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Effects on early mathematics of a program using games, picture books and worksheets

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ABSTRACT

This study examines the effect of three teaching methods, i.e., games, picture books, and worksheets on early mathematics performance among preschool children. The research utilized the test of early mathematics abilities aligned with Malaysia's National Standard Preschool Curriculum. A quantitative approach was adopted employing a multi-site quasi-experimental design with 1,100 preschool children aged 4 and 5 from national preschools in Sabah, Malaysia. Data analysis was conducted using one-way ANOVA and ANCOVA through SPSS version 28. Among the three methods tested (play-based, picture books, and worksheets), the play-based method yielded the highest achievement followed by worksheets and picture books. Although the intervention program implemented in this study did not produce dramatic improvements, it provides positive insights into preschool children's potential for early mathematics performance, especially the importance of using this method in large groups to optimize children's knowledge acquisition and skills. The results revealed a significant impact of teaching methods on early mathematics performance. Teachers should utilize play-based teaching methods to the greatest extent possible to enhance the early math achievement of preschool children.

Contribution/Originality: The novelty of this study is preschool teachers as a reference source in their efforts to reform the need for games, number books, and worksheets.

1. INTRODUCTION

Recently, Asian countries made significant progress in making quality Early Childhood Care and Education (ECCE). Malaysian students' mathematics performance has continued to decline as evidenced by notable drops in average scores in TIMSS and PISA assessments despite substantial investments in advancing education (de la Fuente & Doménech, 2024; Mullis, Martin, Foy, & Arora, 2012; Walker, 2011). The government has emphasized the importance of early education to ensure children receive a strong educational foundation from an early age to address this issue. Several researchers reported that early education yields long-term benefits significantly enhancing children's developmental outcomes and future academic achievements (Osher, Cantor, Berg, Steyer, & Rose, 2021).

Low mathematics achievement among preschoolers is attributed to several factors, including insufficient emphasis on effective teaching practices and students not being given much opportunity to develop a strong foundational understanding of mathematics (Kerschen, Cooper, Shelton, & Scott, 2018; Outhwaite, Aunio, Leung, & Van Herwegen, 2024; Turan & De Smedt, 2022). A significant contributing factor is the lack of research about

effective teaching methods for mathematics (Aksoy & Belgin Aksoy, 2023; Gifford*, 2004). We must continue to identify instructional practices that provide quality instruction for every child considering the importance of early experiences and mathematics education.

Previous studies, such as those conducted by Young-Loveridge (2004) demonstrated that using picture books and games in program improved children's numeracy skills, resulting in significantly greater gains compared to contrast groups. While the impact gradually diminished after the intervention ended, the benefits remained statistically significant for more than a year. However, the study did not specify whether the play-based method or the picture book approach was more effective. This study investigates the effect of three teaching methods on early mathematics performance.

1.1. Research Objectives

1. To identify and compare differences in early mathematics performance among preschoolers exposed to the teaching methods of games, picture books and worksheets.
2. To identify and compare the mean scores of early mathematics performance among preschoolers using games, picture books and worksheets as teaching methods with pre-test scores controlled as covariates.

1.2. Research Questions

1. Is there a significant difference in early mathematics performance among preschoolers exposed to the teaching methods of games, picture books and worksheets?
2. Is there a significant difference in the mean scores of early mathematics performance among preschoolers using the teaching methods of games, picture books and worksheets, controlling for pre-test scores as covariates?

1.3. Research Hypotheses

H_{o1}: There is no significant difference in early mathematics performance among preschoolers exposed to the teaching methods of games, picture books and worksheets.

H_{o2}: There is no significant difference in the mean scores of early mathematics performance among preschoolers using the teaching methods of games, picture books and worksheets controlling for pre-test scores as covariates.

2. LITERATURE REVIEW

2.1. Teaching Methods

Globalization has brought significant changes to various aspects of life, including education in the 21st century. These changes demand innovative teaching methods to cultivate a generation equipped with critical thinking, creativity and competitiveness in the global arena. Effective approaches such as games, picture books and worksheets are essential for fostering young learners' early mathematics skills and supporting their overall development.

2.2. Play-Based Learning

Play is widely recognized as a vital component of early childhood education worldwide. The popular motto in Malaysia "children learn through play" highlights its importance in exposing children to learning-based play. Additionally, it cultivates positive values such as patience, cooperation and mutual respect essential for building a harmonious society (Madondo & Tsikira, 2022).

Studies by Doig and Ompok (2010) indicate that activities involving concrete or tangible materials help children understand mathematical concepts like addition and subtraction. A similar study conducted by Noraidi, Shin, Ompok, Idang, and Sukor (2024) discovered that integrating games with nature significantly enhances

children's cognitive development, making it easier for them to grasp mathematical concepts. Although games are widely recognized as effective learning tools, challenges remain in their integration into curricula.

Since the times of education pioneers like Froebel and Montessori, games have been acknowledged as an essential teaching method. However, the perception of play as mere entertainment persists among parents and society, such as children playing and not learning. Piaget (1962) categorized games into types, such as sensory-motor training and symbolic play, which correspond to children's cognitive development stages. King and Purpura (2021) emphasize how structured games can teach mathematical concepts such as addition and subtraction. Bagès, Hoareau, and Guerrien (2021) argue that games can be implemented through manipulatives and social interactions among teachers and children. Although it is impossible to know how widespread the view is that games are not just as recreational activities, there is evidence from several sources that games are powerful tools for achieving educational objectives.

2.3. Picture Books Method

One recent alternative that has received strong support from many mathematics teachers involves using children's literature to teach mathematics. Casey, Kersh, and Young (2004) suggest that storytelling through children's books serves as an effective tool in mathematics education, providing meaningful value and fostering positive attitudes toward the subject.

Van den Heuvel-Panhuizen, Van Den Boogaard, and Doig (2009) assert that the use of storybooks can make mathematics concepts relevant to children because stories can spark interest, reduce fear of the subject, and promote memory retention and analytical thinking. Ang, Sun, and Cheung (2024) found that the genre of the book, whether in a narrative or non-narrative context, influences the types of interactions that occur and the depth of mathematical thinking that is fostered during the discussion. This suggests that the choice of book can play a crucial role in shaping the learning experience and the extent to which mathematical concepts are explored in a meaningful way.

2.4. Worksheets Method

The use of worksheets in preschool education in Malaysia is often a primary choice for teachers maybe due to the high teacher-student ratios in classrooms and their vital role in reinforcing concepts. However, studies such as those by Siraj-Blatchford and Nah (2014) and Grossman (1996) suggest that worksheets risk creating a passive learning environment where children merely follow teacher instructions and replicate answers without engaging in critical thinking. This makes worksheets less suitable for active learning and play-based approaches, which prioritize creativity and imagination in children. A study by Simsek (2023) found that preservice teachers avoid using worksheets because they can hinder learning through play and limit curiosity and discovery. Since their main goal is teaching, worksheets take away the opportunity for play-based learning. They also reduce a child's natural curiosity by preventing exploration. Additionally, the teachers pointed out that worksheets typically have only one correct answer, yet the same worksheets are for children, ignoring their differences. Grossman (1996) noted that worksheet activities could lower children's self-confidence, particularly when they feel inadequate if their answers do not meet expectations.

Play-based methods allow children to think creatively and solve problems meaningfully. For instance, the integration of play into mathematics teaching enriches children's learning experiences by connecting mathematical concepts with engaging real-world situations. This aligns with Wien (2002) who demonstrated the benefits of shifting from worksheet-based learning to play-based activities, fostering children's enthusiasm for learning. Thus, many researchers and teachers recommend providing opportunities for enjoyable and interactive learning through play to encourage more holistic and effective development while worksheets are often used in preschool contexts.

2.5. Effects of Play-Based Methods on Early Mathematics Performance

Studies indicate that play-and-learn approaches have the potential to significantly enhance mathematics achievement among children. Numerous studies report improvements in numeracy skills following involvement in play-based activities. Kumas and Ergül (2021) revealed that the child-centered and play-based activities effectively supported children's mathematical development. Additionally, the children in the experimental group enjoyed the program and expressed interest in doing similar activities in their classrooms. Kamii and Rummelsburg (2008) emphasized that play links mathematical concepts to real-life situations, enhancing children's learning experiences. Teacher support and guidance during play activities support children's learning and development. According to Nergård (2023) adults' attitudes toward mathematics and their interaction with their children play a crucial role in facilitating and guiding conversations. No matter the messages they convey to their children, adults help create an environment where argumentation and reasoning can flourish, thus enhancing the educational value of play-based learning experiences.

Moreover, play-based methods have been proven more effective in fostering greater understanding and analytical thinking due to repeated play and reinforcement of strategy (Thorell, Lindqvist, Bergman Nutley, Bohlin, & Klingberg, 2009). According to Derman, Kizilaslan, and Arslan (2020) incorporating play and other interactive activities into math lessons greatly enhances basic mathematical knowledge and skills. However, gaps remain in the empirical evidence on the effects of play on early mathematics performance in Malaysia. This highlights the need for specifically designed play activities to further assess their impact.

2.6. The Effects of Using Picture Books on Early Mathematics Performance in Children

Studies show that merging reading with math in engaging ways boosts children's math knowledge and skills. According to Galea, Robidoux, Salins, Noble, and McArthur (2024) regular reading helps develop early literacy and numeracy. A study by Jennings, Jennings, Richey, and Dixon-Krauss (1992) and Casey, Erkut, Ceder, and Young (2008) found that picture books combined with math lessons increase children's interest and understanding of math concepts. Research by Hong (1996) and Peng et al. (2020) reported that using picture books in math teaching improves children's math achievements. However, using manipulatives with picture books didn't significantly enhance performance. Hong (1996) concluded that using picture books with manipulatives doesn't notably impact early math skills.

Young-Loveridge (2004) conducted research in New Zealand. The finding shows that incorporating picture books and games into early math programs enhances the numerical skills of five-year-olds. Although it wasn't clear if picture books or games were more effective. Research suggests that picture books can significantly improve early math achievement. There is still a lack of specific research, especially in Malaysia and among preschoolers. Additional research is necessary to understand the effects of picture books in math teaching (Casey et al., 2008; Jennings et al., 1992; Purpura et al., 2021).

2.7. The Effects of Using Worksheets on Early Mathematical Achievement in Children

Research on the use of worksheets in teaching mathematics to preschool remains limited with differing views on their effectiveness. Ransom and Manning (2013) acknowledged that worksheets are widely accepted and beneficial in teaching. Both digital learning environments generated significantly higher motivation compared to the use of worksheets (Oberdörfer, Elsässer, Grafe, & Latoschik, 2024). As a result, worksheets are considered less developmentally appropriate for optimizing children's learning potential.

2.8. Criticisms of Worksheet-Based Teaching Methods and Alternative Approaches

While worksheet-based teaching methods have faced criticism, researchers such as Bowman, Donovan, and Burns (2001) underscore the significance of employing this approach in large-group settings to enhance children's

knowledge acquisition. A study conducted by Wößmann (2007) revealed the detrimental effects of high teacher-student ratios on academic performance. In classrooms where teachers emphasized task completion and utilized basic skills worksheets as the main instructional tool, students tended to perceive their assignments as obligatory tasks rather than as valuable learning opportunities (Marshall, 1994).

In this context, previous research indicates that the use of various methods, such as worksheets, games and picture books has different impacts on early mathematical achievement in children with no single method proving to be the most effective. Further research is needed to identify the most suitable methods to improve preschool children's mathematical achievements, particularly in the context of education in developing countries like Malaysia.

2.9. Development of Early Numbers

Previous research by Starkey, Spelke, and Gelman (1990) on infants aged six to nine months revealed that they gazed longer at cards displaying a greater number of objects, such as three instead of two. Similarly, Wynn (1992) found that infants aged four to five months focused more on unexpected changes in object quantity through addition or subtraction than on predictable outcomes. A study by Palmer and Baroody (2011) tracked the development of early numerical understanding—specifically the numbers one, two, and three in a child named Blake from 18 to 49 months old. These findings support the widely held belief among experts in mathematics education that children possess innate mathematical abilities from an early age.

3. METHODOLOGY

This study utilized a quasi-experimental design. A total of 1,100 participants were involved in the intervention program. The minimum sample size was calculated using Krejcie and Morgan's (1970) table, which specifies at least 331 participants per method for a population of 2,500.

The sample consisted of preschool children from national preschools in Sabah, including Ministry of Education (MOE) preschools and Jabatan Kemajuan Masyarakat (KEMAS) kindergartens. Participants were assigned to the following three groups based on teaching methods: games, picture books, and worksheets. Each group underwent a pre-test followed by a 10-week early mathematics intervention program and a post-test.

3.1. Study Implementation

Preschool teachers were trained to conduct pre-tests, implement activity-based methods and administer post-tests, all of which were developed by the researcher.

The researcher conducted meetings with all early childhood teachers to explain the study's objectives and encourage their support during the activities. The training sessions were carried out over three weeks divided into three separate sessions. Great attention was given to the intervention program which was outlined in a comprehensive manual. Several pilot studies were conducted to evaluate the suitability of teaching materials used in this study throughout the study.

3.2. Quasi-Experimental Design

According to Crowl (1993) random selection of respondents is often not feasible in educational research due to potential disruptions to school schedules. Therefore, intact sampling was employed, whereby respondents were selected from existing classes without any modifications to their arrangements. This study adopted a non-equivalent control group design with three treatments: games, picture books and worksheets. Efforts were made to ensure that the groups shared similar characteristics, maintaining the study's naturalistic context. The quasi-experimental design incorporated pre-and post- tests as outlined in Table 1.

Table 1. Quasi-experimental design.

Groups	Pre-tests	Intervention	Post-tests
Games	P1	Games with an instructional manual	P2
Picture books	BK1	Picture books with an instructional manual	BK2
Worksheets	LK1	Worksheets with an instructional manual	LK2

3.3. Validity and Reliability of the Study

Campbell and Stanley (1966) categorize validity in quasi-experimental design into two types: internal validity, which relates to the accuracy of the study in representing the actual phenomenon, and external validity, which pertains to the generality of the findings to a larger population. Meanwhile, reliability refers to the consistency of the study's data (Gay & Airasian, 2003; Wiersma, 1985).

3.3.1. Internal Validity

Several measures were taken to ensure internal validity. The researchers developed new teaching aids for the intervention and carefully monitored external factors that could influence experimental results. All participants were of the same age and received a 10-week intervention. Pre- and post-tests with different questions but the same standard were administered to minimize testing effects though disparities in these questions could affect internal validity.

The sample size was increased, and efforts were made to mitigate the Hawthorne effect by providing all the groups with an unusual treatment and ensuring similar abilities across groups to address potential dropouts. Selection bias was controlled by ensuring that respondents' academic abilities were comparable and interactions among respondents in the three treatment groups were managed to avoid contamination.

3.3.2. External Validity

The study population consisted of preschool children from Sabah excluding those involved in the pilot study. The researcher ensured that the respondents were representative of the overall population.

Additionally, teachers were provided with training to ensure consistency in the delivery of the intervention. Activities were conducted naturally within classrooms during school hours to ensure that children were unaware of being observed.

3.3.3. Instrument Reliability

Reliability in research refers to the consistency of an instrument in measuring tasks, ensuring similar results upon repeated measurement (Wiersma, 1985). Chua (2009) outlines three methods for establishing reliability in quantitative research: pre-and post-testing, the split-half method and internal consistency.

3.4. Measurement Instrument

This study used the Early Mathematics Performance test (TEMA) adapted from Ginsburg and Baroody (2003) based on the National Preschool Standard Curriculum (NPSC) 2017. It consisted of 40 questions that were reviewed and modified by the researcher and preschool teachers to ensure alignment with the curriculum standards in mathematics.

TEMA-3 is a norm-referenced parallel forms test intended to identify the level of mathematical ability for children aged 3 through 8 years.

The standardization sample was composed of 1,219 children and internal consistency reliabilities are all above .92. The TEMA-3 assessment includes various questions that evaluate early mathematical skills. It begins with basic number perception and counting, including recognizing small numbers using fingers to represent 1, 2, and

many, counting aloud from 1 to 5, identifying larger quantities up to 10, producing small sets of 1 to 4 items nonverbally, enumerating up to 5 items, and understanding the concept of cardinality—all at an informal level. It then assesses early addition, subtraction, and number properties, such as performing nonverbal addition and subtraction, understanding number constancy, creating sets of up to 5 items, and using fingers to display numbers up to 5.

As counting skills progress, the assessment includes verbal counting up to 10, identifying the next number in a sequence (1 to 9) and reading and writing single-digit numerals. It also examines a child's ability to model simple addition word problems with sums up to 9 using concrete objects, understand part-whole relationships, and represent sets of up to 5 items in writing.

Further skills in number comparison and counting expansion are covered through tasks such as choosing the larger number when comparing values from 1 to 5 and 5 to 10, counting verbally up to 21, identifying the next number in sequences up to 40, enumerating 6 to 10 items, counting backward from 10, and demonstrating equal partitioning or fair sharing of discrete quantities.

The test also includes mental arithmetic and number representation, such as performing mental addition with sums from 5 to 9, producing a mental number line for single-digit values, producing sets of up to 19 items, reading teen numerals, writing two-digit numerals, counting verbally up to 42, and counting by tens up to 50. It assesses the understanding of symbolic additive commutativity, reading two-digit numerals and using a mental number line for two-digit numbers.

Finally, the assessment evaluates mastery of basic addition and subtraction facts, including solving subtraction problems in the form of N − N and N − 1, memorizing addition facts with sums up to 9, recalling sums of 10 and small doubles, solving subtraction facts, such as 10 − N and counting by two.

3.5. Intervention Program

In this study, an intervention program was designed by the authors. A pilot study was implemented with teachers to discuss the suitability of teaching aids such as play-based methods (see Appendix A), picture books (see Appendix B), and worksheets (see Appendix C). All materials were aligned with the test of mathematics abilities (Ginsburg & Baroody, 2003) early mathematical achievement (Mix, Huttenlocher, & Levine, 2002) and early mathematics skills outlined in the Science and Technology Strand of the National Standard Preschool Curriculum (NPCS). Each activity in each group was structured with consistent content standards variations in games, picture books and worksheets. The intervention was conducted over 10 weeks, each session lasting 15 to 30 minutes.

3.6. Pilot Study Findings

The internal consistency analysis revealed that the study instruments demonstrated high reliability. The pre-test reliability was measured at 0.87 while the post-test reliability was initially 0.882 but increased to 0.883 after removing item 4.

Figure 1 illustrates the pre-test fit map where item 1 was excluded since all respondents scored 1 on this question. Similarly, in Figure 2, item 1 remains omitted, and item 4 falls outside the acceptable infit mean square value range of 0.77 to 1.30. According to Pang (2005) items that do not meet the required range should be reviewed for ambiguity, revised for clarity or eliminated from the analysis.

For the actual investigation, the researcher intended to exclude items A1, A4, B1, and B4. However, early childhood education teachers' comments during the instrument presentation emphasized their importance because these elements were in line with the NPCS. The researchers decided to keep them and only modify the child's reaction time.

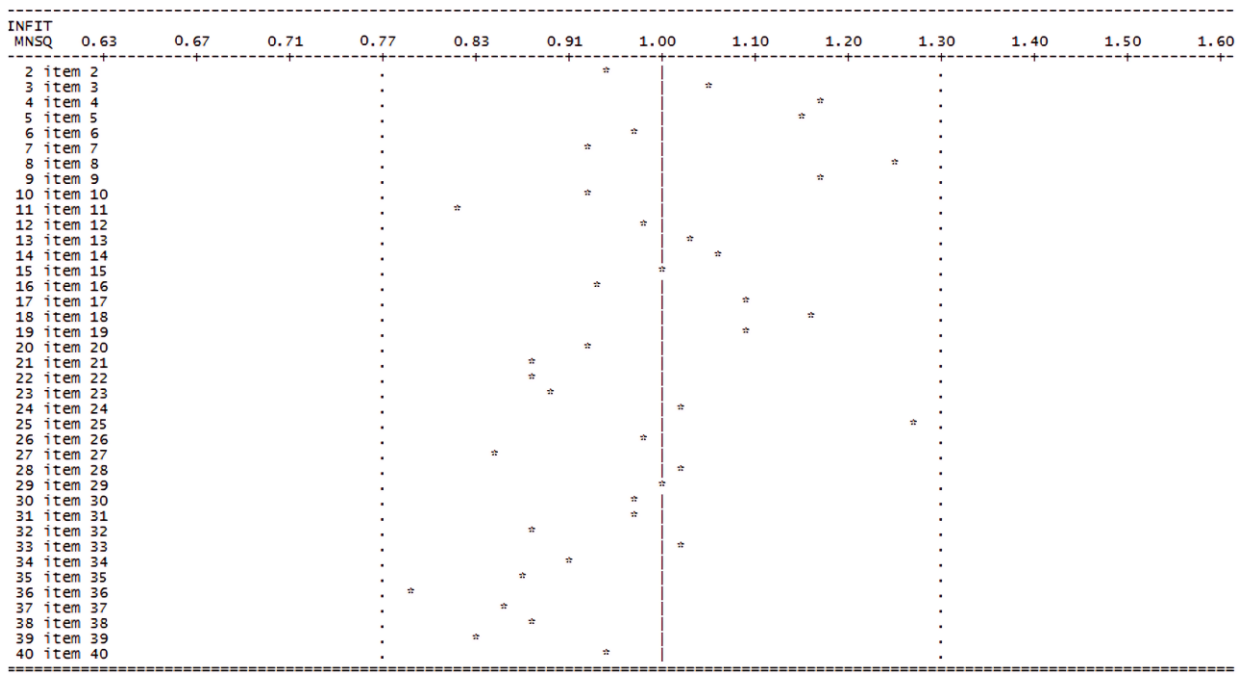

Figure 1. Item fit map in the pre-test.

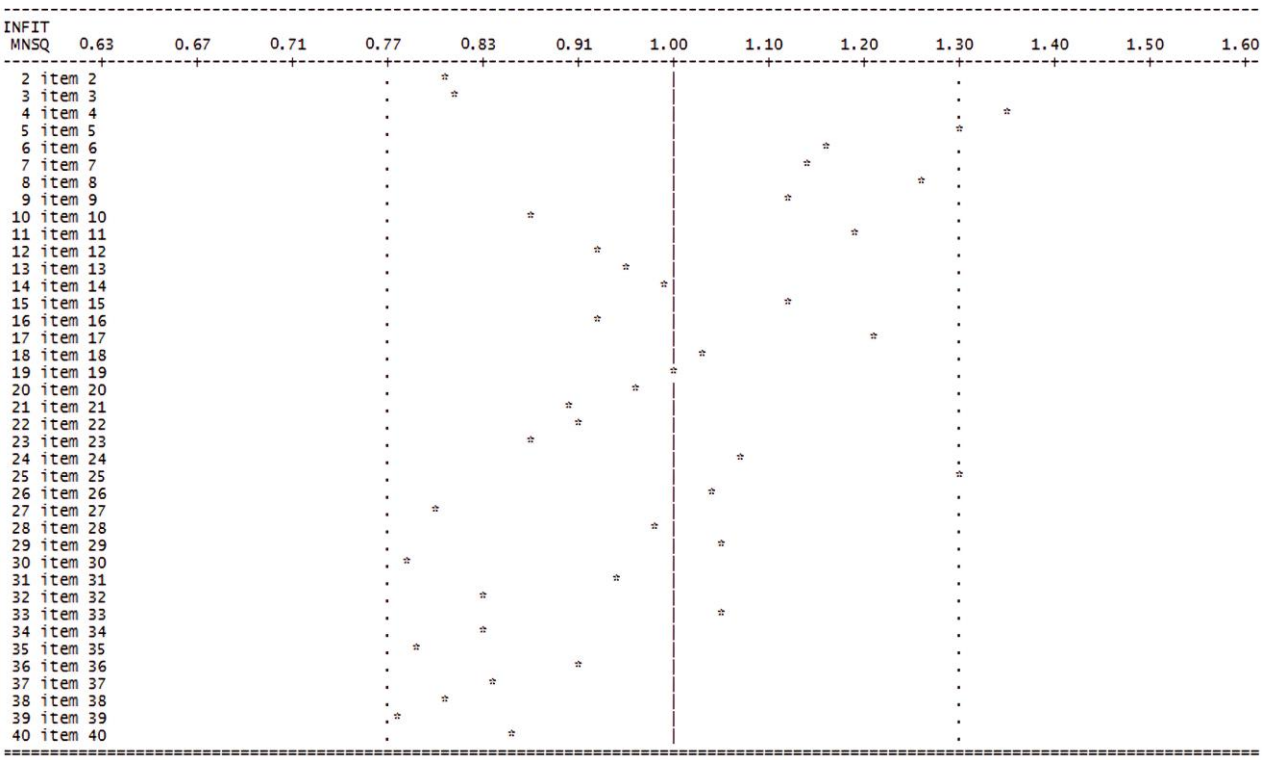

Figure 2. Item fit map in the post-test.

3.7. Data Analysis

Data analysis was conducted using SPSS 27 for Windows, employing descriptive and inferential statistical tests. Inferential statistics were employed to test the study's hypotheses. Independent variables included teaching methods (games, picture books and worksheets) while the dependent variable was early mathematics performance. Analysis of one-way ANOVA and Covariance (ANCOVA) was used to control pre-test scores and eliminate any bias in the analysis. If significant findings emerged, pairwise mean comparisons and estimated marginal means were conducted to determine specific differences between variables.

4. RESULTS

4.1. Difference in Early Mathematics Performance among Preschoolers Exposed to the Games, Picture Books and Worksheets Teaching Methods

Is there a significant difference in early mathematics performance among preschoolers exposed to the methods of games, picture books, and worksheets?

H_{o1}: There is no significant difference in early mathematics performance among preschoolers exposed to the teaching methods of games, picture books and worksheets.

Table 2 displays the results of tests of between-subjects effects for Ho1. The results of the one-way ANOVA test show that the difference in early mathematics performance between the three groups of teaching methods is significant [F (2, 1100) =17.0 and p<.05]. Based on these results, the null hypothesis is rejected.

Table 2. Tests of between-subjects effects for H_{o1}.

Dependent variable: Pre-test					
Sources	**Type III sum of squares**	**Df**	**Mean square**	**F**	**Sig.**
Corrected model	15223[a]	2	7611	17.00	0.00
Intercept	5108396	1	5108396	11437	0.00
Teaching method	15220	2	7611	17.00	0.00
Error	493530	1102	445		
Total	5642481	1106			
Corrected total	508751	1100			

Note: a. R squared = 0.030 (adjusted R squared = 0.027).

Table 3 displays pairwise comparisons for Ho_1. The results of pairwise comparisons (pairwise comparisons) by controlling type 1 error using the Bonferroni method. This shows that the mean value of early mathematics performance for the teaching method for the mean pair of games method and picture books (mean difference=8.68 and p<.05) is significantly different. The mean value of early mathematics performance for the teaching method for the mean pair of games method and worksheets (mean difference=6.50, and p<.05) is significantly different. The mean value of early mathematics performance for the teaching method for the mean pair of picture books and worksheets methods (mean difference=-2.10 and p>.05) is not significantly different. This means that the overall difference in early mathematics performance is due to the difference between the pair of games and picture books methods and the games and worksheets method.

Table 3. Pairwise comparisons for H_{o1}.

Dependent variable: Pre-test				
Teaching method(I)	**Teaching method (J)**	**Mean difference (I-J)**	**Std. error**	**Sig.[b]**
Games	Picture books	8.68*	1.55	0.00
	Worksheets	6.50*	1.50	0.00
Picture books	Games	-8.70*	1.55	0.00
	Worksheets	-2.10	1.55	0.50
Worksheets	Games	-6.50*	1.50	0.00
	Picture books	2.10	1.55	0.50

Note: Based on estimated marginal means.
*. The mean difference is significant at the .05 level.
b. Adjustment for multiple comparisons: Bonferroni.

Table 4 shows the univariate tests for Ho1 which confirm the results in the pairwise comparison table, (p<.05) Sig that there are pairs of comparisons that obtain significant results.

Table 4. Univariate tests for H_{o1}.

Dependent variable: Pre-test					
	Sum of squares	**Df**	**Mean square**	**F**	**Sig.**
Contrast	15223	2	7612	17.00	0.00
Error	493532	1100	447		

The F-test evaluates the effect of teaching methods. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

4.2. Difference in the Mean Scores of Early Mathematics Performance among Preschoolers Using the Games, Picture Books and Worksheets Teaching Methods Controlling Pre-Test Scores as Covariates

Is there a significant difference in the mean scores of early mathematics performance among preschoolers using the teaching methods of games, picture books, and worksheets controlling for pre-test scores as covariates?

Ho2: There is no significant difference in the mean scores of early mathematics performance among preschoolers using the teaching methods of games, picture books and worksheets, controlling for pre-test scores as covariates.

Table 5 displays the results of tests between subjects effects for Ho2. The results of the ANCOVA test show that there is a significant main effect of the independent variable of teaching method on the dependent variable of early mathematics performance [F (2, 1100) =17.00 and p<.05].

The results show that there is a significant main effect of the pre-test control variable on the dependent variable of early mathematics performance [F (1, 1100) =633 and p<.05]. These results show that by controlling the pre-test scores of the study respondents, the teaching method significantly affects the early mathematics performance of the study respondents. The researchers rejected the null hypothesis based on these results.

Table 5. Tests of between-subjects effects for H_{o2}.

Dependent variable: Pre-test					
Sources	**Type III sum of squares**	**Df**	**Mean square**	**F**	**Sig.**
Corrected model	195023[a]	3	65009	229	0.00
Intercept	281193	1	281190	990	0.00
Pre-test	179804	1	179804	633	0.00
Method	10232	2	5115	17.00	0.00
Error	313727	1102	283		
Total	5642487	1106			
Corrected total	508753	1100			

Note: a. R squared = 0.381 (adjusted R squared = 0.380).

Table 6 displays the results of pairwise comparisons for Ho2. The results of the pairwise comparison test of early mathematics performance scores for the teaching method show that after controlling type 1 error by using the Bonferroni method, the comparison pair of games, picture books (mean difference of early mathematics performance = 6.20 and p<.05) and games - worksheets (difference mean early mathematics performance=6.60, and p<.05) obtained significant results.

This shows that the mean score of early mathematics performance for the games method outperforms the picture books and worksheets significantly. The comparison of pairs of picture books - worksheets (mean difference in early mathematics performance=-0.40 and p>.05) obtained a non-significant difference because there was no significant difference in the effect between picture books and worksheets.

Table 6. Pairwise comparisons for H_o2.

Dependent variable: Pre-test				
Teaching methods (I)	**Teaching methods (J)**	**Mean difference (I-J)**	**Std. error**	**Sig.[b]**
Games	Picture books	6.20*	1.30	0.00
	Worksheets	6.60*	1.20	0.00
Picture books	Games	-6.20*	1.30	0.00
	Worksheets	0.40	1.30	1.00
Worksheets	Games	-6.60*	1.20	0.00
	Picture books	-0.40	1.30	1.00

Note: *. The mean difference is significant at the 0.05 level.
b. Adjustment for multiple comparisons: Bonferroni.

Table 7 displays the results of univariate tests for Ho2. The results in the univariate tests show that there is a significant difference for the pairwise comparison results [F (2, 1104) =17.00, and p<.05]. These results confirm that there is a main effect of the independent variable of teaching method on the dependent variable of early mathematics performance after controlling for the pre-test control variable in the study population.

Table 7. Univariate tests for H_o2.

Dependent variable: Post-test					
	Sum of squares	**Df**	**Mean square**	**F**	**Sig.**
Contrast	10232	2	5116	17.00	0.00
Error	313728	1100	284		

The F-test evaluates *effect of teaching method: This test is based on the linearly independent pairwise comparisons among the estimated marginal means.*

5. DISCUSSION AND CONCLUSION

5.1. Teaching Methods and Early Mathematics Performance

Three broad teaching instructional recommendations can be derived from the implication of the comparison of teaching methods on preschool children's early mathematics performance. Play-based approaches were particularly effective due to repeat play and reinforced strategic aspects (Ginsburg & Baroody, 2003; Thorell et al., 2009). Statistical analyses using ANOVA and ANCOVA tests showed significant differences in early mathematics performance with the games method leading to the highest mean scores.

This study also recommends that teachers prioritize games methods over worksheets. Worksheets may cause emotional pressure and hinder mathematical reasoning. Games methods align with how children learn through play as opposed to rigid approaches which are more limited in enhancing mathematical skills (Kumas & Ergül, 2021). Basic math knowledge and skills are improved through play highlighting the importance of fun and engaging learning in early childhood education (Derman et al., 2020). Worksheets in a traditional classroom have the potential to foster a passive learning environment where children simply follow teacher instructions and reproduce answers (Grossman, 1996; Siraj-Blatchford & Nah, 2014). Picture books can provide a context that is interesting and meaningful to children. These findings highlight the importance of providing professional support and guidance to teachers in implementing early childhood education curriculum (Kerschen et al., 2018).

6. CONCLUSION

Although more studies are needed to confirm the effectiveness of using these methods for learning mathematics, the findings of these studies support that such learning methods improve early mathematics performance among preschool children. Our goal is to educate children to become independent thinkers and learners. It is often said that future studies will make greater contributions to transforming the nation's education system by emphasizing innovation and creativity in teaching. This study will create a platform for knowledge

sharing and research that empowers teachers' professionalism and ultimately improves the quality of early childhood education in Malaysia. It is our job as teachers to search continuously for better ways to teach young children.

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Competing Interests: The authors declare that they have no competing interests.
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Appendix A. Play-based learning.

Day	Item	Games reference	Games modification
1.	Understand numbers 1-10 A1 and B1 Perception of small numbers (Informal)	Ginsburg and Baroody (2003). *Quick look.* National preschool standard curriculum (NPSC).	The game is called "How many cats?"
2.	Understand numbers 1-10 A2 and B2 Produce finger display: 1, 2, many (Informal)	Schminke (1985). *Counting game.* National preschool standard curriculum (NPSC).	"Children, show me __ fingers". The game is called "Show yours fingers."
3.	Understand numbers 1-10 A3 and B3 Verbal counting by ones: 1 to 5 (Informal)	Schminke (1985). *Counting game.* National preschool standard curriculum (NPSC).	"Children, how many fingers do you see?" The game is called "Count fingers."
4.	A4 and B4 Perception of more: Up to 10 items (Informal)	National preschool standard curriculum (NPSC).	The number of items goes up to 10. The game is called "Which one is more?"
5.	Understand numbers 1-10 A5 and B5 Nonverbal production: 1 to 4 items (Informal)	Baroody (1989). *Modified hidden penny game.* National preschool standard curriculum (NPSC).	The game is called "Give me a star."
6.	Understand numbers 1-10 A6 and B6 Enumeration: 1 to 5 items (Informal)	Baroody (1989). *Animal spots.* National preschool standard curriculum (NPSC).	The game is called "Cover the body of the snake."

Day	Item	Games reference	Games modification
7.	Understand numbers 1-10 A7 and B7 Cardinality rule (Informal)	Baroody (1989). *The Hidden Stars Game.* National preschool standard curriculum (NPSC).	The game is called " How many do you see?"
8.	Understanding addition within the range of 10 Understanding subtraction within the range of 10 A8 and B8 Nonverbal (Concrete) addition and subtraction (Informal)	Ginsburg and Baroody (2003). *Hiding game.* National preschool standard curriculum (NPSC).	No changes.
9.	Understand numbers 1-10 A9 and B9 Number constancy (Informal)	Baroody (1989). *Hidden penny game.* National preschool standard curriculum (NPSC).	The game is called "How many?"
10.	Understand numbers 1-10 A10 and B10 Produce sets: Up to 5 items (Informal)	National preschool standard curriculum (NPSC).	The game is called "Throw the dice and give me a star."
11.	Understand numbers 1-10 A11 and B11 Produce finger displays to 5 (Informal)	Schminke (1985). *Counting game.* National preschool standard curriculum (NPSC).	The game is called "Show me your finger."
12.	Understand numbers 1-10 A12 and B12 Verbal counting by ones: 1 to 10 (Informal)	Baroody (1989) *Good or bad counter game.* National preschool standard curriculum (NPSC).	No changes are made.
13.	Understand numbers 1-10 A13 and B13 Number after 1 to 9 (Informal)	Baroody (1989). *Number-after race.* National preschool standard curriculum (NPSC).	The game is called "Car race."
14.	Understand numbers 1-10 A14 and B14 Reading numerals: Single-digit numbers (Formal)	Arthur J Baroody (1989). *Zip race.* National preschool standard curriculum (NPSC).	The game is called "What are the numbers?"
15-25.	Understand numbers 1-10 A15 and B15 Writing numerals: Single-digit numbers (Formal)	Williams, Cunningham, and Lubawy (2005). National preschool standard curriculum (NPSC).	The game is called "Write the numbers."
26.	Understanding addition within the range of 10 A16 and B16 Concretely modelling addition word problems: Sums up to 9 (Informal)	Doig and Ompok (2010). *School bus game.* National preschool standard curriculum (NPSC).	The game is called "Let's go to school."
27.	Understanding addition within the range of 10 Understanding subtraction within the range of 10 A17 and B17 Part-whole concept (Informal)	Doig and Ompok (2010). *Gumnut game.* National preschool standard curriculum (NPSC).	The game is called "How many are missing?"
28.	Understand numbers 1-10 A18 and B18 Written representation of sets up to 5 (Formal)	Ginsburg and Baroody (2003). National preschool standard curriculum (NPSC).	The name of the game is changed to "How many?"
29.	Understand numbers 1-10 A19 and B19 Choosing the larger number: Comparison numbers 1 to 5 (Informal)	Knowledge adventure.com. *Bouncing number game.* National preschool standard curriculum (NPSC).	The game is called "The larger number."
30.	Understand numbers 1-10 A20 and B20 Choosing the larger number: Number comparisons 5 to 10 (Informal)	Knowledgeadventure. com. *Bouncing number game.* National preschool standard curriculum (NPSC).	The game is called "The larger number."
31.	Understand numbers 1-10 Understand numbers 10-20 A21 and B21 Verbal counting by ones: To 21 (Informal)	Baroody (1989) *Good or bad counter game.* National preschool standard curriculum (NPSC).	The game is called " Did I count correctly?"
32.	Understand numbers 10-20 A22 and B22	Knowledge adventure. com.	The game is called "The larger number."

Day	Item	Games reference	Games modification
	Number after: Two-digit numbers to 40 (Informal)	Bouncing number game. National preschool standard curriculum (NPSC).	
33.	Understand numbers 1-10 A23 and B23 Enumeration: 6 to 10 items (Informal)	Baroody (1989). *Animal Spots.* National preschool standard curriculum (NPSC).	The game is called "Animals Spots."
34.	A24 and B24 Verbally count back from 10 (Informal)	National preschool standard curriculum (NPSC).	Snakes and ladders games.
35.	Compare quantity of objects A25 and B25 Equal-partitioning: Fair-sharing of discrete quantities (Informal)	Pbskids.org. *Fair-share Game.* National preschool standard curriculum (NPSC).	The game is called "Divide equally."
36.	Understanding addition within the range of 10 A26 and B26 Mental addition: Sums 5 to 9 (Informal)	Baroody (1989). *Behind-the screen game.* national preschool standard curriculum (NPSC).	The game is called "How many in total?"
37.	Understand numbers 1-10 A27 and B27 Mental number line: one-digit numbers (Informal)	Ginsburg and Baroody (2003). *Cards more than.* National preschool standard curriculum (NPSC).	The numbers involved align with KSPK. The game is called "Which is closer?"
38.	Understand numbers 10-20 A28 and B28 Produce sets: Up to 19 items (Informal)	Baroody (1989). *Zip Race.* National preschool standard curriculum (NPSC).	The game is called "What number is that?"
39-49.	Understand numbers 10-20 A29 and B29 Writing numerals: Two-digit numbers (Formal)	Williams et al. (2005). Jom Bentuk Nombor. National preschool standard curriculum (NPSC).	The game is called "Write down the numbers."
50.	Understand numbers 10-20 A30 and B30 Verbal counting: 10-20.	Baroody (1989) *Good or bad counter game.* National preschool standard curriculum (NPSC).	The game is called " Did I get the numbers right?"
51.	Understanding addition within the range of 10 A31 and B31 Verbal counting by ones: Up to 42 (Informal)	Wynroth (1986, in Baroody and Coslick (1998)). National preschool standard curriculum (NPSC).	The dice is built such that the total of the two numbers does not exceed ten. The game is called "Say the Number and Count."
52.	Understanding the sequence of 10, 20, 30, 40, and 50 A32 and B32 Verbal counting by tens: Up to 50 (Informal)	Baroody (1989) *Good or bad counter game.* National preschool standard curriculum (NPSC).	The game is called " Write down the numbers. Did i count correctly?"
53-54.	Understanding addition within the range of 10 A33 and B33 Symbolic additive commutatively (Formal)	National preschool standard curriculum (NPSC).	The game is called "Tell me a story."
55.	Understanding the sequence of 10, 20, 30, 40, and 50 A34 and B34 Reading numerals: Two-digit numbers (Formal)	Baroody (1989). *Zip Race.* National preschool standard curriculum (NPSC).	The game is called "What is that number?"
56.	Understand numbers 10-20 A35 and B35 Mental number line: Two-digit numbers (Informal)	Ginsburg and Baroody (2003). *Cards more than.* National preschool standard curriculum (NPSC).	The game is called "Which is closer?"
57-58.	Understanding subtraction within the range of 10 A36 and B36 Subtraction Facts: N – N and N – 1 (Formal)	Hoffman et al. (2005). *Sassy sunflower subtraction.* National preschool standard curriculum (NPSC).	The game is called "How many palm fruits are left?"
59-60.	Understanding addition within the range of 10 A37 and B37 Addition facts: Sums up to 9 (Formal)	Hoffman et al. (2005). *Wild watermelon addition.* National preschool standard curriculum (NPSC).	The game is called "How many Watermelons Are there?"
61-62.	Understanding addition within the range of 10 A38 and B38 Addition facts: Sums of 10 and small doubles	Hoffman et al. (2005). *Apple dish addition.* National preschool standard	The game is called "How many candies did you get?"

Day	Item	Games reference	Games modification
	(Formal)	curriculum (NPSC).	
63-64.	Understanding subtraction within the range of 10 A39 and B39 Addition facts: Sums of 10 and small doubles (Formal)	Hoffman et al. (2005). *Apple dish subtraction.* National preschool standard curriculum (NPSC).	The game is called "How many apples are left for me?"
65.	Understand numbers 1-10 A40 and B40 Verbal counting by 2s: To 10	National preschool standard curriculum (NPSC).	Count in 2s. The game is called "Count in 2s for Me."

Appendix B. Learning through number books.

Day	Item	Number books reference	Title of the new number books / Closing question
1.	Understand numbers 1-10 A1 and B1 perception of small numbers (Informal)	National preschool standard curriculum (NPSC).	Animals at the Zoo.
2.	Understand numbers 1-10 A2 and B2 produce finger display: 1, 2, many (Informal)	National preschool standard curriculum (NPSC).	Let's count with our fingers.
3.	Understand numbers 1-10 A3 and B3 Verbal counting by ones: 1 to 5 (Informal)	National preschool standard curriculum (NPSC).	Let's count with our fingers.
4.	A4 and B4 perception of more: Up to 10 items (Informal)	National preschool standard curriculum (NPSC).	More or less.
5.	Understand numbers 1-10 A5 and B5 Nonverbal production: 1 to 4 items (Informal)	Metzger (2005). *Five little sharks swimming in the sea.* National preschool standard curriculum (NPSC).	Animals at the Zoo.
6.	Understand numbers 1-10 A6 and B6 Enumeration: 1 to 5 items (Informal)	Metzger (2005). *Five little sharks swimming in the sea.* Ehlert (1996). *Fisheyes.* National preschool standard curriculum (NPSC).	Animals at the Zoo.
7.	Understand numbers 1-10 A7 and B7 Cardinality rule (Informal)	Metzger (2005). *Five little sharks swimming in the sea.* National preschool standard curriculum (NPSC).	Animals at the Zoo.
8.	Understanding addition within the range of 10 Understanding subtraction within the range of 10 A8 and B8 Nonverbal (Concrete) addition and subtraction (Informal)	Barth (2009c). *One more, one less.* Barth (2009d) *Same, more, or less?* National preschool standard curriculum (NPSC).	One more, one less.
9.	Understand numbers 1-10 A9 and B9 Number constancy (Informal)	Anno (1975). *Anno's counting book.* De Regniers (1988). *So many cats!* National preschool standard curriculum (NPSC).	Counting book: Ompok.
10.	Understand numbers 1-10 A10 and B10 Produce sets: Up to 5 items (Informal)	National preschool standard curriculum (NPSC).	Let's count with our fingers.
11.	Understand numbers 1-10	Binaan penyelidik.	Let's count with our fingers.

Day	Item	Number books reference	Title of the new number books / Closing question
	A11 and B11 Produce finger displays to 5 (Informal)	National preschool standard curriculum (NPSC).	
12.	Understand numbers 1-10 A12 and B12 Verbal counting by ones: 1 to 10 (Informal)	Yolen and Teague (2004). *How do dinosaurs count to ten?* National preschool standard curriculum (NPSC).	Count up to ten with Ani and Ana.
13.	Understand numbers 1-10 A13 and B13 Number after 1 to 9 (Informal)	Trotter (2010). *I know my 1 2 3.* Martin, Ahlberg, and Martin (2004). *Chicka Chicka 1 2 3.* National preschool standard curriculum (NPSC).	Numbers zero to nine.
14.	Understand numbers 1-10 A14 and B14 Reading numerals: Single-digit numbers (Formal)	National preschool standard curriculum (NPSC).	Where is that number?
15-25.	Understand numbers 1-10 A15 and B15 Writing numerals: Single-digit numbers (Formal)	Aida (2004). *1 2 3: What do you see?* National preschool standard curriculum (NPSC).	What number do you see?
26.	Understanding addition within the range of 10 A16 and B16 Concretely modelling addition word problems: Sums up to 9 (Informal)	Murphy (1998). *Animals on board.* National preschool standard curriculum (NPSC).	How many in total?
27.	Understanding addition within the range of 10 Understanding subtraction within the range of 10 A17 and B17 Part-whole concept (Informal)	Barth (2009e). *Subtraction Strategies.* Shaskan (2009a). *If You Were A MINUS SIGN.* Baker (1999). *Quack and count.* National preschool standard curriculum (NPSC).	Part – Whole.
28.	Understand numbers 1-10 A18 and B18 Written representation of sets up to 5 (Formal)	Murphy (2004). *Tally O'Malley.* National preschool standard curriculum (NPSC).	Let's visit the Zoo.
29.	Understand numbers 1-10 A19 and B19 Choosing the Larger Number: Comparison numbers 1 to 5 (Informal)	Martin et al. (2004). *Chicka Chicka 1 2 3.* Lionni (1995). *Inch by inch.* National preschool standard curriculum (NPSC).	Which one is bigger?
30.	Understand numbers 1-10 A20 and B20 Choosing the larger number: Number comparisons 5 to 10 (Informal)	Martin et al. (2004). *Chicka Chicka 1 2 3.* Lionni (1995). *Inch by inch.* National preschool standard curriculum (NPSC).	Which one is bigger?
31.	Understand numbers 1-10 Understand numbers 10-20 A21 and B21 Verbal counting by ones: To 21 (Informal)	Martin et al. (2004). *Chicka Chicka 1 2 3.* Scarry (1975). *Best counting book ever.* National preschool standard curriculum (NPSC).	The beautiful butterfly.
32.	Understand numbers 10-20	Trotter (2010). *I know my 1 2 3.*	The donkey is finding its way

Day	Item	Number books reference	Title of the new number books / Closing question
	A22 and B22 Number after: Two-digit numbers to 40 (Informal)	Martin et al. (2004). *Chicka Chicka 1 2 3.* National preschool standard curriculum (NPSC).	home.
33.	Understand numbers 1-10 A23 and B23 Enumeration: 6 to 10 items (Informal)	Crews (2010). *Ten black dots.* Ehlert (1990). *Fisheyes*: A book you can count on. National preschool standard curriculum (NPSC).	Spots on the animal's body.
34.	A24 and B24 Verbally count back from 10 (Informal)	Bang (1991). *Ten, nine, eight.* Kubler (2001). *There were ten in the bed.* Hutchins (1999). *Ten red apples.* National preschool standard curriculum (NPSC).	Ten, nine, eight, seven, six, five, four, three, two, one.
35.	Compare quantity of objects A25 and B25 Equal-partitioning: Fair-sharing of discrete quantities (Informal)	Leffingwell (2006)*Basic math: sharing and dividing.* Hutchins (1986). *The doorbell rang.* Burton, French, and Jones (2011). *One for you, one for me.* National preschool standard curriculum (NPSC).	Equal sharing.
36.	Understanding addition within the range of 10 A26 and B26 Mental addition: Sums 5 to 9 (Informal)	Barth (2009a). *Addition strategies.* National preschool standard curriculum (NPSC).	Addition.
37.	Understand numbers 1-10 A27 and B27 Mental number line: one-digit numbers (Informal)	Martin et al. (2004). *Chicka Chicka 1 2 3.* Lionni (1995). *Inch by inch.* National preschool standard curriculum (NPSC).	Which one is closer?
38.	Understand numbers 10-20 A28 and B28 Produce sets: Up to 19 items (Informal)	Martin et al. (2004). *Chicka Chicka 1 2 3.* Scarry (1975). *Best counting book ever.* National preschool standard curriculum (NPSC).	Where is that number?
39-49.	Understand numbers 10-20 A29 and B29 Writing numerals: Two-digit numbers (Formal)	Aida (2004). *123: What do you see?* National preschool standard curriculum (NPSC).	What number do you see?
50.	Understand numbers 10-20 A30 and B30 Verbal counting: 10-20.	Martin et al. (2004). *Chicka Chicka 1 2 3.* Scarry (1975). *Best counting book ever.* National preschool standard curriculum (NPSC).	Count up to 20 with dog.
51.	Understanding addition within the range of 10 A31 and B31 Verbal counting by ones: Up to 42 (Informal)	Leffingwell (2006). *Basic math: sharing and dividing.* Barth (2009a). *Addition strategies.* Shaskan (2009b). *If You were a plus sign.* National preschool standard curriculum (NPSC).	Addition strategy.
52.	Understanding the sequence of 10, 20, 30, 40, and 50 A32 and B32 verbal counting by tens : Up to	Martin et al. (2004). *Chicka Chicka 1 2 3.* Scarry (1975). *Best counting book ever.*	Tens numbers.

Day	Item	Number books reference	Title of the new number books / Closing question
	50 (Informal)	National preschool standard curriculum (NPSC).	
53-54.	Understanding addition within the range of 10 A33 and B33 Symbolic additive commutatively (Formal)	National preschool standard curriculum (NPSC).	Addition.
55.	Understanding the sequence of 10, 20, 30, 40, and 50 A34 and B34 Reading numerals: Two-digit numbers (Formal)	Martin et al. (2004). *Chicka Chicka 1 2 3.* Long (1996). *Domino addition.* National preschool standard curriculum (NPSC).	Tens numbers.
56.	Understand numbers 10-20 A35 and B35 Mental number line: Two-digit numbers (Informal)	Martin et al. (2004). *Chicka Chicka 1 2 3.* Lionni (1995). *Inch by inch.* National preschool standard curriculum (NPSC).	Which one is closer?
57-58.	Understanding subtraction within the range of 10 A36 and B36 Subtraction Facts: N – N and N – 1 (Formal)	Murphy (1997). *Elevator magic.* Long (1996). *Domino Addition.* Pike and Turner (2007). *Subtraction.* Shaskan (2009b). *If you were a minus sign.* National preschool standard curriculum (NPSC).	Subtraction of mangoes.
59-60.	Understanding addition within the range of 10 A37 and B37 Addition facts: Sums up to 9 (Formal)	Barth (2009b). *How many in all?* Long (1996). *Domino Addition.* Shaskan (2009b). *If you were a plus sign.* National preschool standard curriculum (NPSC).	Addition.
61-62.	Understanding addition within the range of 10 A38 and B38 Addition facts: Sums of 10 and small doubles (Formal)	Barth (2009a). *Addition strategies.* Long (1996). *Domino addition.* Baker (1999). *Quack and count.* National preschool standard curriculum (NPSC).	Addition.
63-64.	Understanding subtraction within the range of 10 A39 and B39 Addition facts: Sums of 10 and small doubles (Formal)	Murphy (1997). *Elevator magic.* Long (1996). *Domino addition.* Shaskan (2009a). *If you were a minus sign.* National preschool standard curriculum (NPSC).	Subtraction.
65.	Understand numbers 1-10 A40 and B40 Verbal counting by 2s: To 10	Hamm (1994). *How many feet in the bed?* Murphy (2003). *Double the ducks.* National preschool standard curriculum (NPSC).	Counting in twos.

Appendix C. Learning through worksheet.

Day	Item	Worksheets reference	Question instruction
1.	Understand numbers 1-10 A1 and B1 Perception of small numbers (Informal)	National preschool standard curriculum (NPSC).	How many objects do you see? Cut and paste the number that represents the quantity of objects.
2.	Understand numbers 1-10 A2 and B2 Produce finger display: 1, 2, many (Informal)	National preschool standard curriculum (NPSC).	Match the fingers on this hand with the correct number.

Day	Item	Worksheets reference	Question instruction
3.	Understand numbers 1-10 A3 and B3 Verbal counting by ones: 1 to 5 (Informal)	National preschool standard curriculum (NPSC).	Can you count these fingers? Circle the hand that has four fingers.
4.	A4 and B4 Perception of more: Up to 10 items (Informal)	National preschool standard curriculum (NPSC).	Circle the part that has more objects just by looking.
5.	Understand numbers 1-10 A5 and B5 Nonverbal production: 1 to 4 items (Informal)	National preschool standard curriculum (NPSC).	Draw the number of balls according to the number shown.
6.	Understand numbers 1-10 A6 and B6 Enumeration: 1 to 5 items (Informal)	National preschool standard curriculum (NPSC).	Count and color the animals in this picture according to their types. How many animals are hiding in the Zoo?
7.	Understand numbers 1-10 A7 and B7 Cardinality rule (Informal)	National preschool standard curriculum (NPSC).	How many animals have you counted? Cut and paste the number that represents the number of animals.
8.	Understanding addition within the range of 10 Understanding subtraction within the range of 10 A8 and B8 Nonverbal (Concrete) addition and subtraction (Informal)	National preschool standard curriculum (NPSC).	Look at the set below. Use the number line to help you identify if it is one or less than one. Write your answer.
9.	Understand numbers 1-10 A9 and B9 Number constancy (Informal)	National preschool standard curriculum (NPSC).	How many flowers are there? Can you tell me without counting?
10.	Understand numbers 1-10 A10 and B10 Produce sets: Up to 5 items (Informal)	National preschool standard curriculum (NPSC).	Write the objects based on the number shown.
11.	Understand numbers 1-10 A11 and B11 Produce finger displays to 5 (Informal)	National preschool standard curriculum (NPSC).	Match the finger display with the number shown.
12.	Understand numbers 1-10 A12 and B12 Verbal counting by ones: 1 to 10 (Informal)	National preschool standard curriculum (NPSC).	Can you help this rabbit find its food? Draw a line after 1, 2, 3 to help the rabbit get its food.
13.	Understand numbers 1-10 A13 and B13 Number after: 1 to 9 (Informal)	National preschool standard curriculum (NPSC).	Count with me, 1, 2, 3, and what comes next? Imagine we are jumping to square number 5. The next number is 6, and then what is it? Write the answer.
14.	Understand numbers 1-10 A14 and B14 Reading numerals: Single-digit numbers (Formal)	National preschool standard curriculum (NPSC).	Colour the number.
15 -25.	Understand numbers 1-10 A15 and B15 Writing numerals: Single-digit numbers (Formal)	National preschool standard curriculum (NPSC).	Write the numbers.
26.	Understanding addition within the range of 10 A16 and B16 Concretely modelling addition word problems: Sums up to 9 (Informal)	National preschool standard curriculum (NPSC).	I will tell you a stories. You can use these pictures or guess to get the answer.
27.	Understanding addition within the range of 10 Understanding subtraction within the range of 10 A17 and B17 Part-whole concept (Informal)	National preschool standard curriculum (NPSC).	I will tell you some stories. You can use these pictures or guess to get the answer.
28.	Understand numbers 1-10 A18 and B18	National preschool standard curriculum (NPSC).	I can't see how many animals there are. Can you show me in a different way without pictures?

Day	Item	Worksheets reference	Question instruction
	Written representation of sets up to 5 (Formal)		
29.	Understand numbers 1-10 A19 and B19 choosing the larger number: Comparison numbers 1 to 5 (Informal)	National preschool standard curriculum (NPSC).	Tell me which number is bigger on the monster's body. Colour the bigger number.
30.	Understand numbers 1-10 A20 and B20 Choosing the larger number: Number comparisons 5 to 10 (Informal)	National preschool standard curriculum (NPSC).	Tell me which number is bigger on the crab's body. Colour the bigger number.
31.	Understand numbers 1-10 Understand numbers 10-20 A21 and B21 Verbal counting by ones: To 21 (Informal)	National preschool standard curriculum (NPSC).	What number do you see?
32.	Understand numbers 10-20 A22 and B22 Number after: Two-digit numbers to 40 (Informal)	National preschool standard curriculum (NPSC).	Count with me, 11, and what comes next? Imagine we are jumping to square number 15. What is the next number: 15, and then what is it? Write that number.
33.	Understand numbers 1-10 A23 and B23 Enumeration: 6 to 10 items (Informal)	National preschool standard curriculum (NPSC).	Count the dots with your finger and write how many there are. How many dots did you count?
34.	A24 and B24 Verbally count back from 10 (Informal)	National preschool standard curriculum (NPSC).	Count backward. Write the missing number and colour it.
35.	Compare quantity of objects A25 and B25 Equal-partitioning: Fair-sharing of discrete quantities (Informal)	National preschool standard curriculum (NPSC).	The cat and the dog share food equally. Cut the fish and bone (divide the fish for the cat and the bone for the dog equally). Do they each have the same amount? Can you tell me without counting?
36.	Understanding addition within the range of 10 A26 and B26 Mental addition: Sums 5 to 9 (Informal)	National preschool standard curriculum (NPSC).	How many in total?
37.	Understand numbers 1-10 A27 and B27 Mental number line: one-digit numbers (Informal)	National preschool standard curriculum (NPSC).	Colour the number that is close to the given number.
38.	Understand numbers 10-20 A28 and B28 Produce sets: Up to 19 items (Informal)	National preschool standard curriculum (NPSC).	Colour the numbers.
39 -49.	Understand numbers 10-20 A29 and B29 Writing numerals: Two-digit numbers (Formal)	National preschool standard curriculum (NPSC).	Write down this number.
50.	Understand numbers 10-20 A30 and B30 Verbal counting: 10-20.	National preschool standard curriculum (NPSC).	Connect the dots from number 10 to 20 to help the village mouse find the city mouse.
51.	Understanding addition within the range of 10 A31 and B31 Verbal counting by ones: Up to 42 (Informal)	National preschool standard curriculum (NPSC).	Find the sum.
52.	Understanding the sequence of 10, 20, 30, 40, and 50 A32 and B32 verbal counting by tens: Up to 50 (Informal)	National preschool standard curriculum (NPSC).	Count like this: 10, 20, continue counting and write the number to help Mary go to kindergarten.
53-	Understanding addition within	National preschool standard	I will tell you some stories.

Day	Item	Worksheets reference	Question instruction
54.	the range of 10 A33 and B33 Symbolic additive commutatively (Formal)	curriculum (NPSC).	Write the number sentence in the provided box.
55.	Understanding the sequence of 10, 20, 30, 40, and 50 A34 and B34 Reading numerals: Two-digit numbers (Formal)	National preschool standard curriculum (NPSC).	Colour the numbers.
56.	Understand numbers 10-20 A35 and B35 Mental number line: Two-digit numbers (Informal)	National preschool standard curriculum (NPSC).	Colour the number that is close to the given number.
57-58.	Understanding subtraction within the range of 10 A36 and B36 subtraction facts: N – N and N – 1 (Formal)	National preschool standard curriculum (NPSC).	Write the answer.
59-60.	Understanding subtraction within the range of 10 A36 and B36 subtraction facts: N – N and N – 1 (Formal)	National preschool standard curriculum (NPSC).	Write the answer.
61-62.	Understanding addition within the range of 10 A38 and B38 Addition facts: Sums of 10 and small doubles (Formal)	National preschool standard curriculum (NPSC).	Write the answer.
63-64.	Understanding subtraction within the range of 10 A39 and B39 Addition facts: Sums of 10 and small doubles (Formal)	National preschool standard curriculum (NPSC).	Write the answer.
65.	Understand numbers 1-10 A40 and B40 Verbal counting by 2s: To 10	National preschool standard curriculum (NPSC).	Count in 2s for me. What number is left? Complete the empty box.