcome the numeracy problems.

Besides, the children also have agreed that the game card provided a positively beneficial improvement in their numeracy achievement (Overall mean = 4.75; $SD = 0.32$). It is interesting to note that in this study children's felt that game card has attracted their attention in learning numbers. This finding is parallel with previous studies which stated that games could sustain the children's concentrations and engagement in learning even after a long period and multiple rounds of playing [17, 20]. Hence, it is a challenge to the teachers to help the younger children to be exposed to inappropriate experiences and teaching strategies by actively introducing the mathematical concepts, methods, and language [23].

From the observation, there was a high level of motivation and enjoyment among children who were excited when learning numeracy through the game card. As can be seen in the figures, all children have cheerful facial expressions during play the games even though they are a loss. This is because games can stimulate the learning environment to become attractive and comfortable [5, 11]. Learning the environment while playing can provide a positive range and comfortable situation for children. Besides that, teachers also play an important role in learning through games in supporting and approaching each child to participate actively in the game [15, 5; 24]. Consequently, it will increase the

children's engagement in the game even for long periods or multiple sessions which is hard to retain children's engagement in the traditional way [12 . 25].

During the learning process occurred informally with the guidance by the teacher, children viewed their teacher being more supportive, approachable, and interested. Hence, children can learn with no pressure and fear of failure since they enjoyed the game [5, 24]. It will give children's chance to communicate with less anxiety to describe orally their move in any game and discussion occurs within them [5, 8, 12, 16, 23]. This can be seen in the finding which the children discuss the answer by using their prior mathematical knowledge and concept regarding numbers confidently. It is showed that children had less anxiety, more confidence, and dare to take risks when playing the games [12, 25, 13, 14]. It can be concluded that learning numeracy through games could enhance children's achievement, enjoyment, engagement, motivation, and communication regarding mathematical concepts.

This research was an only small-scale research where the findings could not be generalized to a larger population; the results in this research may not be enough to provide in-depth insights into Malaysian primary children's achievement in mathematical learning as overall. For future studies, the scope of the sample could be expanded to include a greater number of children and schools, and mathematics teachers would thus be able to make use of the results to better, handle low-achievers and formulate remedial measures for them. It is hoped that the information and research findings obtained in current and future attempts will give rise to better strategies and measures for promoting student understanding and achievement in numeracy in the future.

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5. REFERENCES

- [1] D. K. Reid, Counting on it: Early numeracy development and the preschool child, Camberwell VIC 3124: Australian Council for Educational Research, 2016.
- [2] T. W. Watts, G. . J. Duncan, R. S. Siegler and . P. E. Davis-Kean, "What's Past Is Prologue: Relations Between Early Mathematics Knowledge and High School Achievement," American Educational Research Association, pp. 353-360, 2014.
- [3] N. M. Tajudin, N. Idris and S. R. Ali, "Assessing Thinking Strategy of Numeracy Primary School Pupils," Communications on Applied Electronics (CAE), pp. 6-11, 2016.
- [4] D. Frye, A. J. Baroody, M. Burchinal, S. M. Carver, N. C. Jordan and J. McDowell, Teaching Math to Young Children, Institute of Education Sciences (IES), 2014.

- [5] B. W. Seer, "The Teacher's Role in Promoting Literacy and Numeracy," 2013. [Online]. Available: www.urnwa.org. [Accessed 2019].
- [6] R. M. Majzub, "Critical Issues in Preschool Education in Malaysia," *Recent Advances in Educational Technologies*, pp. 150-155, 2014.
- [7] E. Miller and J. Almon, "Crisis in the Kindergarten," *Alliance for Childhood*, 2009.
- [8] G. B. Ramani, M. L. Rowe, S. H. Eason and K. A. Leech, "Math talk during informal learning activities in Head Start families," *Elsevier Inc.*, pp. 15-33, 2015.
- [9] UNICEF. (2018). *Learning Through Play*. UNICEF.
- [10] M. R. Dillon, H. Kannan, J. T. Dean, E. S. Spelke and E. Duflo, "Cognitive science in the field: A preschool intervention durably enhances intuitive but not formal mathematics," *Science*, 2017.
- [11] S. R. Ali and F. Mukhtar, "A CASE STUDY OF FUN LEARNING WITH NUMERACY OF PRESCHOOLERS," *International Journal of Early Childhood Education Care*, pp. 51-58, 2017.
- [12] E. Afari, "Investigating the Effectiveness of Mathematics Games on Students' Attitudes and the Learning Environment," *Science and Mathematics Education Centre, Curtin University*, 2012.
- [13] S. Nisbet and A. Williams, "Improving students' attitudes to chance with games and activities," *Australian Mathematics Teacher*, 2009.
- [14] A. Dowker, K. Bennett and L. Smith, "Attitudes to Mathematics in Primary School Children," *Child Development Research*, pp. 1-8 (8 pages), 2012.
- [15] E. deVries and L. Thomas, "Teaching Mathematics and Play-based Learning in an Indigenous Early Childhood Setting: Early Childhood Teachers' Perspectives.," in *Shaping the future of mathematics education: Proceedings of the 33rd annual conference of the Mathematics Education Research Group of Australasia*. Fremantle: MERGA, 2011.
- [16] F. Vogt, B. Hauser, R. Stebler, K. Rechsteiner and C. Urech, "Learning through play – pedagogy and learning outcomes in early childhood mathematics," *EUROPEAN EARLY CHILDHOOD EDUCATION RESEARCH JOURNAL*, p. 589–603, 2018.
- [17] G. B. Ramani and R. Siegler, "Oxford Handbooks," 2014. [Online]. Available: <https://www.researchgate.net/publication/263503931>. [Accessed 2019].
- [18] G. B. Ramani and N. R. Siegler, "It's more than just fun and games: Play-based mathematics activities for Head Start families," *Elsevier Inc.*, pp. 1-12, 2018.
- [19] J. M. Young-Loveridge, "Effects on early numeracy of a program using number books and games," *Elsevier Inc.*, pp. 82-98, 2004.
- [20] C. Cohrssen, A. Church and C. Tayler, "Play-Based Mathematics Activities as a Resource for Changing Educator Attitudes and Practice," *SAGE Open*, pp. 1-14, 2016.
- [21] M. I. Susperreguy, H. Douglas, C. Xu, N. Molina-Rojas and J.-A. LeFevre, "Expanding the Home Numeracy Model to Chilean children: Relations among parental expectations, attitudes, activities, and children's mathematical outcomes," *Elsevier*, pp. 1-13, 2018.
- [22] S. P. Hwa, "Pedagogical Change in Mathematics Learning: Harnessing the Power of Digital Game-Based Learning," *Educational Technology & Society*, vol. 21, no. 4, 2018.
- [23] NCTM, "NCTM Position," 2013. [Online]. Available: [https://www.nctm.org/uploadedFiles/Standards_and_Positions/Position_Statements/Early%20Childhood%20Mathematics%20\(2013\).pdf](https://www.nctm.org/uploadedFiles/Standards_and_Positions/Position_Statements/Early%20Childhood%20Mathematics%20(2013).pdf). [Accessed 2019].
- [24] S. Z. Ahmad and A. A. Mutalib, "Preliminary Study: An Investigation on Learning Assistance Requirement among Low Achievers in Primary Schools," *International Journal of Computer Applications (0975 – 8887)*, pp. 48-54, 2015.
- [25] A. J. Kiss, "Investigating Young Children's Attitudes toward Mathematics: Improved Measurement and the Relation to Achievement," *UNIVERSITY OF MINNESOTA*, 2018.

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