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Developing Number Concepts in Young Children through Educational Games

Hesham Alomyan[1,*], Ali Alelaimat[2], Mohammad Hamzeh[3], Deborah Green[4]

[1]Department of Educational Sciences, University of Petra, Jordan
[2]Queen Rania Faculty for Childhood, the Hashemite University, Jordan
[3]College of Educational Sciences, Middle East University, Jordan
[4]School of Education, University of South Australia, Australia

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Abstract Many children appear to experience low motivation towards learning mathematics, which may negatively impact on their performance and engagement in further learning. More recently, educational games have been presented as a way of improving student motivation and performance in mathematics. The current study aimed to explore the impact that educational games had on the development of number concepts in kindergarten children aged between 5 and 6 years in Amman, Jordan. Employing purposive sampling techniques, fifty-five (N=55) kindergarten children (25 males and 30 females) in private kindergartens participated in the study. The sample was randomly distributed into two groups: twenty-nine (29) in the experimental group and twenty-six (26) in the control group. Researchers developed an innovative Mathematical Educational Games Program (MEGP) and an achievement test for children. Results indicated a significant difference between the control and experimental groups in favour of the experimental group with no significant difference being attributed to gender. In addition, the results showed no interaction between gender and the MEGP. This paper will therefore discuss the implications of these findings on the development of number concepts with kindergarten-aged children.

Keywords Kindergarten Children, Number Concepts, Mathematics Educational Games, Mathematics Teaching, STEM

1. Introduction

Concepts are referred to as overall common attributes among general conceptual forms, mental images or symbols that a child forms for items they name. For example, the concept of the color red can be learnt by showing the child a tomato or strawberry and naming the colour. They further refer to knowledge gained by experiences or by questioning others. Children develop a set of concepts as a result of accumulated experiences to satisfy their need to search, investigate, and develop their capacity to utilize their surrounding environment to solve problems (Qitami, 2000). Thus, concepts are important to the educational experiences of kindergarten-aged children as they form the basis of mental and cognitive development (Piaget, 1958). For kindergarten children, the acquisition of concepts is a major pillar in learning since it is the cornerstone of the learning process thus requiring a focused methodology to assist development (Bakker, Van den, & Robitzsch, 2015). Yet, often young children find abstract concepts in mathematics challenging which decreases their motivation to learn. To address this, it is important that mathematics is not merely an unrelated routine operation or set of skills. Instead, it has its own organization and knowledge-based structure that depends on mathematical notations, algorithms, and skills which are used to solve mathematical questions through mathematical concepts (Abu-Zainah, 2003); all of which are abstract and difficult for the young mind to understand.

Despite the importance of mathematics, children generally believe that it is difficult (Stodolsky, Salk, & Glaessner, 1991). This develops a 'chicken and egg' situation leaving researchers to ponder whether low interest and lack of confidence leads children to think mathematics is difficult or is it a perceived difficulty that leads to lower confidence and self-efficacy; both of which potentially set up a perceptual cycle. In either scenario, negative feelings may persuade a child to avoid learning mathematics (Brown, Brown, & Bibby, 2008), thus, the need to find engaging ways of ensuring mathematics is interesting and fun is an important element in student

success.

Educational games are noted as being engaging and may provide a solution. For instance, Elyas and Mortada (2014) suggest that it is possible to develop concepts of numbers using several methods, one of which is to embody concepts using physical teaching aids like educational games that are related to the learner's life world. These games work on providing various concepts in a way that positively stimulates the child's interaction and aids the development of knowledge, including number concepts (Dana, 2009). This knowledge is important, making it necessary to provide children with a variety of activities that encourage them to discover and learn how to effectively manage the environment. Games offer a stimulating environment in which students can explore and discover in a fun and interactive way, thus making them active learners; something that Biggs (2003) argues is important. Accordingly, the present study explored the effect of a mathematics educational games program on developing number concepts among kindergarten children. This program, developed by the current researchers, used sensory activities to enhance the child's ability to understand issues associated with numbers.

2. Literature Review

Difficulties that children experience in learning mathematics, coupled with low interest and confidence, have motivated educators and researchers to explore new ways of making learning more engaging. One of these ways is educational games. Abt (1970) highlights the importance of using games in education arguing that they are an effective teaching and learning tool for students of all ages and in a range of contexts. He further purports that they are a highly motivating way to effectively convey the concepts and facts of many subjects; something that is particularly important in mathematics. Part of the reason why games are effective is that they encourage children to use their senses while learning. For this reason, various educational games are now widely used by children at home and school.

Many researchers recognise the importance of using games in teaching and learning mathematics, prompting further exploration into their effect on learning different mathematical concepts (e.g., Bose & Seetso, 2016; Ibrahim & Hmaid, 2017; Mousley & Perry, 2009; White & McCoy, 2019). Some studies focused on how educational games motivate students to learn mathematics (e.g., Barreto, Vasconcelos, & Orey, 2017; Dickey, 2007; Tuzun, Yılmaz-Soylu, Karakus, Inal, & Kizilkaya, 2009) with the majority finding that games motivate students to learn. For example, Kebritchi and Hirumi (2010) examined the effect of computer games on high school students' motivation and success. Initially, computer knowledge, English grammar, and mathematical knowledge were examined with a group of students learning without computers or games and another group who received instruction through computers in a laboratory environment. It was observed that the motivation of those with computer-driven learning was higher, highlighting the potential role of games in education.

Other studies investigated the role of educational games in enhancing a student's confidence in learning mathematics (e.g., Ku, Chen, Wu, Lao, & Chan, 2014; Radford, 2000) and found that games enhanced confidence. For instance, Ku et al., (2014) investigated the effect of digital game-based learning on fourth-grade students' confidence and performance in mathematics. The study revealed that the game-based learning approach yielded better outcomes than paper-based settings in both confidence and performance.

Furthermore, studies have tested the relationship between playing educational games and students' achievement in mathematics (e.g., Abbas, 2007; Akinsol, 2007; Alharbi, 2010; Alhelah, 2005; Drigas & Pappas, 2018; Foster, Anthony, Clements, Sarama & Williams, 2016; Faraj-Allah, 2013; Gandora, 2007; Mousley & Perry, 2009; Otaifi, 2012; Shelby, 2009; Zeidan & Afana, 2007; Souliman, 2007). These studies found a positive correlation between playing educational games, especially electronic games, and students' achievement. For example, Foster, Anthony, Clements, Sarama, and Williams (2016) evaluated the effects of the Building Blocks software on young children's mathematics performance and found higher post-test scores on numeracy for those who were engaged with the software. Similarly, Alharbi (2010) identified the effectiveness of educational electronics games on second-grade students' mathematics achievement in Medina, Saudi Arabia. They found significant results including differences in test results in endurance of learning impact between the control and experimental groups in favour of the experimental group.

Studies have also explored the use of educational games to develop concepts in mathematics. For instance, Otaifi (2012) investigated the effect of educational games for developing concepts of numbers and mathematical skills in first-grade children in an elementary school in Assiut, Egypt. The study concluded that when compared to those in the control group, students in the experimental group who used educational games developed an in-depth understanding of the meaning and magnitude of numbers, the effect of calculations on numbers, and had the ability to recognize the impact of calculations and their use in real-life situations. Similarly, Abbas (2007) explored the effect of using computerized games for mathematics on third-grade students by using a levelled traditional method. The sample consisted of 62 students who were divided into two groups: the control group of 32 males and females who used traditional methods, and the experimental group of 30 students who used computerized games. Supporting others, findings indicated statistically significant differences in the

achievement of the control and experimental groups in favour of the experimental group. Mousley and Perry (2009) studied a group of children aged 5-8 years in Australia and found that children can gradually learn mathematical concepts at an early age through play. The study indicated that mathematical concepts could be developed in children as early as four years of age, highlighting the importance of intervening early.

Akinsol (2007) investigated the effect of using simulation games to evaluate high school students' achievement in mathematics and their attitudes towards these games. The study employed an achievement test, a trend scale towards mathematics, and a set of simulation games that corresponded to the curriculum content. The sample comprised of 146 students from a secondary school in Nigeria who were divided into experimental and control groups. Findings highlighted significant differences in the mathematical skills test favouring the experimental group. More recently, Turgut and Temur (2017) conducted a meta-analysis to examine 24 studies that investigated the effect of employing educational games on mathematics teaching and academic achievement with results revealing that games positively impacted teaching mathematics and academic achievement.

Most studies have employed computerized educational games with different models and strategies (e.g., Abbas, 2007; Akinsol, 2007; Alharbi, 2010; Alhelah, 2005; Faraj-Allah, 2013; Gandora, 2007; Mousley & Perry, 2009; Otaifi, 2012; Papp, 2017; Shelby, 2009; Zeidan & Afana, 2007; Souliman, 2007) which are not always available to children from low socioeconomic backgrounds, nor are they available in less affluent schools. Therefore, the current study addressed this gap by employing educational games that are embedded in practical activities making them easy and inexpensive for teachers to create and apply.

The majority of studies that investigated the effect of educational games on learning mathematics were conducted with school students (e.g., Abbas, 2007; Akinsol, 2007; Alharbi, 2010; Otaifi, 2012) and preschool children (e.g., Mousley & Perry, 2009), yet little research has explored the effect of such games on kindergarten children (age 3-5). As noted, this age group is paramount as development starts at 4 years of age; hence, the current study recruited kindergarten children to provide insights that appeared to be missing in previous studies.

3. Research Problem and Questions

Learning during early childhood meets a child's basic desire to explore and discover. It guides children to develop direct and genuine methods of identifying the world around them by using their physical senses to interact and experiment with their environment. During early childhood, children often start their communication with their surrounding environment by interacting with plants and animals therefore most learning at this age is gained through play. As a result, children become more familiar and appreciative of the creatures and environment around them. The experiences provided for children at this stage are based on direct and sensual practices, helping them to become more capable of carrying out mathematical operations, which, in turn, develops their general abilities and promotes the development of cognitive problem-solving skills (Kola-Olusanya, 2005).

Several studies have highlighted the difficulty that children have in understanding concepts of numbers (Otaifi, 2012; Mousley & Perry, 2009; Souliman, 2007); something that was also highlighted by the Ministry of Education in Jordan (Jabir, 2016). These studies confirmed the significance of developing number concepts in children; however few studies have explored this in Jordan. Gaining insight into the Jordanian context is crucial to understand and expose children to the most recent initiatives/practices related to the development of number concepts. This exposure should be based on a program that utilizes educational games that gradually develop skills at the kindergarten level. Hence, the current study will address the following questions:

1. What is the impact of a Mathematical Educational Games Program (MEGP) in developing number concepts for kindergarten children aged between 5 and 6 years?
2. Are there any significant differences related to gender and/or the interaction between children's gender and the MEGP for developing number concepts for kindergarten children?

4. Research Hypotheses

This study attempts to examine the following hypotheses:

Hypothesis One: There is no significant difference in developing number concepts for kindergarten children between groups using the MEGP.

Hypothesis Two: There is no significant gender difference in developing number concepts for kindergarten children between groups due to the interaction between gender and the MEGP.

5. Research Limitations

This study was conducted within the following boundaries:

1. ***Objective limits*****:** The present study is limited to investigating the effect of an educational games program on improving number concepts for kindergarten children in Amman, Jordan.

2. ***Human limits*****:** The study is limited to investigating the effect of using the MEGP on a

sample of kindergarten children within the Directorate of Special Education in the city of Amman, Jordan, for the 2018/2019 academic year.

3. ***Spatial limits*:** The study is limited to applying the MEGP to two kindergarten schools in the city of Amman, Jordan.
4. ***Time limits*:** The study is limited to investigating the MEGP during the period of the second semester of the 2018/2019 academic year.

6. Research Sample

The research sample consisted of fifty-five (*N=55*) kindergarten children (25 males and 30 females), aged between 5 and 6 years of age from two kindergartens in Amman. Moreover, the selected kindergartens were categorized randomly into two groups: an experimental group consists of (29) children, and control group consists of (26) children.

The selection of kindergartens followed a purposive sampling method, where the two kindergartens were selected due to their ability/ willingness to carry out the study and the similarity in their: teaching plans, academic programs, curriculum and educational activities. Both kindergartens shared similarities in the facility structure and educational equipment; general similarity in teacher training and education levels; annual fees for each student were approximately the same, which reflected a similar economic background. Hence, the selected kindergartens represented two equivalent samples from the point of view of the academic program, expertise, number of children, and family socioeconomic levels. Table 1 shows the sample distribution according to gender and group.

Table 1. Study sample distribution by gender and group

	(control)	(Experimental)	Total
Males	12	13	25
Females	14	16	30
Total	26	29	55

To examine the equivalency of children's achievement for both the experimental and control groups before carrying out the experiment, the means and standard deviations of each group's performance levels were pre-tested followed by a T-test to identify differences between the two groups. Table 2 illustrates this.

Table 2. Means and standard deviations and T-test results on the pre-test for the two groups

Group	Total	Mean	Standard Deviation	T-Value	Statistical significance
Experimental	29	20,68	4,04	1.25	0.28
control	26	18,98	4,96		

Table 2 shows that there are no significant differences ($\alpha \leq 0.05$) between the average pre-test scores for the two groups, indicating that they were equivalent in achievement.

Table 3 represents the means and standard deviations along with the results of the T-test between males and females achievement in the pre-test.

Table 3. Means and standard deviations and T-test results on the Pre-test for Males and females

Group	Total	Mean	Standard Deviation	T-Value	Statistical significance
Males	25	20.05	4.04	-0.44	0.65
Females	30	20.30	4.69		

Table 3 shows that there were no significant differences ($\alpha \leq 0.05$) between the average in the pre-test scores for males and females, indicating that achievement due to gender was equivalent.

7. Research Instruments

To achieve the objectives of the study, the following instruments were used:

Measurement Instrument

A paper-based achievement test, developed by the researchers, was employed to measure children's achievement levels of number concepts 1-10 that are contained in the educational material. The content analysis of the educational material for the preliminary level and the educational objectives associated with the concepts of targeted numbers were determined.

The researchers drafted 50 questions for the test (Refer to the sample questions in appendix 2). The procedure was performed by having the teacher read the questions to the children who then indicated by colouring or circling the correct answer on the test paper. Each answer was assigned 1 if correct and 0 if not. The test was evaluated out of 50 marks with the highest mark being 50 and the lowest being 0. The duration of the test was determined by averaging the total time required for the fastest and the slowest children as identified in the pilot study, which consisted of twenty (20) children and resulted in assigning a total duration of 45 minutes.

The test validity was verified via a committee consisting of six faculty members from Jordanian universities, one educational supervisor from the Jordanian Ministry of Education, and three kindergarten teachers in Amman. Afterwards, the researchers made the required adjustments that focused on the test's representation of the educational material.

The test reliability was verified by applying it to an external sample consisting of students who had already learnt the concept of numbers. The external sample had twenty (20) students from a kindergarten, which was not

part of the main study. The same children retook the identical test two weeks later. The Pearson correlation coefficient for both experiments was 92% thus deeming the tool sufficient for the purposes of this study.

Each question's coefficient was calculated based on the exploratory sample, and the coefficients ranged from 0.43 to 0.63. The discriminant correlation factor for each question was also generated based on the exploratory sample, and ranged from 0.46 to 0.81, which indicated that the test questions had an average level of difficulty and discrimination.

Treatment Instrument

A Mathematical Educational Games Program (MEGP) was developed by the current researchers for developing number concepts by using conventional games, which employed sensory activities to enhance children's ability to understand issues associated with numbers. This was carried out through eleven (11) sessions including various activities suitable for preliminary level kindergarteners based on age-appropriate practices. The duration of each activity was 45 minutes (Appendix 1 illustrates one of these activities). The program was conducted according to the children's needs and individual interests and was based on constructivist theories of learning that argues that learning occurs by building on knowledge through experience, knowledge blocks and beliefs (Wadsworth, 2004). Several psychological and educational studies emphasize that children learn more effectively when employing their senses which highly contributed to the formation of a child's personality in its various dimensions and their developmental, physical, social and emotional abilities (Ausubel, 1978; Carin, 1997; NAEYC, 1982; Jonassen, 1991) Following are the bases on which the program was developed:

1. Appropriate integration in all developmental areas of children's physical, mental, social, and emotional needs (Almy, 1975).
2. Teachers' notes and observations of child development priorities (Almy, 1975; Biber, 1984).
3. Learning as an interactive process in which teachers prepare the learning environment for children to interact with the material, adults, and other children to achieve the learning objectives. Accordingly, activities were designed to highlight skills through sensory activities and interaction (Biber, 1984).
4. Activities linked to reality and their relationship to children's' lives, due to a child's need to experience real things and events. Learning occurs when children touch, try and interact with items and people in their natural surroundings. Children's active participation in experiences is considered a key motivator toward learning.
5. Children's broad interests and development, where children need several chances to recreate the skills required to represent their learning.

Likewise, the teacher plays a major role in setting a challenging and motivating learning environment by choosing various activities through:

6. Providing different activities and materials that allow the child to choose one or more of them.
7. Allowing children to choose the mode of participation in an activity as an individual or as part of a group.
8. Helping children who are unable to choose or enjoy activities.
9. Giving children opportunities to be proactive and practice their selection of skills and activities.

During the implementation of the program, the following issues were taken into account:

1. Learning outcomes that have been formulated according to the objectives of a subject and the concepts contained within.
2. The program was implemented on a daily basis in accordance with the kindergarten's schedule and the implemented activities at a rate of one week per unit.
3. The time required for each session varied depending on the applied activity but did not exceed 30 minutes per activity.
4. Activities were designed in collaboration with kindergarten teachers by referencing various sources in the field of mathematical activities or were based on appropriate activities for kindergarten children in accordance with existing activities in the program.
5. When designing activities, a child's development and the need for a sensory education were taken into consideration.

8. Research Procedures

After obtaining approval from the kindergartens to participate in the study, meetings were conducted with teachers who were introduced to and trained in the program. Teachers were then requested to provide an evaluation of the activities that were already proposed in terms of their suitability for the age and social environment of the children in their context while also providing suggestions for additional activities. Teachers were then trained to implement the activities within their daily program. Before starting the activities, teachers explained the procedures of each activity to the experimental group (See appendix 1). After finishing the activities, the numbers scale test for examining the understanding of number concepts was applied to the experimental and control groups at the end of the experimentation period (one semester). The answers were manually marked and uploaded to the computer where they were analyzed using the Statistical Package for Social Sciences (SPSS).

Finally, application numbers of children in the control and experimental groups were measured after the end of

the period of application (one semester). Responses were corrected manually and the analyzed computerized data introduced.

9. Research Variables

The study included the following variables:

Independent variables: the MEGP and gender.

Dependent variables: the level of children's understanding of number concepts for the cases that could be measured by the prepared scale.

10. Research Design

The researchers used a quasi-experimental approach as it was considered to be suitable to the nature of the study. A pre-test was conducted to ensure the groups' equivalency. Furthermore, a post-test was given to provide comparative results of achievement levels.

Two groups were included, a control and an experimental group. The program was applied to the experimental group, while the control group was taught using traditional teaching methods. The post-test was given to both groups to identify the impact of the program on children's learning of number concepts.

11. Statistical Analysis

To answer the research questions, means and standard deviations for both groups members' grades were calculated. Additionally, a two-way analysis of variance (ANOVA) was executed to identify the significance of differences between the means. Finally, a T-Test for independent samples was conducted to identify the significance of differences between the average grades for male and female students in the experimental group.

12. Results and Discussion

Results for the first hypothesis testing

"There is no significant difference, at the significance level of ($\alpha \leq 0.05$), in developing concepts of numbers for kindergarten children between groups using the MEGP."

To verify this hypothesis, means and standard deviations were calculated for the pre and post-test. The results are shown in Table 4.

Table 4 highlights a difference between the overall means, of 34.12 for the experimental group post-test grades, and 31.18 for the control group in favour of the experimental group. To verify that the difference between the means of the experimental and control groups is statistically significant, analysis of covariance (ANCOVA) was carried out. Results for the covariance analysis are presented in Table 5 below.

Table 5 shows that the results of the pre-test did not reach the level of significance where the P-value reached 2.23. This value is not significant at the level of $\alpha \leq 0.05$, indicating that there is equivalence between members of the two groups. With regards to the MEGP for both groups (control and experimental), significant differences existed between the means that reached a level of statistical significance where the P-value was 8.26, a value not significant at the level of significance $\alpha \leq 0.05$.

Results in Table 5 illustrate that means for members of the experimental group for the post-test were higher than those for the control group for the same test indicating that the proposed program contributed to a significant difference for those in the control group.

Table 4. Means and standard deviations for control and experimental group grades for the pre-test and post-test achievement

	Post-Test		Pre-Test		
Group	Standard Deviation	Mean	Standard Deviation	Mean	Total
Experimental	5.32	34.12	4.04	20.68	29
Control	4.62	31.18	4.96	18.98	26
Total	5.41	32.76	4.70	19.83	55

Table 5. ANCOVA for achievement differences based on the MEGP and gender

Source of variation	Sum of squares	Degrees of freedom	Average squares	F	Significance
Pre-test	145.13	1	145.00	2.23	0.136
Groups	542.50	1	544.53	8.26	0.004
Gender	77.55	1	77.55	1.18	0.27
Gender × groups	1188.35	1	1142.5	18:03	0033
Error	8962.26	50	65.90		
Total	10915.79	54			

The results, thus far, demonstrated that the program of mathematical educational games that was used with the experimental group, had a significant impact on children's understanding of number concepts. Further, it demonstrated that a kindergarten child could gain new concepts through innovative mathematical educational games designed specifically for children where children were able to use their bodies and engage their physical capabilities to express those concepts and newly acquired knowledge; thus, achieving the objective of the program. This supports Piaget's (1936) cognitive learning theory stating that children learn better when they actively construct knowledge through interacting with their environment. This was the reason why results showed a significant difference between mean scores of children in the experimental and control groups in favour of the experimental group in the overall score for the post-test, that is, after the implementation of the mathematical educational games program.

The results also showed an increase in children in the experimental group's understanding of number concepts which reflects positively on the impact of the program. In contrast, the control group's members did not show any apparent improvement. These findings are consistent with the postulates underlying the research, which hypothesized that mathematical concepts can be developed with training and support of a disposition that already exists in all children.

The achievement of the experimental group could be attributed to various interesting activities offered in the program that stimulated children's thinking, particularly the use of numerous approaches to activities including a question-response technique. The approach that was employed provided different types of questions, which contributed to stimulating and enhancing the concepts while offering a suitable psychological environment to stimulate thinking.

The approach used herein created a pleasant environment, which produced an atmosphere full of fun and play, provided different types of games. Allowing children to display greater interaction through stimulating and challenging games where collaboration was fostered supporting Vygotsky's (1978) social learning theory in which children learn and develop knowledge through interacting with others.

The advancement of the experimental group could also be attributed to repetition. The program allowed room for emphasizing the concepts through various activities, not enabling children to advance until making sure that the current skill was mastered. The skills were selected to represent daily activities, relate to the child's environment, apply reinforcement of concepts and, eventually, reward the achievement of skill mastery. The results for the first hypothesis were consistent with the findings of studies by Faraj-Allah (2013), Otaifi (2012), Mousley and Perry (2009), Souliman (2007), and Gandora (2007).

Results for the second hypothesis testing

"There is no significant difference, at the significance level of ($\alpha \leq 0.05$), in developing number concepts for kindergarten children between groups due to gender and the interaction between gender and the teaching method (MEGP)."

To verify this hypothesis, means and standard deviations were calculated for the post-test according to gender and teaching method. The results are presented in Table 6.

Table 6. Means and standard deviations for control and experimental group grades for post-test achievement based on gender.

	Females		Males	
Group	Standard Deviation	Mean	Standard Deviation	Mean
Experimental	5.85	34.63	3.09	33.50
Control	4.33	32.89	2.86	31.70

Table 6 reveals that the male average in the experimental group in the post-test was 33.50, compared to the male average in the control group in the same test of 31.70. Alternatively, the female average for the experimental group in the post-test was 34.63, and the female average in the control group in the same test was 32.89.

To verify that the difference between the means of the experimental and control groups, depending on the gender of the child and after modifying the pre-test, yielded a statistically significant difference of $\alpha \leq 0{,}05$, a covariance analysis was therefore carried out. Results of the covariance analysis are shown in Table 5.

Table 5 shows that the results of the pre-test for the gender variable did not reach the level of statistical significance, where the F-value reached 1.18. Since this value is not significant at the level of significance $\alpha \leq 0.05$ it indicates that there is no significant differences in the student's understanding of number concepts due to gender.

Having no statistically significant differences between males and females in the experimental group could be attributed to the content and activities of the program, which were designed according to a gaming strategy. The concepts in the program were presented in the form of activities derived from children's daily experiences and, therefore, already corresponding to their abilities, interests and satisfying their continuous need for movement and escape from a boring classroom environment that requires them to be seated for long periods of time. This result is consistent with the literature. For example, Ku, Chen, Wu, Lao, and Chan (2014) stated that learning mathematics through games is more effective than traditional learning and students feel more comfortable, therefore their performances enhanced. In addition, Yılmaz (2014) articulated that teaching through games positively effects students' achievement and subsequently their attitudes towards mathematics improve.

The proposed program is consistent with modern

principles of education, which call for teaching expertise and knowledge that is appropriate for children and adopts pedagogical approaches that stimulate curiosity and combine both education with play while reinforcing other concepts such as the perception of social, mental, and other vital roles, on the other.

Table 5 also indicates that there are no significant differences concerning the interaction between gender and the proposed program. The results of the statistical analysis also indicate that there are no statistically significant differences between males and females in developing number concepts. This finding is consistent with Gandora (2007) who pointed to a lack of statistically significant differences between genders in the development of mathematical concepts.

Yet, this result contradicts Faraj-Allah (2013) and Zeidan and Afana (2007) whose studies found significant male-female differences in favour of females in the development of mathematical concepts.

The results of this study indicate that there is no significant interaction between gender and the teaching method (for the control and the experimental groups), suggesting that the effectiveness of the proposed program is not affected by gender. The insignificance of gender to student achievement can be attributed to the nature of the applied activities and the approach of implementing an activity, such as role-playing, in the program. Furthermore, both males and females nowadays have an equivalent educational level (learning model) inside classrooms as well as the time given for each topic. Moreover, the behavioural objectives that teachers set for educational material are not differentiated for males and females. Therefore, using mathematical educational games will allow both genders to achieve an effectively and satisfy the teaching process objectives.

13. Conclusions and Implications

This study explored the effect of educational games on the development of number concepts among kindergarten children. Findings demonstrated that it is possible to create a game-based teaching program that can be easily adapted according to kindergarten children's needs and consequently enhance their learning and help them acquire positive attitudes towards mathematics.

Outcomes of the present study benefit designers of mathematical curriculum for kindergarten children by adding new dimensions and drawing their attention to the importance of including educational mathematical games in the curriculum. The games program proposed in this study can easily and effectively be used in teaching kindergarten children mathematics as it supports interactivity, inspires collaborative work, encourages active participation, and enhances a motivation for learning.

Hence, it is recommended that kindergartens employ educational games. Such approaches have been accepted by stakeholders and are recognized as being important in achieving various learning objectives while increasing learning speed. It is therefore important to conduct training courses and workshops for in-service schools and kindergarten teachers in the preparation of educational games and various game-based pedagogies for teaching mathematics. Supporting this, there is a need for policymakers in the education sector to make educational games an integral part of teaching mathematics in kindergarten.

Finally, it is hoped that this study will contribute to the existing body of knowledge on educational games and that the presented program can be used to effectively promote learning mathematics in children.

Appendix 1

MEGP

Activity number 1

Number of children: **Level: KG2**

Date: **Time: 45 minutes**

Activity location: inside the activity hall

Objectives of the activity:

- Get the child to know number 1.
- Help the child to distinguish the concept of number 1 from other concepts.
- Get the child to write number 1.

Name of the game: Configure the number

Tools used: colored dough - blackboard.

Procedures

The teacher divides the children into groups, and each child is presented with a piece of dough and writes the number 1 on the blackboard. The teacher requests the children to make a ball of the dough representing the number 1. If a child made a mistake, he or she gets out of the game. The teacher discusses the cause of the mistake made by the child and then the teacher announces the name of the winner after discussing reasons of the win. Children then conclude that the ones who lost the game did not form the dough correctly for the number written on the blackboard. The game is repeated so that another shape is drawn on the board and children are asked to write the number that indicates it.

Assessment:

- The child colors one apple of a number of apples.
- The child writes number 1 on the blackboard.

Appendix 2

Number concepts test

Test instructions

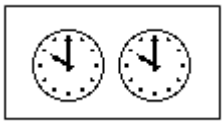
1- This test consists of (50) questions
2- The test is applied individually to each child
3- Each child is asked to refer only with his hand to the correct answer (and to write if necessary)
4- The test application time is (45) minutes

Answer the following 50 questions:

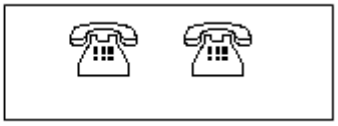
1- Write under the figure (shape) the number indicated by it 

2- Read the following number: **1**

3- Place a sign (✓) on the image denoting the number 1.




4- Write the appropriate number under each of the following forms

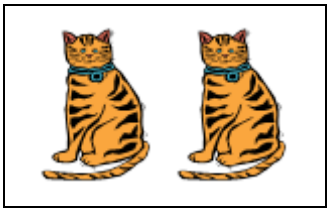
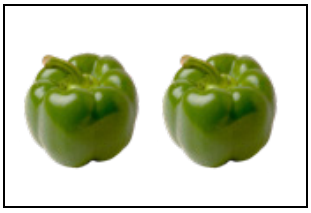
_____ _____

5- Write the number indicated by the figure

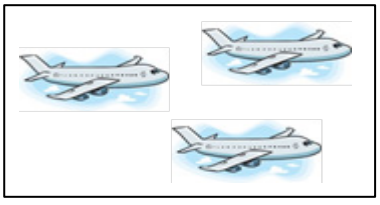

_____

6- Read the following number: **2**

7- Place a sign (✓) on the image denoting the number 2.

8- Write under the figure the number indicated by it.



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