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The effect of Touch Math multi-sensory program on teaching basic computation skills to young children identified as at risk for the acquisition of computation skills

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Abstract

The purpose of this paper was to investigate the effect of Touch Math multi-sensory program on teaching basic computation skills to young children identified as at risk for the acquisition of computation skills. The children selected for the present study were all kindergarteners from two public kindergarten schools, located at Nasr city, Cairo. 40 children from both schools were included. Of the children who participated in the study (N= 40), 72% were male and 28% were female. Mean age was 5.3 years. A quasi-experimental, two-groups pretest-posttest design was employed, where the same dependent variables (addition skills and subtraction skills) were measured in the two groups of children before (pretest) and after (posttest) a treatment was administered. Using two-way ANOVA, the author analyzed the data from the pre- and post-test. The data were analyzed using the Statistical Package for the Social Sciences (SPSS) 18.0. The results of the two-way ANOVA and t- test showed that there were differences in post- test mean scores between experimental and control groups in addition and subtraction skills. In favor of the experimental group, which indicated the effectiveness of Touch Math multi-sensory program. Implications for practice, recommendations for future research and conclusion were included.

Keywords: Touch Math multi-sensory program, basic computation skills, young children, at risk for the acquisition of computation skills

Introduction

Although onset, recognition, and diagnosis of specific learning disorder usually occurs during the elementary school years when children are required to learn to read, spell, write, and learn mathematics, precursors such as language delays or deficits, difficulties in rhyming or counting, or difficulties with fine motor skills required for writing commonly occur in early childhood before the start of formal schooling (Al Sawi ,2013, American Psychiatric Association ,2013 ,Mohammed, ,2013,Mourad,2013,Mourad ,2014 ,Mourad ,2018).Problems with reading fluency and comprehension, spelling, written expression, and numeracy skills in everyday life typically persist into adulthood(APA,2013).Kindergarten-age children with specific learning disorder may have trouble learning to count. Young children, as young as kindergartens, have trouble with number recognition, difficulty counting, difficulty subitizing, difficulty corresponding numbers to objects and difficulty with auditory memory of numbers (e.g., phone number) (Neelkamal, Teresa and Dilip, 2018).

In order for young children to learning more advanced math, they should be fluent and accurate with math facts. Without having a firm foundation in basic mathematical concepts, those young children are highly likely to be at risk for the acquisition of computation skills, and might struggle even throughout their academic careers. Teachers try different supplemental instructional materials to develop their lesson plans and to teach their children how to add, subtract, multiply, or divide. These include drill and practice techniques, memorization, the use of manipulatives, and numerous worksheets. TouchMath is one approach. It is a multisensory approach, used with basic computation math skills. Children, in this approach, according to

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Bullock (2000), manipulate and memorize math facts. Children, in TouchMath see, touch, say, and hear each digit.

They achieve in basic computation higher than other students who do not use the TouchMath approach. In TouchMath the numbers 1-5 have a single TouchPoint while numbers 6-9 use double TouchPoints represented by a dot inside of a circle. If children are willing to use TouchMath for computation purposes, they are to touch numbers with a single TouchPoint only once and count aloud once. As to the numbers that have the double TouchPoints, they are to touch twice and say them aloud twice (TouchMath, 2004). Bullock (2009) began using this approach with her struggling students. She placed counting points on numbers. To her surprise, she notices immediate results with her students; they were beginning to make the transition from concrete to symbolic learning.

Using the same approach with three elementary students with mild disabilities, Scott (1993) found that students were able to maintain their knowledge and were able to generalize their knowledge to other mathematical situations. Ullrich 's students had positive attitudes towards math as a result of being taught using TouchPoint and they felt that the use of the TouchPoints was the key strategy that increased their scores. This made Ullrich comfortably that TouchPoints on numerals bridges the gap between concrete experiences and abstract concepts" (Ullrich, 2013). Children, even those identified as at risk for the acquisition of computation skills, are likely to learn faster because they access information through several learning styles. Once children understand the Touching/Counting patterns, they can solve addition/subtraction math problems with an easy and correct manner.

The research regarding the implementation of Touch Math Program suggests that this program may be considered a reliable intervention for children with mental disabilities (Boon, Cihak and Fletcher,2010; Hugh, 2010; Matthias, Karolina and Jennifer ,2018; Mourad and Hesham, 2013), students with the most significant cognitive disabilities (Jessica, 2019), autism (Cihak and Foust ,2008) and young children (Amaal, 2013; Vanessa, 2009).

There is a consistent need to help children identified as at risk for reading or math disabilities learn computation skills with different supplemental instruction methods. It is hypothesized that supplemental math instruction, e.g. Touch Math multi-sensory program, is not always apparent or used by teachers when planning their math lessins. "Math interventions are much less common for young learners than are reading interventions (Jordan, 2007, p. 64)

Problem statement

Although many children before the school entering are taught to add and subtract in traditional ways such as using fingers or abacus, that is, without supplemental instructional techniques such as Touch Math multi-sensory program, some children, such as those identified as at risk for the acquisition of computation skills, may require Touch Math multi-sensory program that incorporates a structured, systematic, and multi-sensory approach in order to master basic computational skills (addition skills and subtraction skills in this study). Only two studies (e.g. Amaal, 2013, Vanessa, 2009) were conducted on young children.

Purpose of the study

The purpose of this study was to investigate the effect of Touch Math multi-sensory program on teaching basic computation skills to young children identified as at risk for the acquisition of computation skills.

Significance of the study

As effectiveness of Touch Math as a multisensory approach in early childhood, particularly those identified as at risk for the acquisition of computation skills is very limited, the present study contributes to the literature about Touch Math by gathering data from an experimental design on the effectiveness of Touch Math with this type of children.

Hypotheses

H1.: There will be significant statistical differences between experimental (taught with Touch Math multi-sensory program) and control (taught in a traditional way) groups in addition skills in post-test in favor of the experimental group.

H2.: There will be significant statistical differences between experimental (taught with Touch Math multi-sensory program) and control (taught in a traditional way) groups in subtraction skills in post-test in favor of the experimental group.

Method

Participants

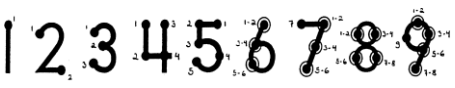
The children selected for the present study were all kindergarteners from two public kindergarten schools, located at Nasr city, Cairo. There were 380 children enrolled at both schools (KG1, and KG2). There were two female teachers in each classroom. The researcher approached each school principal and was asked for consent. Only KG2 children were targeted. Curriculum Based Test-Addition (CBT-A) and Curriculum Based Test-Subtraction (CBT-S) were administered to all children their classrooms with the help of the classroom teacher. Those who had Low achievement scores on both tests (at least 1.5 standard deviations [SD] below the population mean, APA, 2013, P.70. Mourad Ali, 2018, P.109), were included. Only 40 children from both schools were included. Of the children who participated in the study (N= 40), 72% were male and 28% were female. Mean age was 5.3 years. The two groups were matched on Curriculum Based Test- Addition (CBT-A) and Curriculum Based Test- Subtraction (CBT-S) (Pre-Test). The differences were not significant.

Instruments

Curriculum Based Test-Addition (CBT-A). This test was developed specifically for this study. It is paper and pencil test that contains eight simple addition problems (e.g. 1+1, 2+2, 3+3, 4+4, 5+5, 6+6, 7+7, 8+8). The problems were put in cards. Each card had only one problem, and children give answer to each problem in the individual card. Total score for the test ranger from 0-8 scores. Alpha Cronbach's α = .831 was obtained for the test.

Curriculum Based Test- Subtraction (CBT-S). This test was developed specifically for this study. It is paper and pencil test that contains eight simple subtraction problems (e.g. 2-1, 3-2, 4-2, 5-1, 6-2, 8-6, 7-2, 6-3). The problems were put in cards. Each card had only one problem, and children give answer to each problem in the individual card. Total score for the test ranger from 0-8 scores. Alpha Cronbach's α = .865 was obtained for the test.

Design



A quasi- experimental, two-groups *pretest-posttest design* was employed, where the same dependent variables (addition skills and subtraction skills) were measured in the two groups of children before (*pretest*) and *after* (*posttest*) a treatment was administered.

Data analysis

Using two-way ANOVA, the author analyzed the data from the pre- and post-test. The data were analyzed using SPSS 18.0.

Procedure

Three phases were followed

Phase I Pre- Test. The pre-test was administered on the total of 40 children from the targeted schools. In well lit and ventilated room in each of the two schools, children were tested. Instructions were given the children classroom teacher, making sure that that the children clearly understood and followed the instructions. Sufficient time was given to complete the test. 30 minutes was taken to complete pre- test.

Phase II Treatment. Children were randomly divided into experimental and control groups, each had the same number of children. The experimental group were taught addition and subtraction using Touch Math multi-sensory program. Instruction was given by the school teacher after being trained in the program. The following instructions were given to the experimental group: “We have learn to do addition and subtraction. Right? Today, we are going to do it with a new method. It is called Touch Math. We can use this method on numbers 1 to 9. We will have colored dots. These will be on each number and tell us the “Touch points”. It involves visual, auditory, and tactile learning. Using your fingers, you can count these Touch Points. numerals 1 to 5 have single Touch Points, while numerals 6 to 9 have double Touch Points ". In addition, children are taught to count the dots. For example, when adding 3 + 5, the students are taught first to count the dots on the number 4 and then to continue counting the dots on the number 5, until all the eight dots have been touched and counted. Each session lasted for 30 minutes. The training program had 19 sessions, three times a week for 7 weeks.

Phase III Post test. At the end of 19 sessions, the Post Test was administered on all the Children of both groups. Responses were carefully recorded and scored.

Findings of the study

Testing H1. To determine whether there would be significant statistical differences between experimental (taught with Touch Math multi-sensory program) and control (taught in a traditional way) groups in addition skills in post-test, two-way ANOVA analysis for the differences in post- test mean scores between experimental and control groups in addition test was used. The abbreviated analysis of variance output is shown in Table 1. T- test results for the differences in post- test mean scores experimentales and control groups in Addition skills are shown in Table 2. The results of the two-way ANOVA Table1. reported that F (1, 37) = 40.431, p < .0005. (see figure 1. for the differences in mean scores on Curriculum Based Test- Addition)

Table 1. Tests of Between-Subjects Effects
Dependent Variable: addition skills (post test)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	122.825a	2	61.413	24.492	.000	.570
Intercept	94.193	1	94.193	37.566	.000	.504
Pre A	7.225	1	7.225	2.882	.098	.072
group	101.378	1	101.378	40.431	.000	.522
Error	92.775	37	2.507			
Total	1176.000	40				
Corrected Total	215.600	39				

a. R Squared = .570 (Adjusted R Squared = .546)

Further more, Table 2. Show T-test results for the differences in post- test mean scores between experimental and control groups in Curriculum Based Test-Addition (CBT-A). As shown, T = 6.627, p < 0.01. (See figure 2 for the differences in mean scores on Curriculum Based Test-Addition).

Table 2. T-test results for the differences in post- test mean scores between experimental and control groups in Curriculum Based Test-Addition (CBT-A)

Group	**N**	**Mean**	**Std. deviation**	**T**	**Sig.**
Experimental	20	6.60	0.821	6.62	0.01
Control	20	3.20	2.14		

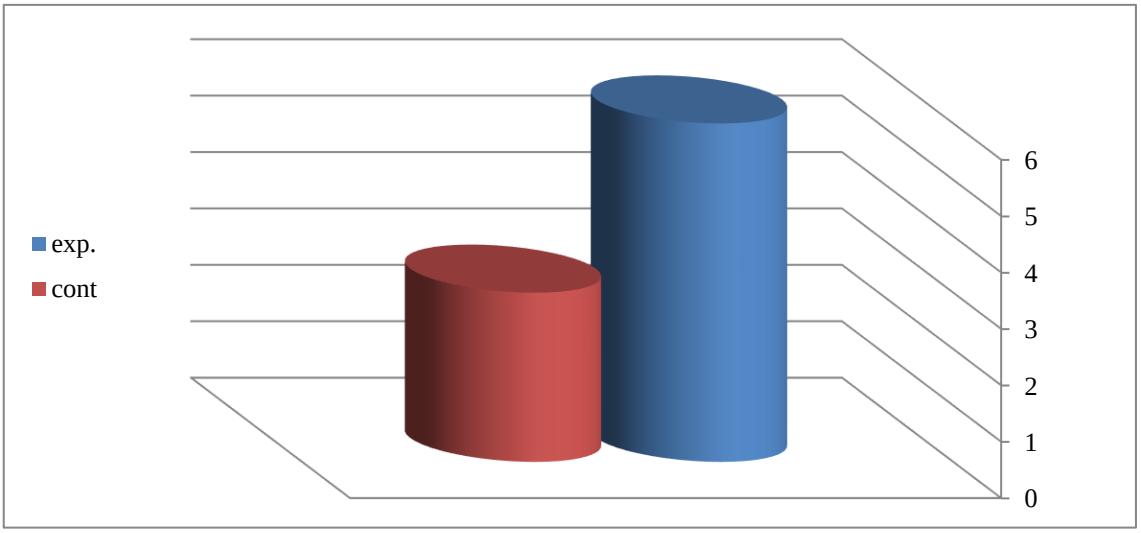


Figure 1. Experimental and control groups mean scores on Curriculum Based Test-Addition (CBT-A) (post test)

Testing H2. To determine whether there would be significant statistical differences between experimental (taught with Touch Math multi-sensory program) and control (taught in a traditional way) groups in subtraction skills in post-test, two-way ANOVA analysis for the differences in post- test mean scores between experimental and control groups in subtraction test was used. The abbreviated analysis of variance output is shown in Table 3. T- test results for the differences in post- test mean scores experimentales and control groups in subtraction skills are shown in Table 4. The results of the two-way ANOVA Table3. reported that F (1, 37) = 369.843, p < .0005. (see figure 2. for the differences in mean scores on Curriculum Based Test- subtraction)

Table3. Tests of Between-Subjects Effects
Dependent Variable: subtraction skills (post test)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	194.728[a]	2	97.364	187.901	.000	.910
Intercept	189.413	1	189.413	365.545	.000	.908
Pre.S	1.128	1	1.128	2.177	.149	.056
gro	191.640	1	191.640	369.843	.000	.909
Error	19.172	37	.518			
Total	1006.000	40				
Corrected Total	213.900	39				

a. R Squared = .910 (Adjusted R Squared = .906)

Further more, Table 4. Show T-test results for the differences in post- test mean scores between experimental and control groups in Curriculum Based Test- Subtraction (CBT-S). As shown, T = 19.03, p < 0.01. (See figure 2 for the differences in mean scores on Curriculum Based Test-subtraction).

Table 4. T-test results for the differences in post- test mean scores between experimental and control groups in Curriculum Based Test- Subtraction (CBT-S)

Group	N	Mean	Std. deviation	T	Sig.
Experimental	20	6.65	0.745	19.03	0.01
Control	20	2.25	0.716		

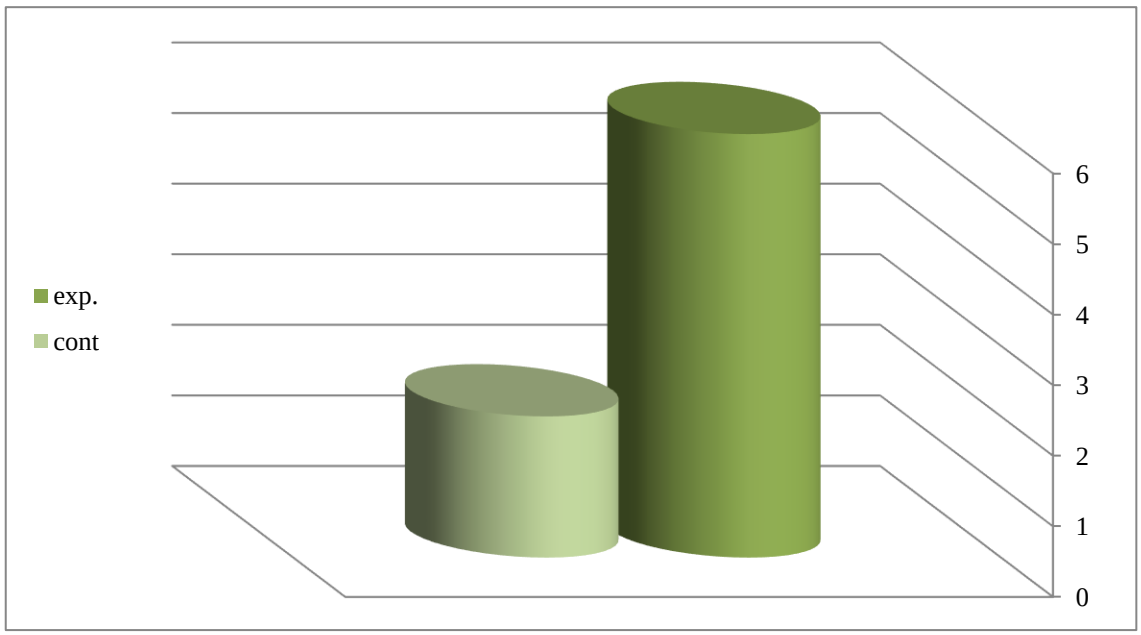


Figure 2. Experimental and control groups mean scores on Curriculum Based Test-Subtraction (CBT-S) (post test)

Discussion

In order to determine the effectiveness of the Touch Math multi-sensory program, pre- and post-tests in addition and subtraction operations administered to all groups. Each group (the treatment group whose children were taught with Touch Math multi-sensory program and control group whose children were taught in a traditional way) received instruction for 19 sessions. Findings from this study were in the same line with previous research that employed TouchMath for different types of students (Mostafa,2013). Touch Math multi-sensory program in this study showed positive results for young children identified as at risk for the acquisition of computation skills. In this regard, the findings extend our knowledge on the effect of Touch Math multi-sensory program on teaching basic computation skills to young children identified as at risk for the acquisition of computation skills.

It was noticed that children, in the experimental group, before the intervention, used to use their fingers doing the addition and subtraction operations. However, when they were part of the treatment condition, that is, when they were taught with Touch Math multi-sensory program, they no longer used their fingers in doing addition and subtraction operations. They became more confident in their abilities, their performance improved and they showed much interest in math.

During the post-test, Children in the treatment condition showed lower variability, which indicated that their performance on addition and subtraction operations improved greatly, and scored almost near one another.

Implications for practice

Based upon findings from this study and the data from the current TouchMath literature, teachers, especially those who work with young children, should consider the use of TouchMath, as a

multi-sensory approach with children identified as at risk for the acquisition of computation skills. It can be concluded from the finding of this study that TouchMath, as a multi-sensory approach must be taught using direct instruction of the dot-notation system. Teachers should be models of how to help children count the points on each number, and they should also give feedback if any child makes a mistake, that is, when he/she counts the number incorrectly. It is recommended that they teach children clearly and explicitly, guide practice though the use of the dots on the numbers, and give specific praise when children succeed in using the strategy. This will, no doubt increase the success of the intervention.

Limitations of this study

The results of this study showed that TouchMath, as a multi-sensory approach, could be considered a possible evidence-based strategy for children identified as at risk for the acquisition of computation skills. However, this study had some Limitations. First, the results from this study for children identified as at risk for the acquisition of computation skills cannot be anticipated to generalize to normal children or those in other geographical areas or different backgrounds in other private or public schools. It was noticed also that children went from needing frequent help in solving addition and subtraction problems to being able to solve them independently when taught with Touch Math multi-sensory program.

Recommendations for future research

More research that look at different computation skills, such as multiplication and division, with children identified as at risk for the acquisition of computation skills is needed. Since most studies have small groups, future researchers need to look at using and implementing a whole-school-based program, employing TouchMath, as a multi-sensory approach. Future research should include larger sample sizes for research findings generalization.

Conclusion

The current study aimed at providing further and additional information on the effectiveness of TouchMath, as a multi-sensory approach in teaching young children identified as at risk for the acquisition of computation skills both addition and subtraction operations. It suggested that TouchMath, as a multi-sensory approach was effective in teaching young children identified as at risk for the acquisition of computation skills. Based on the findings from this study, young children identified as at risk for the acquisition of computation skills showed an increase in all children in the treatment condition scores in Curriculum Based Test-Addition (CBT-A) and Curriculum Based Test- Subtraction (CBT-S). This current study added to and expanded previous research on TouchMath, as a multi-sensory approach. In order to be able to master computation skills, children identified as at risk for the acquisition of computation skills need direct instruction. If they were not successful in this, then they will not be able to master more complex mathematical skills such as reasoning tasks and using money (Cihak & Foust, 2008).

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