Araştırma Temelli Etkinlik Dergisi (ATED) / Journal of Inquiry Based Activities (JIBA)
Vol 15, Issue 2, p. 125-145, 2025

Investigating the Effect of an Interactive Educational Digital Game Program on Disadvantaged Children's Mathematical Skills and Working Memory Performance

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ABSTRACT

The purpose of this research is to examine the effect of the Interactive Educational Digital Game Program on the Mathematics Skills and Working Memory Performance of 7-8 year old children who are hospitalized and stay in children's homes. The study was conducted on 5 children hospitalized in Malatya İnönü University Turgut Özal Medical Center Training and Research Hospital Pediatric Liver Transplantation Service and Malatya Social Services Institution children's home were conducted with 25 children. The prepared Interactive Educational Digital Game Program was applied one-on-one by the researcher, 3 days a week for 12 weeks. In the study, the Early Mathematical Ability Test TEMA-3 A Form Scale was used to measure children's mathematical skills and the Working Memory Scale was used to measure their development in working memory. The data obtained in the study were analyzed with the Wilcoxon signed-rank test program, one of the non-parametric tests, and it was concluded that the Interactive Educational Digital Game Program increased the mathematical skills and working memory performance of 7-8 year old children who were hospitalized and stayed in children's homes.

Keywords: Interactive educational digital game; mathematical skills; disadvantaged children; working memory.

Article Information:
Research Article
Submitted: July 7, 2025 Revised: September 1, 2025 Accepted: September 13, 2025

How to cite:
Toka, B. & Büyüktaşkapu Soydan, S. (2025). Investigating the Effect of an Interactive Educational Digital Game Program on Disadvantaged Children's Mathematical Skills and Working Memory Performance. *Journal of Inquiry Based Activities*, 15(2), 125-145.

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Note: This article is derived from "Investıgatıng The Effect Of An Interactıvr Educatıonal Dıgıtal Game Program On Dısadvantaged Chıldren's Mathematıcal Skılls And Working Memory Performance", a master's thesis prepared by first author in KTO Karatay University Graduate School of Education.

Introduction

Recently, there has been a growing emphasis on the motivational benefits of technological tools for children, as they offer the potential to impart specific knowledge or skills in a fun and engaging way (Chauhan, 2017; Wouters et al., 2013; Zheng & Spiers, 2014). Meta-analyses have shown that technology use has a positive impact on young children's learning and development (Chung et al., 2018; Jamshidifarsani et al., 2019; Williams & Beam, 2019). Research suggests that children who participate in digital game-based learning are more motivated because they are more willing to learn than those who do not participate (Wrzesien & Alcaniz Raya, 2010) and therefore more effective in terms of knowledge acquisition (Papastergiou, 2009). Systematic reviews of digital educational games' effectiveness also reveal their positive impact on children's education (Connolly et al., 2012; Girard et al., 2013; Wouters et al., 2013; Kebritchi et al., 2010).

A literature review indicates that digital game-based learning is frequently utilized to enhance children's early numerical skills and working memory. Studies have found that digital educational games are effective for learning numbers and addition-subtraction operations in first-grade children (Kim et al., 2018; Obersteiner et al., 2013; Räsänen et al., 2009; van der Ven et al., 2017; Wilson et al., 2009). The studies reviewed found that digital gaming improved dyscalculics' maths skills (Benavides-Varela et al., 2020).

Many studies have designed digital game-based training programmes to target different attention functions in addition to working memory. Intensive training through these programmes can improve children's executive function skills and attention, according to the results of these studies (Bikic et al., 2017; Vander Oord et al., 2014). Additionally, studies have shown that the video game used in training can enhance visuospatial attention (Bertoni et al., 2019). The games, children have to direct visual-spatial attention resources to specific tasks, e.g. moving a bunny correctly or rapidly detecting stimuli that appear in different areas of a screen (Dale et al., 2020; Franceschini & Bertoni, 2019).

Digital games are frequently utilized to enhance children's mathematical ability, working memory. Numerous studies in the literature have established a correlation between children's mathematics skills and working memory. Calculation skills (Tobia et al., 2016), word problems and print math (Koponen et al., 2007) and counting (Cirino, 2011) have all been found to be highly correlated with visuospatial working memory (Zhang & Lin, 2015). Additional research has demonstrated that deficiencies in working memory can result in challenges with retaining and retrieving mathematical facts (Simmons & Singleton, 2008; Vanbinst et al., 2015). Given the developmental correlation between working memory and mathematical abilities, and the requirements for digital games to be effective, this study aims to enhance both children's math and working memory capabilities.

Although digital games have many positive effects on children's development, some studies have highlighted concerns about their negative impact (Fuller et al., 2017; Ma et al., 2017; Plowman et al., 2010). However, when used intentionally, technology can be an effective tool to support children's learning and development, according to the NAEYC (NAEYC & FredRogers Center, 2012). Adults need to monitor what children are doing and encourage and support when needed. In conclusion, digital tools can be more beneficial with appropriate parental support. Research suggests that high-quality educational apps, chosen by adults for their young children, can encourage learning from digital content when used in combination with adult scaffolding (Neumann & Neumann, 2016; Radesky et al., 2016). Based on this information, it was decided to develop an interactive application that utilizes scaffolding to support children's working memory and math skills through educational digital games.

Testing the effectiveness of an interactive educational digital training program for children in disadvantaged groups has the potential to provide solutions to educational challenges faced by these children. Therefore, the program was implemented with sick children who required long-term hospitalization and children residing in foster homes. Children who are ill and require extended hospitalization for various conditions are unable to attend school. This situation has a negative impact on the academic achievement, self-esteem, and social communication of affected children, preventing them from accessing the same educational opportunities as their peers with healthy development (Lumvd., 2019; Shiu, 2001). Consequently, prolonged absence from school and insufficient access to learning opportunities can lead to academic difficulties (Lumvd, 2019; Prevatt et al., 2000; Shiu, 2001; Vannatta et al., 1998). Children who reside in orphanages experience a decline in academic achievement and cognitive development due to their inability to benefit from activities such as completing homework assigned by their teachers, repeating lessons, and receiving parental support at school.

Upon examining the literature, it is evident that children in orphanages and those in need of protection exhibit higher rates of deficiency in executive functions, including visual memory and attention tests (Pollak et al., 2010; McGoron et al., 2012), attention, cognitive inhibition (Merz & McCall, 2011). Based on this information, it can be concluded that supporting the education of children who are unable to attend school due to illness or lack of parental care is crucial for their academic success and overall development. Therefore, this research aimed to investigate the effect of an interactive educational digital games on the mathematics skills and working memory performance of hospitalized and non-hospitalized children.

Method

Research Design

This study examined the effect of the Interactive Educational Digital Game Program on the mathematical skills and working memory performance of children aged 7-8 who were hospitalized or living in children's homes (home-like units for children aged 0-18 in need of protection). The study began on February 12, 2022, with pre-tests, and data was collected on May 14, 2022, at the end of the 12-week education process, with post-tests administered. Due to the pandemic, the study was conducted with a limited sample group. Therefore, a “single group pretest-posttest experimental design without a control group” was used in this study.

In studies prepared without a control group, pre-tests are administered to the group or groups before the experimental study. After the experimental study, the same scales are administered as post-tests (Sönmez & Alacapınar, 2014).

Participants

The study was conducted with the participation of 5 children hospitalized in the liver transplant ward and 25 children living in children's homes in Malatya province. Most of the children hospitalized have been undergoing treatment for more than 2 months. Many of the children living in children's homes were placed in the institution several years ago. The number of children in children's homes varies between 6 and 10. There are 4 mothers responsible for each home. The mothers take care of the children in 12-hour shifts. In the hospital, the children stay in separate rooms, and their parents take care of them. The study included 5 hospitalized children aged 7-8 and 25 children who were living in children's homes. Participants were 46.7% female (n=14) and 53.3% male (n=16). Thirteen (43.3%) were seven years old and seventeen (56.7%) were eight years old.

Measures

Working Memory Scale: The scale was developed to determine the working memory performance of children aged 5-10 years by Ergül, Özgür-Yılmaz and Demir (2016). The scale comprises nine subscales, including verbal and visual working memory. These subscales are Digit Recall, Word Recall, Nonsense Word Recall, Backward Digit Recall, First Word Recall, Pattern Matrix, Block Recall, Choosing the Different One, and Spatial Recall. A total of 1494 children aged 5 and 10 participated in the study. Content validity was ensured through expert opinions, while construct validity was determined through explanatory and confirmatory factor analysis. The reliability of the scale was assessed using the test-retest and test-splitting techniques. It varied from 0.69 to 0.85 for first test, 0.66 to 0.84 for second test and 0.68 to 0.99 for main application the coefficient. The test-retest reliability values ranged between .41 and .83.

Test of Early Mathematics Ability-3: This assessment tool was designed by Ginsburg and Baroody in 1983 to measure the mathematic skill of children between the ages of 3- 8 years. The test was subsequently re-published in 1990 (as TEMA-2) and 1993 (as TEMA-3). Both versions of the TEMA-3 utilised pictures, countable small objects, and mathematical symbols as materials, and each child was assessed individually. The test's raw scores are converted into mathematics scores, which determine the child's mathematics ability by using the score chart and the child's chronological age. Erdoğan (2006) conducted adaptation, validity, and reliability studies of the Early Mathematics Ability Test-3 in Turkish. Expert opinion was sought on the appropriateness of TEMA-3 items for Turkish culture and 60-72 month old children. At .92 for Form A and .93 for Form B, the KR-20 score was also high.

Education Program

The Interactive Educational Digital Game Program is designed to run for 12 weeks, three days a week. The program includes 65 games from MentalUP and 31 games from Kidtab Galaxy. MentalUP is an educational digital game program included in the education program. It is supported by TÜBİTAK (Scientific and Technical Research Council of Türkiye) and approved by Yıldız Technical University. The program's games aim to support children's development in various areas, including attention, memory, visual, verbal, numerical, and logical skills. They are educational games that can be played on tablets, computers, and phones. Kidtab Galaxy is an educational digital game program developed by Davut ASLAN and his team from Ankara University. The games in this application are designed to improve children's literacy, language and cognitive skills. When selecting educational digital games to improve children's math skills, we prioritized games that support the development of attention, memory, vocabulary and visual memory. These games also improve working memory performance, including addition, subtraction and multiplication. Eight different games were assigned by the researcher for the groups of five to work on each week. Motivational, soft and hard scaffolding strategies were selected for each game. Before starting the game, children received clear instructions, feedback, evaluation, validation and modeling strategies to improve their comprehension and ability to continue playing. The educational digital games used in the training program were selected from the MentalUP program (65 games) and KidtabGalaxy (31 games). Six of these games played within the scope of the education program are given below. Figures 1, 2, 3 and 4 were selected to support children's visual memory development and math skills. In Figure 1, children are asked to squirt water as many times as the number on the flower. In the game in Figure 2, children are asked to choose a number by not adding the numbers so that the sum of the numbers is 10. In the game in Figure 3, they are asked to count the birds flying in the sky and mark the sum of the birds they count according to the number under the game. The games in Figures 4, 5 and 6 were selected to support children's verbal and visual memory in working memory. In the game in Figure 4, children were asked to match similar objects. In the game in Figure 5, children were asked to match the same letters. In the game in Figure 6, they were asked to match objects in similar words. (MentalUp, 2022; Kidtab, 2022)

Figure 1.

Mathematics Education: Recognizing Numbers

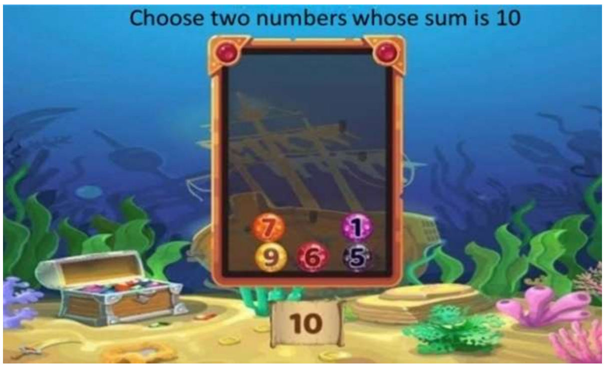

Figure 2.

Mathematics Education: Addition of Numbers

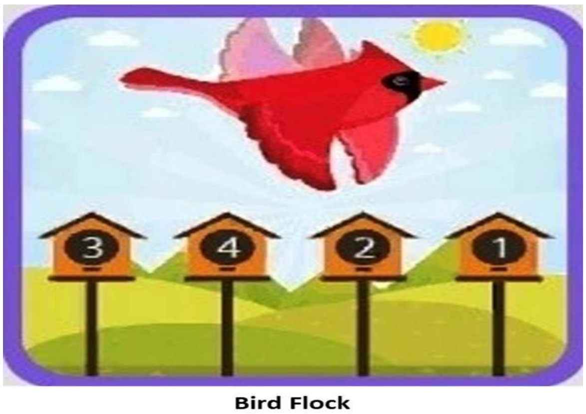

Figure 3.

Mathematics Education: Counting

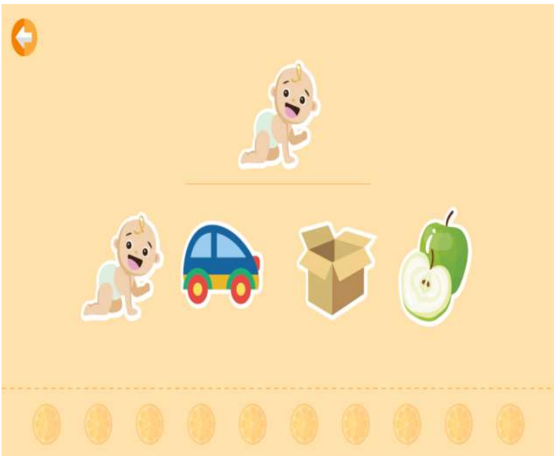

Figure 4.

Mathematics Education: Counting

Figure 5.
Working Memory: Letter Information

Figure 6.
Working Memory: Phonological Awareness

Results

Regarding the sub-objective of the study "Interactive Educational Digital Game Program increases the mathematics skills of children staying in children's homes." the mathematics skill levels of the children were compared. The findings obtained as a result of the Wilcoxonsigned-rank test are shown below.

Procedure

The interactive educational digital game program consists of 96 games selected from Mentalup and KıtdapGalaxy games. With these games, it was aimed to improve children's math skills and working memory development. The program coordinator prepared the TOKA games to be played in groups of 5 children 3 days a week for 12 weeks. Before starting the program, program coordinator TOKA informed the parents of the hospitalized children, the hospital administration and the children's home administration about the content of the program and the scales to be used. The program coordinator TOKA implemented the training program by obtaining the approval of the parents and the management of the children and ensured the children's continuous participation in the training.

Ethics statement

Ethics committee approval was obtained from the university before starting the implementation process of the study. The data of this study were collected with the participation of children hospitalized in hospital and children staying in children's homes in Malatya. Before starting the data collection process, parents, children and institutional administrators were informed and their voluntary participation was ensured. Parents and children who volunteered for the study were informed about the study and then their consent was obtained. Children who voluntarily agreed to participate were asked to sign a document with their parents that included the written and visual content of the information given verbally. In addition, participants were asked to provide any justification in case of any situation that disturbed them during the study.

Upon examining Table 1, a meaningful difference was observed between the pre-post test values of children residing in children's homes who participated in the Interactive Educational Digital Game Program. The difference was observed in their Mathematics skill level, verbal memory, verbal short-term memory, visual memory, visual short-term memory, visual working memory, and working memory. Upon analysis of the rank averages and sums of the scores, it was observed that the post-test scores of all 25 children had increased compared to their pre-test scores. Based on these results, it can be concluded that the Interactive Educational Digital Game programme is effective in improving the mathematical skills and working memory performance of children who live in children's homes.

Table 1

Analysis Data of Mathematics Skill and Working Memory Sub-dimensions of Children Who Stay in Children's Homes

	Pre-Post test	n	Rank Avarage	Rank Total	z	p
Mathematical Ability	Negative Rank	0	.00	.00	4.381	.000*
	Pozitive Rank	25	13.00	325.00		
	Equal	0				
Verbal Memory	Negative Rank	0	.00	.00	-4.497	.000*
	Pozitive Rank	25	13.00	325.00		
	Equal	0				
Verbal Short-Term Memory	Negative Rank	0	.00	.00	-4.294	.000*
	Pozitive Rank	23	12.00	276.00		
	Equal	2				
Verbal Working Memory	Negative Rank	0	.00	.00	-4.500	.000*
	Pozitive Rank	25	13.00	325.00		
	Equal	0				
Visual Memory	Negative Rank	1	4.50	4.50	-4.125	.000*
	Pozitive Rank	22	12.34	271.50		
	Equal	2				
Visual Short-Term Memory	Negative Rank	1	5.00	.00	-4.107	.000*
	Pozitive Rank	22	12.32	271.00		
	Equal	2				
Visual Working Memory	Negative Rank	0	.00	.00	-4.211	.000*
	Pozitive Rank	22	11.50	253.00		
	Equal	3				
Working Memory	Negative Rank	0	.00	.00	-4.437	.000*
	Pozitive Rank	25	13.00	325.00		
	Equal	0				

*p<.05

Table 2

Analysis Data of Children in Hospitals on Mathematics Skill and Working Memory Sub-Dimensions

	Pre-Post test	n	Rank Avarage	Rank Total	z	p
Mathematical Ability	Negative Rank	0	.00	.00	-2.032	.042
	Pozitive Rank	5	3.00	15.00		
	Equal	0				
Verbal Memory	Negative Rank	0	.00	.00	-2.070	.038
	Pozitive Rank	5	3.00	15.00		
	Equal	0				
Verbal Short-Term Memory	Negative Rank	0	.00	.00	-2.121	.034
	Pozitive Rank	5	3.00	15.00		
	Equal	0				
Verbal Working Memory	Negative Rank	0	.00	.00	-2.041	.041
	Pozitive Rank	5	3.00	15.00		
	Equal	0				
Visual Memory	Negative Rank	0	.00	.00	-2.032	.042
	Pozitive Rank	5	3.00	15.00		
	Equal	0				
Visual Short-Term Memory	Negative Rank	0	.00	.00	-2.041	.041
	Pozitive Rank	5	3.00	15.00		
	Equal	0				
Visual Working Memory	Negative Rank	0	.00	.00	-2.041	.041
	Pozitive Rank	5	3.00	15.00		
	Equal	0				
Working Memory	Negative Rank	0	.00	.00	-2.070	.038
	Pozitive Rank	5	3.00	15.00		
	Equal	0				

*p<.05

Upon examining Table 2, a significant difference was observed in the pre-test scores of hospitalized children who participated in the Interactive Educational Digital Game Program, specifically in their Mathematics skill level, verbal memory, verbal short-term memory, visual memory, visual short-term memory, visual working memory, and working memory. Upon analysis of the rank averages and sums of the scores, it was observed that the post-test scores of all five children had increased compared to their pre-test scores. This result suggests that the Interactive Educational Digital Game program is effective in improving the mathematical skills and working memory performance of children staying in the hospital.

Table 3

Analysis Data for the Mathematics Skill and Working Memory sub-dimensions Retention Test Scores of Children Who Stayed in Children's Homes

	Post-Test Resistence Test	n	Rank Avarage	Rank Total	z	p
Mathematical Ability	Negative Rank	6	4.75	28.50	-.749	.454
	Pozitive Rank	3	5.50	16.50		
	Equal	16				
Verbal Memory	Negative Rank	2	2.00	4.00	-.577	.564
	Pozitive Rank	1	2.00	2.00		
	Equal	22				
Verbal Short-Term Memory	Negative Rank	1	1.00	1.00	-1.000	.317
	Pozitive Rank	0	.00	.00		
	Equal	24				
Verbal Working Memory	Negative Rank	1	1.50	1.50	.000	1.000
	Pozitive Rank	1	1.50	1.50		
	Equal	23				
Visual Memory	Pozitive Rank	2	2.00	4.00	-.577	.564
	Negative Rank	1	2.00	2.00		
	Equal	22				
Visual Short-Term Memory	Pozitive Rank	1	2.50	2.50	-1.000	.317
	Negative Rank	3	2.50	7.50		
	Equal	21				
Visual Working Memory	Pozitive Rank	0	.00	.00	-1.414	.157
	Negative Rank	2	1.50	3.00		
	Equal	23				
Working Memory	Pozitive Rank	1	3.00	3.00	-1.342	.180
	Negative Rank	4	3.00	12.00		
	Equal	20				

*$p<.05$

Upon examining Table 3, it was found that there was no significant difference in the retention post-test scores of children who participated in the Interactive Educational Digital Game Program while staying in children's homes, regardless of their level of mathematics skill, verbal memory, verbal short-term memory, visual memory, visual short-term memory, visual working memory, or working memory.

Table 4

Analysis Data for the Retention Test Scores of Children in Hospitals for Mathematics Skill and Working Memory sub-dimensions

	Post-Test Resistence Test	n	Rank Avarage	Rank Total	z	p
Mathematical Ability	Pozitive Rank	0	.00	.00	.000	1.000
	Negative Rank	0	.00	.00		
	Equal	5				
Verbal Memory	Pozitive Rank	0	.00	.00	.000	1.000
	Negative Rank	0	.00	.00		
	Equal	5				
Verbal Short-Term Memory	Pozitive Rank	1	1.00	1.00	-1.000	.317
	Negative Rank	0	.00	.00		
	Equal	4				
Verbal Working Memory	Pozitive Rank	0	.00	.00	1.000	.317
	Negative Rank	1	1.00	1.00		
	Equal	4				
Visual Memory	Pozitive Rank	0	.00	.00	.000	1.000
	Negative Rank	0	.00	.00		
	Equal	5				
Visual Short-Term Memory	Pozitive Rank	0	.00	.00	.000	1.000
	Negative Rank	0	.00	.00		
	Equal	5				
Visual Working Memory	Pozitive Rank	0	.00	.00	1.000	.317
	Negative Rank	1	1.00	1.00		
	Equal	4				
Working Memory	Pozitive Rank	0	.00	.00	.000	1.000
	Negative Rank	0	.00	.00		
	Equal	5				

*p<.05

Upon examining Table 4, it was found that there was no significant difference in the retention post-test scores of the hospitalized children who participated in the Interactive Educational Digital Game Program at the level of Mathematics skill, verbal memory, verbal short-term memory, visual memory, visual short-term memory, visual working memory, and working memory.

Discussion

This study shows that the Interactive Educational Digital Game Program improved children's mathematics skills. These findings are consistent with previous studies that used the Interactive Educational Digital Education Program in different cultures and samples.

In their study, Pasnik and Llorente (2013) played digital games with interactive whiteboards and computers to support preschool children's mathematical skills. At the end of the study, they found that children's math skills such as counting, subtraction and number recognition improved. Rosenfeld et al. (2019), played digital games for 10 weeks to support the math skills of preschool children from low economic backgrounds. The games were drawn from four PBS KIDS programs and were named Curious George, Cat in the Hat Knows It!, Sid the Science Kid, and Dinosaur Train. They found that children in the PBS KIDS Transmedia Math Supplement condition scored significantly higher on researcher-developed measures of counting, number recognition and titling, and shapes and patterns compared to children in the Technology and Media condition (1.43 points, effect size = 0.22, $p < 0.001$) and the BAU condition (1.51 points, effect size = 0.24, $p < 0.001$). Pasnik and Llorente (2013) and Rosenfeld et al. (2019) conducted a study on economically underprivileged preschool children. The study found that mathematics education provided through digital games, videos, and technological tools had longer-lasting effects than mathematics education provided solely through technological support. McCarthy et al (2018) observed in their study that digital games improve children's numerical and arithmetic skills. In their study conducted in 2018, McCarthy et al. played 16 digital games featuring the Curious George animated character for 4 weeks in order to support the mathematics skills of economically underprivileged preschool and first grade children. As a result of the study, they found that children's numbers, operations and math skills increased. Diah, Ehsan and Ismail (2010) developed an educational mobile game model called 'Mathrush' for primary school mathematics education. The study concluded that mathematics education can be achieved through game-based learning using mobile devices. Zaranis, Kalogiannakis and Papadakis (2013) The study aimed to examine the contribution of digital applications accessed through phones and tablets to the mathematics education of preschool children. The results showed that the use of phones and tablets increased children's mathematical skills. De Castro et al. (2014) found that computer games increased children's interest in mathematics topics and improved their mathematical achievement. In their study on children who struggle with learning mathematical concepts. This study was conducted with children with dyscalculia between the ages of 7 and 10 who were studying in the 2nd grade of primary school. In the study, 18 computer games were played 2 days a week for 60 minutes to increase children's math skills. At the end of the study, it was determined that there was an increase in the development of number concepts in children's mathematics skills. Silvia

Benavides et al. (2020) found that digital-based games can support children's mathematical skills. In a study in which the number skills of primary school students were improved with an educational program called '123 Bakery' consisting of four modules, it was found that the number skills of children improved (Kim et al., 2018). Similarly, Wilson et al. (2009) conducted a study to support number skills, where children were trained with the 'Number Race' game, resulting in an improvement in their number skills. In their study aimed at improving primary school students' four operations skills in mathematics. İncekaya and Taşdemir (2019) found that the digital game improved these skills. Similarly, Yavuzkan (2019) found that educational digital games had a positive effect on the mathematics achievement of 5th grade students. However, there was no significant difference in attitude. İncekaya and Taşdemir (2019) designed a snake game using C# programming language. This game was played by children in the 3rd and 4th grades of primary school to support their four operations skills in mathematics. According to the results of the study, 85% of the students concluded that the study was useful in understanding and improving their knowledge of four operations in mathematics. Kara (2021) discovered that educational mobile math games had a positive impact on primary school children. In his study, Kara (2021) aims to reveal the experiences and opinions of teachers and students regarding the gamification application to be carried out in the classroom using the educational mobile mathematics game "Hoverland". At the end of the study, it was shown that educational digital games facilitated children's learning of mathematical concepts. Aktaş, Bulut and Aktaş (2018) also found that a digital game designed for basic arithmetic operations improved the mental processing skills of 6th grade students. Aktaş, Bulut and Aktaş (2018) conducted their study with 6th grade children between the ages of 10-13. They played the mobile digital game named "Operations Impossible" to improve children's four operations skills in mathematics. At the end of the study, they found that mobile games in mathematics education improved children's ability to perform mental operations.

Thorell et al. (2009) provided computerized training for 5 weeks to support the development of visual-spatial working memory and inhibition in preschool children. As a result of the study, children significantly improved in spatial and verbal working memory tests and attention. Boot, Blakely and Simons (2011) trained participants who played video games for less than three hours a week to play a new non-violent video game. Following the training, it was concluded that the participants performed better in several memory tasks, including working memory and short-term memory.

In another study on video games, Franceschini and Bertoni (2019) trained children with dyslexia using action video games. At the conclusion of the study, it was observed that the visual attention and reading speed of children had increased. Cheng et al. (2020) gave 8-day training to 88 children with dyslexia attending primary school. The children were divided into two groups; the intervention group was trained in the apple picking game, while the control group received an English dictation task. At the end of the study, it was determined that there was a significant improvement in the intervention group's arithmetic performance, approximate number system (ANS) acuity and visual form perception. Franceschini et al. (2017) discovered that training children with dyslexia through action video games helped accelerate the shift of attention from visual to auditory and improved reading skills by enhancing visual-spatial attention and phonological working memory. Similarly, Bikic et al. (2017) trained adolescents with computer games and observed an improvement in attention skills and working memory performance. Van der Oord et al. (2014), children with attention deficit and hyperactivity disorder were provided with education through games, resulting in an improvement in their working memory. Similarly, expert players of action video games were found to have higher visual-spatial and attentional performance than non-players by Green and Bavelier (2003). Kroesbergen et al. (2014) investigated the relationship between working memory and early arithmetic skills in preschool children. They provided working memory training to one group and working memory and early arithmetic skills training to another group. The research findings indicate that the working memory and early arithmetic skills of all children who benefited from the educational program improved. McKenzie et al. (2003) showed that both verbal and visuospatial working memory skills were related to mathematics performance in 8- to 9-year-olds, whereas in younger children, mathematics performance was primarily influenced by visuospatial skills. This research supports the positive effects of providing education that supports both working memory and mathematical skills simultaneously. The findings suggest that such education can improve both working memory and mathematical skills.

Conclusion and Recommendations

The study is limited to the 7-8 age group; in future studies, the program can be applied to a broader sample of children in various countries around the world and across different age groups. The study is limited to measurements of mathematical skills and working memory; in future studies, different educational digital games can be examined for their levels of support for different areas of child development. Due to the study being conducted during the pandemic, an experimental design without a control group was used. In new studies, a pre-test-post-test experimental design with control groups could be used to perform comparative analyses.

The study revealed that the Interactive Educational Digital Game Program improved the math skills and working memory performance of disadvantaged children. Based on these studies, the educational process of children in the disadvantaged group who are hospitalized and unable to attend school can be supported with educational digital games. Children staying in children's homes can be supported by providing adults caring for them in the home environment with the tools to use scaffolding strategies. The cognitive development of children in the disadvantaged group can be supported using scaffolding strategies through educational digital games.

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