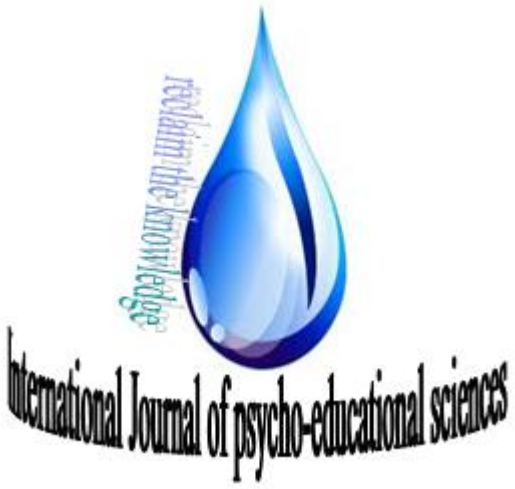

Effect of Multisensory Approach on Increasing Math Skills Children with Mild Intellectual Disabilities

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Abstract

The purpose of this study was to explore effect of multisensory approach on increasing math skills of children with mild intellectual disabilities. A total of 38 children with mental disabilities from three Fekrya schools in Kafr EL Sheikh Governorate; namely Kafr EL Sheikh Fekrya School ,Baltim Fekrya School, and Disouq Fekrya School(Schools for those who have intellectual disabilities)participated. T-test Analysis was employed for data analysis. Results. Findings from this study indicated the effectiveness of the program employed in math skills in the target children . Discussion. On the basis of the findings, the study supports the idea of Touch Math as a powerful intervention for children.

Keywords. *Multisensory approach, Touch Math , children with mental disabilities, Math skills .*

Introduction

Students with intellectual disabilities frequently have difficulties with mathematics , including basic skills (Nesbitt-Vacc & Cannon, 1991; Podell, Tournaki- Rein, & Lin, 1992; Van Luit, & Naglieri,1999;Young, Baker, & Martin, 1990),money applications(Test, Howell, Burkhart, & Beroth ,1993; Fredrick-Dugan, Test, & Varn, 1991; Sandknop, Schuster, Wolery, & Cross, 1992), and problem-solving activities (Mastropieri, Scruggs, &Shiah, 1997; Morin & Miller, 1998). For example, students with intellectual disabilities are less proficient and use less effective strategy instruction in completing and solving mathematics problems than their "typically" functioning peers(Goldman, Pellegrino, &Mertz, 1988). However, performing basic computational mathematics is essential for student success and to foster independent living skills. Acquiring these computational skills for many students with intellectual disabilities may require the use of manipulatives.

Touch Math is multi-sensory manipulative system (Bullock, 2005) approach, which utilizes the corresponding number of dots on numerals 1-9 to help students remember the numeral's value when computing basic math concepts. This approach can be used in solving addition, subtraction, multiplication, or division (Scott, 1993; Wisniewski & Smith, 2002). Touch Math is beneficial for many struggling students because other traditional math strategies have failed them and because of its use of auditory, visual, and tactile strategies to reinforce the counting technique. In both studies, all students involved improved their math computation time and accuracy considerably. Scott (1993) also cited that Touch Math is useful because of its use of a variety of learning styles and modalities in teaching math.

The *Touch Math technique* appears to teach addition according to the same strategies that students naturally develop to solve addition problems. The system offers a method for teaching addition that involves *count-all* and *count-on* strategies, but does not require the *retrieval of stored facts from memory*, an area of difficulty for many students with intellectual disabilities. Students are encouraged to repeat their answers to problems aloud when using the Touch Math technique; it is expected that addition facts will gradually be stored in a student's long-term memory. A study conducted by Marsh and Coke in 1996 proved that the repetition of visual materials aided retrieval from the memory. The Touch Math technique also has the advantage of being a multisensory method, as it involves the use of auditory, visual, and tactile information. The use of multisensory approaches in teaching the basic concepts of mathematics has been

supported by many researchers (Scott, 1993; Thornton, Jones, and Toohey, 1983). Furthermore, the technique assumes less prior knowledge of arithmetic on behalf of the learner. This knowledge involves remembering and counting numbers from 1 to 20, and to count-on from the largest number when adding and to count-down when subtracting(Calik& Kargin , 2010, P.197)

Scott (1993) determined the effectiveness of TouchMath to teaching three skills (a) single and double column addition with regrouping, (b) two-digit subtraction with regrouping and (c) three-digit subtraction with regrouping for students with moderate intellectual disabilities. Three fourth grade students with learning and intellectual (mild and moderate) disabilities and IQ are from 44-92 participated in the study. The dependent variable was the percent correct of problems on a paper and pencil worksheet. The worksheet consisted of column addition, double-digit and triple-digit subtraction problems with regrouping. There were four probe periods with four intervention training sessions lasting fifteen to thirty minutes the special education in the resource room. Results indicated that all three participants were able to master all skills at 85% or higher quickly after training sessions were complete.

Bedard (2002) investigated a dot notation system's effect on addition facts achievement with elementary regular and special education students. Six first grade classrooms containing 110 students participated in the quasi-experimental non-equivalent group pretest-posttest design. Four self-contained classrooms and two inclusion classrooms were utilized. The control group (52) and treatment group (58) were described as low-income white students ranging from 6-7 years old. The independent variable was the dot notation system TouchMath and the dependent variable mathematic achievement in addition facts. The control group was instructed with the Harcourt Brace (2000) workbook and objectives. Both pre and post measures contained 49 addition problems with sums between two through ten. Instruction took place in the regular education classroom for 45-minute sessions over a week. The results showed a significant difference between pretests and posttests with the TouchMath group based on t-test statistic despite the brevity of the study (1 week). The control group did not demonstrate a significant difference though actual raw data demonstrated minimal changes between groups.

Wisniewski and Smith (2002) explored a touch point system implementation into a math curriculum to increase student achievement scores for students with intellectual and learning disabilities. Four participants in 3rd and 4th grade were categorized as other health impaired, mild intellectual disabilities, or learning disabilities. A decrease in time to complete the worksheets was the desire result of the TouchMath application. Participants were only tested once and then determined that the students had mastered the TouchMath procedure without visual notation system displayed. The multisensory method was applied to boost percent correct and decrease the number of minutes required to complete the assessment. Mad Minute addition tests were employed as the pre and posttest measures consisting of addition facts and 30-40 double digit addition problem with and without regrouping. Instruction took place in the special education resource room during 20-minute sessions. Student four significantly increased percent correct and decreased completion rate by half. Student one was the only participant that did not decrease completion rate but increase percent correct. Student two scored lower on posttest but required less time to complete the measure.

Cihak and Foust (2008) used an alternating treatments design with students classified with autism to investigate the use of TouchMath to teach single digit addition problem-solving skills versus a number line approach. Three seven and eight year old elementary students with IQ ranging from 40-50 and diagnosed to have severe (2) and average (1) levels of autism

participated during the regularly scheduled resource class time. The dependent variable was if there was a functional difference between the two methods to solve addition problems. The percentage of single-digit addition math problems was assessed. Two different probe worksheets with ten single digit addition problems were used to assess math skills. Instruction was based on a least to most prompt hierarchy to guide students to the correct answer as well as an adapted model-lead-test procedure to teach both methods across seventy-four sessions. Testing sessions last from 5-20 minutes. Touch points were found to be more effective and preferred by the participants. There was enough evidence to support a functional difference between the two methods. For two participants the touch point system demonstrate much higher gains but one student showed similar increases in percent problems correct for both methods employed.

Calik (2010) investigate the effectiveness, generalizability, and the permanency of the instruction with the touch math technique. Direct instruction was used to the instruction of the basic summation skills of the students with mild intellectual disabilities. A multiple probe design across the subjects was used in this study. The participants included three students with mild intellectual disabilities in inclusive classrooms. They were second grader and their ages were 7-8 years old. The results of the study show that the use of touch math technique, based on direct instruction approach is effective in teaching the basic summation skills to the students with mild intellectual disabilities. The social validity results demonstrated that all the teachers have positive views towards the touch math technique and express that they would use this technique in their classes.

Despite evidence indicating that mild intellectual disability is the most common developmental disability, research related to mathematics development concerning children with mild intellectual disability is sparse. The few published research studies that have included this group of children are primarily related to teaching and learning, and are limited by (a) small sample size (i.e., less than four participants); (b) failure to randomly assign students to study conditions; and (c) limited scope. The scope of studies that include children with mild intellectual disabilities have focused on instruction related to teaching students how to count money (Cihak & Grim, 2008; Stith & Fishbein, 1996), learning mathematics facts (Bouck et al., 2009; Geurts, 2006; Hayter, Scott, McLaughlin, & Weber, 2007; Zisimopoulos, 2010) and mathematics strategies (Creekmore & Creekmoore, 1983).

This study aims to further explore the effect of Touch Math as a multisensory approach on increasing math skills in children with mild intellectual disabilities. this study seeks to give answer to the following question :

1- Are there differences in post–test scores mean between control and experimental groups on Math Skills Test ?

Method

Research Design

The pre-test post-test equivalent groups design was adopted for this study. Equal number of subjects group from Fekryas Schools, were randomly assigned to control and experimental groups, in order to eliminate all the threat to internal validity .Thus, any difference between experimental group and control group are due to the treatment. The pre-test post-test design was

employed to study the effectiveness of the Touch Math Program on increasing math skills of children with mild intellectual disabilities

The participants

Three Fekrya schools in Kafr EL Sheikh Governorate; namely Kafr EL Sheikh Fekrya School ,Baltim Fekrya School, and Disouq Fekrya School(Schools for those who have intellectual disabilities) were approached by the first researcher. There were two classrooms for those who have mild intellectual disabilities in Baltim Fekrya School .One classroom had 10 children(8 boys , and 2 girls) , and the other one had 9 (all were boys); with total number of 19 children (They were assigned to be the experimental group).Those children had IQ ranging from 69 to 74 (Mean IQ= 72) as indicated in their files(Before entering the school , the child's IQ was assessed using an Intelligence Test by a psychologist),and they aged from 6 to 8 years old (Mean Age= 7 years old).While the control group was drawn from two other schools ; namely Kafr EL Sheikh Fekrya School(n=12 children; 9 boys and 3 girls),and Disouq Fekrya School (n=7 children, 6 boys and a girl).Those children had IQ ranging from 69 to 74 (Mean IQ= 73) as indicated in their files(There , they follow the same procedure)),and they aged from 6 to 10 years old (Mean Age= 8 years old).Parents and school personnel were informed about the study and agreement was sought .

Materials/Instrument

The TouchMath system (Bullock, 2005) was the intervention utilized during the treatment phase. It was based on the placement of dots on numbers (1-9). The student was asked to state the number aloud. The student was expected to count aloud as they make contact on the points. For subtraction, the students must be able to count backwards from 20.

The Math Skills Test . The researchers developed a 20-items test . It has five subtests; *Tracing The Numbers* (5 items) , where children are asked to trace the number and draw a ring around the number of objects to math the number (the right answer is given 1 mark) , *Missing Number* (5 items),where children are asked to write down the missing number(the right answer is given 1 mark),*Single–Skills Computation*(5 items),where children are asked to do simple addition problems (the right answer is given 1 mark), and *Quantity Discrimination*(5 items), where the children should identify the number or quantity in the set with the highest value(the right answer is given 1 mark).

Procedures

All instruction, training, observations and probes occurred during the regular school day. The data was collected in three phases.

Phase I: Pre- Test

The pre-test was administered on the total of 38 subjects from 3schools.The subjects were allowed sufficient time to complete the test. No time limit was set for completion of the test. On an average the subjects took 40 minutes to complete pre- test.

Phase II: Treatment

38 subjects were randomly divided into two groups; namely the experimental and control Group. Each group constituted of 19 students each. Subjects in the experimental Group were

exposed to the Touch Math Program by the first researcher. Experimental group and the control were taught math skills simultaneously in their class-room.

The Experimental Group learnt math skills using the Touch Math program. The intervention lasted for 12 sessions , 15- 20 minutes each. Those children in the experimental group were given following instructions: "Today I am going to teach you a new method to do additions. This method is called Touch Math. First we will learn to use it on numbers 1 to 9. The colour dots on each number tell us the "Touch points" and you can count the Touch Points by using your finger or a pencil. "Like this is number one, number one has one touch point now touch and count the number of points on this number :one"

The subjects counted numbers 1 to 5 aloud as they touched the single touch Points. For numbers up to 5 the subjects had to touch at the points only once where as for numbers 6 to 9 each point had to be touched while counting the points for each number. To ensure that subjects arrive at the right twice; subjects had to follow a pattern answer, that the subjects were constantly reminded to follow the sequence of pattern for each number. The researcher each group and immediate feedback was given to the subjects. The subjects practiced touching the Points of the numbers in the correct sequence till they attained mastery in counting each number. After the subjects attained mastery in counting the touch Points, the subjects learnt addition .The content included one digit to one digit with and without carry-over, two digits with two digits with and without carry-over, and three digits to three digits with and without carry-over.

Phase III Post test

The Post test was administered on all the students of Control Group and Experimental Group at the end of 12 sessions. Responses were carefully recorded and scored.

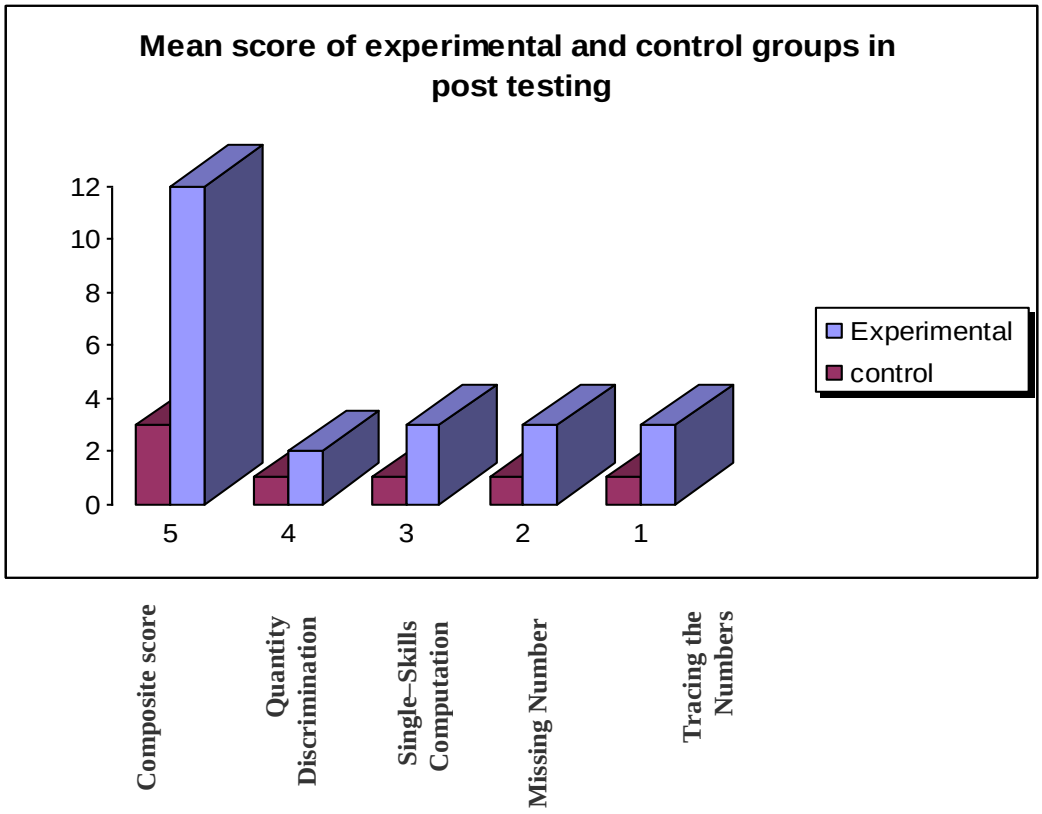
Results

Table 1. shows T. test results for the differences in post- test mean scores between experimental and control groups in Math Skills Test ;subtests scores and the composite score .

Table 1. *T- test results for the differences in post- test mean scores between experimental and control groups in Math Skills Test; subtests scores and the composite score*

Tests	**Group**	**N**	**Mean**	**Std Deviation**	**T**	**Sig.**
Tracing The Numbers	Exp.	19	3.05	2.4	12.02	0.01
	Cont.	19	0.789	6.3		
Missing Number	Exp.	19	3.21	3.4	12.02	0.01
	Cont.	19	0.947	5.8		
Single–Skills Computation	Exp.	19	3.00	3.0	10.48	0.01
	Cont.	19	0.894	5.3		
Quantity Discrimination	Exp.	19	2.68	2.5	9.62	0.01
	Cont.	19	0.789	5.7		
Composite Score	Exp.	19	11.94	1.17	14.09	0.01
	Cont.	19	3.47	2.34		

The table shows that (t) values were as follows: 12.02 for *tracing the number*, 12.02 for *Missing Number*, 10.48 for *Single–Skills Computation*, 9.62 for *Quantity Discrimination*, and 14.09 for the *Composite Score*. This values all are significant at the level (0.01) in the favor of experimental group.



Graph1:*Mean scores of Math Skills Test in the post-test obtained by experimental and control groups.*

Discussion

The main objective of the present study was to explore whether there were differences in post–test scores mean between control and experimental groups on Math Skills .The results of this study as revealed in table 1 and supported by graph 1 show that the Touch Math program as a multisensory approach was effective in increasing math skills of children in experimental group, compared to the control group whose individuals were left to be taught traditionally.

This study supports and extends the literature regarding students with intellectual disabilities and math skills (Amaal, [this volume]; Bedard,2002; Cihak & Foust, 2008; Calik,2010; Scott,1993; Wisniewski and Smith, 2002).

Touch Math is a concrete means of solving addition problems that does not rely on memorization of facts and does not require the use of physical manipulatives such as fingers, counters, or blocks. Thus, the student with poor memory abilities is able to advance with their

math skills while still appearing more like their classroom peers. The discreetness of the touching and counting of touchpoints is important for a child who is mainstreamed into a regular classroom in order for them to feel and appear more like their classmates. Hanrahan et al. (1993) suggested that many intellectually handicapped would prefer to guess incorrectly that count with visible objects, such as blocks or fingers. In addition to this being a concrete and discreet method of solving problems, the Touch Math program, as a multisensory approach, is able to accommodate the learning styles of most students.

This allows the students to be successful with one approach and, as the program has been developed for addition through to complex division, the students can continue developing their math skills using the same general method.

Experimental group gained better scores in addition test than did control group in post-test though there were no statistical differences between the two groups in pre- test. This is due to the program which met the experimental group's needs and interests. On the contrary, the control group was left to be taught traditionally. This goes in line with our adopted perspective which indicates that traditional methods used in our schools do not direct students as individual toward tasks and materials , and do not challenge their abilities.

Limitations

Some limitations of this research that are thought to have an effect on the results of the research are as follows: a) The number of participants makes it difficult to support arguments for generalization to other populations. This study contained a population selected based on availability and does not represent the characteristics of typical school populations. So, larger samples must be investigated before broad conclusions can be made, b) Second, prior knowledge of the TOUCHMATH program was unknown at the time of this study and with the carry over effects, the potential of this prior knowledge can alter the outcome of the study.

Suggestions for Future Research

Results of this study have been very favourable for the Touch Math method; however further investigation of this program is warranted. Results from a study investigating the effectiveness of this program for a group of students with intellectual handicaps would provide more practical implications for the classroom. Observations of the Touch Math class that the subjects participated in suggest that this program is effective in a group setting. However, a more thorough investigation is needed.

This study also raised questions of generalizability that researchers may want to investigate more thoroughly. The possibility that some children with intellectual handicaps may not generalize the use of this method to different settings or with different instructors is very important when determining the effectiveness of the approach. The ability to implement the method when the subjects are presented the numbers in a different mode or in a different setting is essential if the program is going to be of any value to the student. The subjects in this study did demonstrate some generalizability, and investigating ways of increasing this generalization is also important.

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