A Synthesis of Empirical Research on Touch Point Method to Teach Mathematics to Students with Special Needs

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Abstract

Math difficulties are common among students with special needs. They are significantly lower in computation. The touch point method seems to be an effective method to address this area. The purpose of this synthesis is to determine whether there is evidence to support touch points with students with special needs as a method to teach the four basic mathematical operations. The results indicate that there is evidence to support touch points with students with special needs as a method to teach addition and subtraction. It is effective, generalizable, and socially valid in teaching basic and advanced addition and subtraction skills to students with mild, moderate, significant needs. However, some limitations in the literature allow for few conclusions about the intervention effects and generalization. Also, future research is discussed.

A Synthesis of Empirical Research on Touch Point Method to Teach Mathematics to Students with Special Needs

Learning mathematics is essential for all students with special needs regardless of their disabilities. All students with disabilities will need mathematics skills in order to face their academic and daily life experiences (Calhoon, & Fuchs, 2003). It will help students with special needs to be successful in their academic and daily life experiences. For example, learning the basic math operations is necessary for independent-living skills (Cihak & Foust, 2008). Without these skills, students with special needs may not be able to live independently.

However, previous research has shown that students with special needs are below their typical peers in the four basic math operations-addition, subtraction, multiplication, and division. They use less effective and efficient strategies in solving math problems (Scott, 1993). They may score lower on word problems than students without disabilities (math outcome). According to the National Center for Education Statistics (2011), 24% of fourth-grade students who scored below the 25^{th} percentile on the mathematics assessment were identified as students with disabilities. Moreover, it has been estimated that approximately 6% to 7% of school-age students has math disorders. A review of the literature indicated that math disorders are as common as reading disorders (Swanson, & Jerman, 2006).

One way to address underachievement in mathematics is to provide effective academic interventions. The touch point method seems to be one of the effective methods that have been used successfully with students with special needs. The following paragraphs will be devoted for describing the touch point method and the importance of using this method for students with special needs.

Touch Point Method

Description of the touch point method. Touch points is a multisensory method used to teach mathematics operations. It employs visual, auditory, and kinesthetic learning styles to reach many kinds of learners (Mays, 2008; Butler, Miller, Lee, & Pierce, 2001). With this method, students touch points on numbers (i.e. one to nine) to solve an addition, subtraction, multiplication, and division problems. They touch and count points aloud in order to learn in multisensory ways. Since they think aloud while they are working on problems, they receive immediate feedback from the teacher (Scott, 1993).

This method has been developed by Kramer and Krug (1973) for use with students with special needs. They developed it for only teaching addition and subtraction. They suggested that each number should have single points. For instance, number 7 would have seven points (see figure 1). In the beginning, the points are prominent. Then, the points would grow less prominent until they are totally removed. In early research, Kokaska (1975) studied its effectiveness in teaching addition and subtraction for students with special needs.

Figure 1. Touch point with single points on number one through nine.

Later, the touch point method has been refined by Bllock, Pierce, and McClenlland (1989). They also developed it to teach division and multiplication (Pupo, 2000). Instead of having single points on numbers one through nine, they suggested that numbers one through five have single points, numbers six and eight have double points, and numbers seven and nine have single and double points (see figure 2). To teach addition, the authors suggested using count all and count on strategies. When using count all strategy, they count all points on the first and second numbers. On contrast, count on strategy requires students to continue counting from the

large number. When teaching subtraction, they utilize count backward strategy. This means they are taught to touch the top number and say it. Then, they touch and count backward on the bottom number.

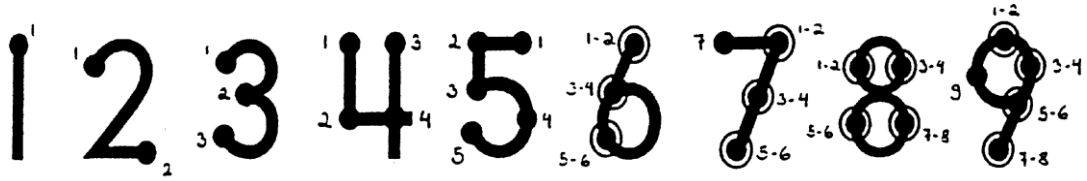

Figure 2. Touch points with single and double points on number one through nine.

When using this method, students first learn the positions of the points on each number from one through nine (Simon & Hanrahan, 2004). After students learned the positions of the points, they are taught to count all points to solve addition problems. For example, in adding five plus three, they would first touch and count the points on the number five and then continue touching and counting the points on the number three to reach the answer which is, in this case, eight. By reaching the mastery level (i.e. 100% accuracy), they are instructed to identify the largest number and then count on from that number. For instance, to add six plus seven, they first point to the number seven and say its name and then continue touching and counting points on the number six (Butler et al., 2001; Simon & Hanrahan, 2004). After they learn addition, they are introduced to subtraction. To teach subtraction, they are taught to use count backward strategy. For example, to solve 8-4 =, they would touch the top number, which is eight, and say it. Then, they touch points on the bottom number (i.e. four) and count backward.

Importance of the touch point method. One of the most important features of the touch point method is the use of multiple sensory modalities. Several research encouraged using the multisensory method to teach mathematics for students with special needs (Scott, 1993). By using the touch point method, students will have the opportunity to see, say, hear, and touch in

order to solve a problem. For example, to answer 3+5=, they will first see and read the problem aloud. Next, they will touch the points in order to answer it. After they answered it, they are encouraged to repeat looking and reading aloud the problem and the answer. By doing that, students could be able to gradually store it in their long term memory (Simon, & Hanrahan, 2004).

This is also encouraged by the principles of the universal design for learning (UDL). The first principle of the UDL emphasizes that teachers should provide multiple means of representations. According to the Center for Applied Special Technology (2011), students differ in the way they understand information that is presented to them. For instance, some students with special needs may need different ways to understand content. Other students may be able to understand information quicker through visual and auditory means rather than printed text. Therefore, it seems that using many means of representations is essential. When teachers use multiple representations, learning and transfer of learning will occur. In sum, it will help to meet the needs of all leaners, including those students with special needs (CAST, 2011).

In the touch point method, teachers will use many means of representations to explain mathematical skills (i.e. addition, subtraction, multiplication, division). They will provide the same information through many modalities such as vision, hearing, and touch. Teachers will write problems on the board so that students can see it. Then, the problems will be read and the points will be touched to explain the steps for answering the problems. This will give students the opportunity to see, hear, and touch points in order to learn how to solve the problems.

The second principle of UDL is providing multiple means of action and expression. Students differ in the way they express what they know about a topic. So, there is no one way of expression that will fit the needs of all students. This entails teachers to provide options for

expression to help students show what they know. For example, teachers may teach students to use a variety of strategies to solve problems (CAST, 2011). This principle is involved in the touch point method. Students have the option to use count all or count on strategy. They may answer an addition problem by counting all points on both numbers or only counting points on small numbers. To answer 2+3 =, some students prefer to count points on both numbers (i.e. two and three). Others may think this strategy is boring since they do not need to count points on the large number (i.e. three). So, they only say the large number and continue counting points on the small number (i.e. two)

The last principle of UDL is providing multiple means of engagement. According to CAST (2011), students can be engaged and motivated in different ways. Some students may prefer to work alone to complete their tasks. Others like to work within small groups. Therefore, there is not only one way of engagement that will meet the needs of all students. As a result, teachers should provide many options for engagement (CAST, 2011). In touch points, students can work alone or with his peers to solve problems. Also, when practicing drawing points and writing numbers, students can choose to use one color or different colors to draw points and write numbers.

Furthermore, according to Bruner (1968), there are three stages of mental developments. The first one is the concrete stage. In this stage, children learn through manipulative activates. Next stage is pictorial. Children now can use pictures to learn new skills. Symbol is the last stage of mental developments. They finally will be able to use symbols such as numbers. Touch points utilize all these stages. First, students touch and draw points on each number. Also, they may cut and color points. After they learn the positions of the points, they move to using the points to answer the problems. In this stage, students can use pictures of points on each number to answer

problems. These points are then removed gradually to help students move to the last stage (i.e. symbol). In this stage, students are provided problems without points on numbers and they are asked to answer them (Vinson, 2004).

Another important aspect of touch points is teaching this method in sequential steps. Students are first taught to touch and count points on all numbers. After that, the points are only added to the small number. In this step, they do not have to touch and count points on the large number. Instead, they say the large number and then continue counting and touching points on the small number. When they master this step, they move to the final step. In the final step, they are expected to solve problems without using points (Touchmath, n.d.).

Based on the previous information, the touch point method seems promising for students with special needs. It could help them to learn addition, subtraction, multiplication, and division. Therefore, the purpose of this paper was to determine whether there is evidence to support touch points with students with special needs as a method to teach the four basic mathematical operations.

Method

Search Procedure

Search terms. Several terms have been used in order to identify potential studies for this research synthesis. These terms are touch points, touch math, dot-notation method, multisensory method, manipulative system, and representational method. Also, these research terms were used in combination with mathematics, addition, subtraction, math instruction, students with disabilities, students with special needs, struggling students, at risk students, math interventions, and academic interventions.

Sources. The primary resources for this research synthesis were Academic Search Premier, Education Research Complete, Educational Resources Information Center (ERIC), Professional Development Collection, American Psychological Association (PsycCRITIQUES), Psychology and Behavioral Sciences Collection, Education Full Text, Psychological Abstracts online (PsycINFO,) and Citation Indexes. In addition to that, Google Scholar engine was used in order to identify more relevant studies. Finally, studies cited in the articles were checked in order to find additional studies that have not been identified through the previous resources. Using these resources, 14 studies were identified. These studies were then evaluated to determine whether the studies met the inclusion criteria for this research.

Inclusion Criteria

The following criteria were used to include studies in this research synthesis:

1. The studies must be peer reviewed.
2. The studies must have used the touch point method to teach mathematics skills.
3. The study must have included at least one student with special needs such as learning disabilities, intellectual disabilities, autism, and ADHD.
4. The participants must be aged from 5 to 18 years.
5. Interventions must have taken place in elementary or secondary schools.

Exclusion Criteria

Studies that have not used touch points as independent variables were excluded from this research synthesis. So, studies that taught students with special needs some mathematic skills were excluded if they did not use touch points as an independent variable. Also, studies that used touch points with typical students were excluded because this research synthesis focused on studies that included students with special needs. This means studies must have included at least

one student with special needs in order to be included in this research synthesis. Moreover, studies that have not taken place in elementary or secondary schools have been excluded because this research synthesis have focused on students aged from 5 to 18 and students who have been taught in schools.

Method for coding studies

The studies that met the inclusion criteria for this synthesis were coded based on specific features of the study. Coded variables included: number of students, gender of students, age of students, type of disabilities (i.e. learning disabilities, intellectual disabilities, autism, and physical disabilities), treatment settings (i.e. separate rooms, resource rooms, self-contained classrooms, orthopedic impairment classroom), research design, dependent and independent variables, dependent measures, length and dosage of the interventions, treatment fidelity, and social validity.

Result

Eight studies that included 25 students with special needs were included in this research synthesis. Table 1 summarized the study characteristics. Table 2 provided some information about the independent and dependent variables, results, and intervention fidelity, and social validity.

Participants

The total number of students was 25. The female students were 15 (60%) and the male students were 10 (40%). Most participants were elementary students with moderate needs such as autism and intellectual disabilities (50%). However, some studies included students with mild needs such as learning disabilities (35%), and only one study included students with significant

needs. In addition, a small number of participants were secondary students (12%). The age of participants ranged from 7 to 14 years.

Research Designs and Dependent Measures

All studies used single subject research; however, they have used different designs. Most of the studies used multiple probe design across subjects (63%). Alternating-treatments design has been used twice (25%). Only one study used pre-test and post-test design. To measure students' performance, all studies used worksheets.

Setting

None of the studies were implemented in the general education classroom. Instead, the interventions were provided either in the special education classroom (50%) or in a separate room (50%). The special education classroom could be an orthopedic impairment classroom, resource room, or self-contained classroom. The separate room was a room other than the special education classroom such as library conference room.

Length and Dosage of Implementation

All studies reported information about the length and the dosage of the interventions except one study. This study did report information about the length, but it did not report information about the dosage. The length of the interventions ranged from 4 weeks to 12 weeks. The mean of the length of the interventions was eight weeks. The studies that focused on students with moderate and significant needs lasted longer and were provided on a daily basis. On contrast, the interventions that were given to students with mild needs lasted shorter and were given twice or three times a week.

Variations in the Touch point Methods

From the studies, it appeared that the implementation of the intervention across the studies has some similarities and differences. Similarly, all studies started the interventions by teaching the students with special needs the positions of the points on all numbers (i.e. one through nine). To master this skill, the researchers developed a variety of activities. The teachers first modeled touching and counting points on each number and then the students touched and counted the points. The students drew and colored points on each number, and they wrote all numbers with their points. They did all these activities until they reached 100% mastery of touching points on all numbers (i.e. one through nine) (Avant& Heller, 2011; Calik & Kargin, 2010; Cihak & Foust, 2008; Fletcher, Boon, & Cihak, 2010; Kokaska, 1975; Popo, Hanrahan, 1994; Scott, 1993; Simon & Hanrahan, 2004).

Next, some studies used count all and count on strategies. After the students learned these strategies, the points were removed and the students could still touch the number with their pencil from memory to solve the problems (Avant& Heller, 2011; Calik & Kargin, 2010; Popo, Hanrahan, 1994; Scott, 1993; Simon & Hanrahan, 2004). In contrast, one study used only count on strategy (Kokaska, 1975) and two studies used only count all strategies (Cihak & Foust, 2008; Fletcher, Boon, & Cihak, 2010). In these three studies, the points were never removed.

Effects of Interventions

From the results, it seemed that the touch point method was effective in teaching basic math skills for students with special needs. Most of the studies used this intervention successfully to teach only adding single-digit problems. The result of these studies indicated that some students were able to improve their performances dramatically. They improved from a mean of 0% correct to 95% correct (Popo, Hanrahan, 1994; Fletcher, Boon, & Cihak, 2010). In another study, students were able to improve their mean of 37% correct before using the touch

point method to a mean of 100% correct after using the touch point method (Calik & Kargin, 2010). Other research taught basic addition and subtraction. One student improved from a mean of 0% correct to 100% correct. The other two students improved from a mean of 38% correct to 94% correct (Kokaska, 1975).

In addition to that, this method has been effectively used to teach advanced math skills. For instance, this method was effectively used in teaching students with special needs how to answer two- and three-digit addition and subtraction problems with regrouping (Simon & Hanrahan, 2004; Scott, 1993). Some students were able to improve their performances on adding and subtracting two- and three-digit problems with regrouping. Before the intervention, they were able to answer only 8% of the addition and subtraction problems. After they leaned this method, they answered 96% of the problems (Scott, 1993).

Moreover, two studies compared touch point strategy and number line strategy in teaching addition for elementary and secondary students with moderate and significant needs. They indicated that touch points was more effective than number lines in teaching addition for these students. The students were able to learn the touch point strategy faster and used it more accurately than the other strategy. By using touch point strategy, their performances improved significantly and quickly as compared to number lines. They improved from a mean of 4% correct to 92% correct, compared to 30% while using number lines. In addition, during the replication phase, the content from the number line strategy was taught by using the touch point strategy. The results showed that the students were able to answer more problems by using the touch point strategy. During the number lines, students were able to answer only 17% of the problems. After they used touch points, they then reached a mean of 100% (Cihak & Foust, 2008; Fletcher, Boon, & Cihak, 2010).

Finally, some of the studies assessed the generalization skills. They found that the students with special needs were able to generalize their knowledge of the touch point method to different settings (e.g. general education classroom) and to problems that have not been practiced during the whole interventions. For example, Calik and Kargin (2010) indicated that all students were able to generalize the skills that they learned individually to the general education classroom. Similarly, Avant and Heller (2011) found that the students with significant needs generalized the use of touch point method to the daily math instruction. According to Simon & Hanrahan (2004), all students generalized the use of touch point method to addition problems that have not practiced during the instructional sessions.

Social Validity

Five (63%) studies reported social validity. Of these five studies, two (25%) studies used formal methods to determine the intervention acceptability such as a teacher questionnaire. The other three (38%) studies used informal methods such as students' comments or if they would prefer to use the intervention when they did not have to use it. The remaining studies (38%) did not report it, but it seemed from the result that the students liked it.

From the results, it was obvious that the students with special needs liked the touch point method. Their teachers also had positive attitude towards the touch point method. For example, some students with special needs indicated that they would like to be taught how to use this method to learn other skills such as subtraction and multiplication. When the students learned the touch point method, they chose to use it when they were told that they could use any method to answer the problems. In addition, the teachers mentioned that they would use it in their classes with other students with special needs. They also stated that the touch point strategy was relatively easy to implement and it could be easily used in inclusive math classrooms.

Discussion

Based on the findings from this synthesis, it was obvious that the touch point method could be an effective intervention for teaching addition and subtraction for a variety of students with special needs. For example, this method has been successfully used to teach addition and subtraction for students with learning disabilities, intellectual disabilities, autism, and physical disabilities. The touch point method could be effective for students with mild, moderate, and significant needs. Also, this method is more effective than number lines in teaching addition and subtraction for students with special needs.

Moreover, the students successfully retained the touch point method after the completion of interventions. They generalized it to problems that have not been used during the instructional sessions. They were also able to generalize their knowledge of the touch point method to a different setting. For instance, some students with special needs were able to use the touch point method in the general education classroom and some students with significant needs used this method at home. This is because touch points seems to be easy to implement and to use in any setting. According to Cihak & Foust (2008), teachers stated that the touch point strategy was relatively easy to implement and it could be easily used in inclusive math classrooms.

However, some research indicated that some students with special needs had some difficulties in learning the touch point method. For example, some students did not discriminate between the double and single touch points. Sometimes, they touched the double points and count them as single points (Cihak & Foust, 2008). Also, one student had difficulties remembering the pattern of points on number seven. When the points were removed from number seven, she would count nine points instead of seven points (Simon & Hanrahan, 2004).

In conclusion, there was evidence to support touch points with students with special needs as a method to teach addition and subtraction. It was effective, generalizable, and socially valid in teaching basic and advanced addition and subtraction skills to students with mild, moderate, significant needs. However, some limitations in the literature allow for few conclusions about the intervention effects and generalization. These limitations will be discussed next.

Limitations

The results of this synthesis revealed several limitations. First, the studies included a small number of students with special needs. Each study included only three students with special needs. The total number of all students across the studies was 25 students. This would limit the generalization of the results of the intervention to larger populations. Second, this method has been rarely used with students with mild and significant needs. Only two studies used this intervention with students with mild and significant needs. Most studies focused on using this intervention with students with moderate needs. So, generalizing this result to students with mild and significant needs seems to be difficult. Third, they taught the students with special needs individually. They have not tried to teach this method in a small group. Also, they taught it in separate rooms or in the special education classrooms. They never taught this method in the general education classrooms. For this reason, the results are limited to individual teaching and teaching that occur outside the general education classrooms. Fourth, this method has not been used to teach multiplication and division for students with special needs. Therefore, the effect of this method in teaching multiplication and division for students with special needs is questionable.

Future Direction

Future researchers may consider including large samples and students with a variety of disabilities. They may focus more on using the touch point method with students with mild and significant needs since the previous studies focused on students with moderate needs. They could try this intervention with students with behavioral disorders, ADHD, and students with traumatic brain injury.

Now, more students with special needs are included in the general education classrooms. However, all previous studies taught this method individually. They did not try to implement this intervention in the general education classrooms. Also, they did not teach it in small groups in the special education classrooms. Therefore, future research should study how touch points could be taught in the general education classrooms. They may also study the possibility of teaching this method in small groups in the special education classrooms.

Furthermore, it is obvious that some students with special needs have difficulties in learning division and multiplication. It has been indicated that they need to learn a strategy to help them understand division and multiplication. So, one might expect that there has been some research about using the touch point method to help students with special needs learn these skills. However, this is not the case. The findings indicated that this method has not been used for teaching division and multiplication for students with special needs. Therefore, future research should study how this method could be effective in teaching these concepts for students with special needs.

This synthesis indicated that the points on numbers in this method could be single or single and double points. This would suggest that future research may compare using the touch point method with single points and this method with single and double points. This seems to be important, especially for students who may not recognize the differences between the single and

double points. For example, Cihak & Foust (2008) indicated that students with autism did not discriminate between the double and single touch points. Sometimes, they touched the double points and count them as single points. Also, some students with ADHD may not be able to distinguish between single and double points because they have attention problems.

Moreover, some students with ADHD have difficulties in mathematics. It has been indicated that they benefit of direct instructions and adapting the delivery or modality of teaching based on the learning style of each individual student. For example, students with ADHD would learn effectively by using multiple sensory modalities (Daley, & Birchwood, 2010; Raggi, & Chronis, 2006). Additionally, previous research suggested that students with ADHD would perform better if they are actively engaged. For instance, it has been proven that students with ADHD perform better from reading orally versus silent reading. Also, peer tutoring is more effective than traditional instruction for students with ADHD. When they take notes during classes, they would be more attentive than listening passively to lecture format classes (Raggi, & Chronis, 2006). As a result, the touch point method seems to be a promising method for students with ADHD. The reason for that is that touch points includes all the previous elements. It is based on direct instruction and it utilizes many senses. Students who are using this method have active roles. They touch, hear, say, write, and count. Thus, future researchers should study the effectiveness of the touch point method on teaching mathematic skills for students with ADHD.

Finally, the findings suggested that this method could be adapted for use with some students with special needs. For example, Avant and Heller (2011) adapted this method for use with students with physical disabilities. They enlarged numerals, points, and worksheets. Also, they added colors and arrows to highlight the points' positions and important directions. With this in mind, further research may adapt this method for use with some students with special

needs. For example, they may adapt this method for students with ADHD. They could try different colors and sticky notes which have been effectively used with students with ADHD. By adapting this method for use with students with ADHD, the touch point method could be more effective in teaching them the basic or the advanced math skills.

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Table 1

Study Characteristics

Study	Research questions	Simple size	Gender		Student age (years)	Disability	Research design	Length of interventions	Dosage of intervention	Setting
			Male	Female						
Avant& Heller (2011)	Is touch point method effective in teaching basic addition skills to students with physical disabilities? Can they generalize it to their regular math class?	3 students	2	1	8 9 7	1 spina bifida 1 cerebral 1 stroke	Multiple probe, multi baseline across participant s design	6 weeks	Every day	Orthopedic impairment classroom
Calik & Kargin, (2010)	Is touch point method effective in teaching basic addition skills to students with ID? Can they generalize	3 students	1	2	8 8 8	1 BID (IQ 73) 1 MID (IQ 69) 1 BID (IQ 75)	Multiple probe design across subjects	6 weeks	Monday through Friday, twice in a day	A room

	the skills they learn to the classroom environment? Can they sustain the skills they learn? What are the opinions of teachers in Turkey regarding using touch points to teach t students with ID?									
Cihak & Foust (2008)	Are there functional differences between touch point and number lines for teaching single-digit addition problems for students with autism?	3 students	1	2	7 7 8	Autism	alternating - treatments design	12 weeks	Every day	Resource room

Fletcher, Boon, & Cihak, (2010)	Are there functional differences between touch point and number lines for teaching single-digit addition problems for students with MID?	3 students	2	1	13 13 14	1 MID 2 MID and autism	alternating - treatments design	12 weeks	Every day	Self-contained classroom
Kokaska, 1975	Is touch point method effective in teaching addition and subtraction for students with intellectual disabilities?	4 students	0	4	Not reported	Intellectual disabilities	Pre-test, post-test	5 months	Not reported	Special education classroom
Popo, Hanrahan, 1994	Is touch point method effective in teaching single-digit addition problems for students with moderate intellectual	3 students	1	2	12 11 12	moderate intellectual disabilities	Multiple probe design across subjects	6 weeks	Four days a week for 40 minutes	Separate room

	disabilities?									
Scott, (1993)	Is touch point method effective with students with mild disabilities?	3 students	2	1	9 10 11	1 LD 2 ID	multiple-probe design across subjects	4 weeks	15- to 30-min session each day	Library conference room
Simon & Hanrahan, (2004)	Would students with LD be able to learn and apply successfully the touch point method to solve addition problems?	3 students	1	2	10 10 10	LD	multiple-probe design across subjects	6 weeks	40 min on Tuesdays and Wednesdays 60 min on Friday	A quiet room
Total and range	-----	25	10	15	7-14	Mild to intensive needs	-----	4-12 weeks	3-10 sessions	Special education classroom to a separate room

Table 2

Study	Training session	Variables		Measures	Result	Strengths	Major flaws	Intervention fidelity	Social validity
		Independent	Dependent						
Avant& Heller (2011)	Students were taught to touch points and count aloud. They were taught to begin by touching the top point of the numeral. Then, they were taught to use count on and count all to solve the addition problems. With count all strategy, the students were taught to count all points whereas with count on strategy,	Touch points method. This method requires students to touch points to solve addition problems. Numerals one through five have single points, but numerals six trough nine have double points. To answer 3+2=, the students would answer the problem by touching and counting points on both	The percentage of correct addition problems with sums up to 20	Worksheets	It is effective in teaching the target skills and they generalized it to the general education classroom and one student used it at home. Student A improved from a mean of 53% correct to 89% correct. Student B improved from a mean of 47% correct to	Adapts it for use by students with physical disabilities Includes three types of physical disabilities Provides appropriate adaptations for each student	Small sample Examines only addition with sums up to 20 Takes place in IO classroom Teaches students individually	A detailed checklist was developed to judge whether the intervention was correctly implemented during training and teaching sessions. The intervention validity was 100% across all subjects	It seemed that this method is socially effective because they were effectively using the method 5 months after the intervention ended and they asked to be taught how to use this method to answer subtraction and multiplication problems

	the students were taught to touch the large number and say it and then continue counting points on the next numeral	numbers and then write the answer. The authors adopted this method to accommodate the students' disabilities. For example, they enlarged numerals, points, and worksheets. Also, they added colors and arrows.			94% correct. Student C improved from a mean of 21% correct to 94.5% correct				
Calik & Kargin, (2010)	Teachers used small numbers with points and large numbers without points. Teachers first taught the students the points' positions	Touch point method based on direct teaching approach. This method requires students to touch points to solve addition problems.	The percentage of correct responses for basic addition skill in mathematics	Worksheets	They increased their addition skills and generalized it to the general education classroom. Student 1 improved from a	Takes place in another country Uses it in inclusive school	A small sample Just students with ID Examines only addition skills Takes place in separate classroom	Researcher implemented the intervention, so the researcher followed a specific steps to make sure that the intervention was	All teachers have positive views towards this method and they would use it in their classes

	on each number until they learned it. Next, by modeling the teachers showed the students how to use the touch point to solve the problems. The students then practiced it and they aided through modeling and guided practice.	Numerals one through five have single points, but numerals six trough nine have double points. To answer 3+2=, the students would answer the problem by touching and counting points on both numbers and then write the answer. After the students learned the points' positions, the pointes would be removed and the students would then touch points			mean of 33% correct to 100% correct. Student 2 improved from a mean of 40% correct to 100%. Student 3 improved from a mean of 30% correct to 100% correct.			implemented correctly and every steps was delivered right	

		with their pencil from memory.							
Cihak & Foust (2008)	Students first practiced touching and counting points on each number. Then, they were taught how to use the touch points to solve addition problems.	Touch point and number line methods. Touch point method requires students to touch points to solve addition problems. Numerals one through five have single points, but numerals six trough nine have double points. To answer 3+2=, the students would answer the problem by touching and counting points on	The percentage of single-digit addition problems answered correctly	10 addition problem worksheet	Touch point strategy is more effective, and it was functionally more effective than the number-line strategy when they were compared and replicated. When using touch point method, students improved from a mean of .7 correct to 72% correct, but when using number	Compares two methods	A small sample Just students with autism Teach students individually Teach just single-digit math skills	The teachers used an itemized checklist that included the steps of each method to make sure that they would implement the intervention as the researcher planned. When used this checklist, they could implement the intervention completely and correctly.	The teachers indicated that the touch point strategy was relatively easy to implement and it could be easily used in inclusive math classrooms

		both numbers and then write the answer. Number line is a visual learning tool that the students would use to answer addition problems. It includes numbers one through twenty. To answer 5+3=, they would first point to number five on the number line and then they would move their fingers to the right side three positions to reach the answer.			line, they improved to a mean of 17% correct. They then reached a mean of 100% correct by using touch point method for the content that have been used during number line				

Fletcher, Boon, & Cihak, (2010)	Students first practiced touching and counting points on each number. Then, they were taught how to use the touch points to solve addition problems.	Touch point and number line methods. Touch point method requires students to touch points to solve addition problems. Numerals one through five have single points, but numerals six trough nine have double points. To answer 3+2=, the students would answer the problem by touching and counting points on both numbers and then write	The percentage of single-digit addition problems answered correctly	10 addition problem worksheet	Touch points strategy is more effective, and it was functionally more effective than the number-line strategy when they were compared and replicated. When using touch point method, they improved from a mean of 4% correct to 92% correct, compared to 30% while using number line	Use it with secondary students Compares two method with new group	A small sample Just students with MID Students are taught individually Examines only single-digit math problems Take place in self-contained classroom	The teachers used a checklist that included the steps of each strategy. When they completed a step, they checked it. So, they ensured that they implemented the intervention as the researcher planned.	From the results, it seems that the students like touch point method because their performances improved dramatically and quickly as compared to number line

		the answer. Number line is a visual learning tool that the students would use to answer addition problems. It includes numbers one through twenty. To answer 5+3=, they would first point to number five on the number line and then they would move their fingers to the right side three positions to reach the answer.							
Kokaska, 1975	Students first practiced	Touch point method. It requires	The percentage of	8 addition and subtraction	Students 1 and 3 improved	First study used this interventio	teaches just female students	It seemed that she did it correctly	She did not include information

	touching and counting points on each number (1-9). Then, they were taught how to use the touch points to solve addition and subtraction problems.	the students to touch points in order to solve addition and subtraction problems. Numerals one through nine have single points. To answer 7+2=, the students would answer the problem by touching and counting single points on both numbers and then write the answer. Then, they just touch and count single points on small numbers. After the	addition and subtraction problems answered correctly	problems worksheet	from a mean of 0% correct to 100% correct. Student 2 improved from a mean of 38% to 100% correct. Student 4 improved from a mean of 38% correct to 88% correct	n with students with disabilities She used it to teach addition and subtraction	Uses single points on all numbers, so large numbers (8,9) have many points	because she divided the intervention into small steps. After she complete one step, she checked, so she tried to deliver each step correctly before she moved to the next step.	about social validity, but it seemed that the students liked the strategy because they improved their performance significantly and quickly

		students learned the points' positions, the pointes would be removed and the students would then touch points with their pencil from memory.							
Popo, Hanrahan, 1994	First, the teachers taught the students points' positions on each numbers (1-9). Then, the students would be taught how to solve addition problems by using touch point strategy. After they	Touch points method. The method requires the students to touch points to solve addition problems. Numerals one through five have single points, but numerals six trough nine have double points. To answer	The percentage of addition problems answered correctly	addition problems worksheet	The three students improved from a mean of 0% correct to 98%, 97%, 95% correct	They used multiple probe design	A small sample Teaches addition Teach students individuall y	It seemed that the intervention was delivered as the researcher planed.	They indicated that the students liked the intervention because this method helped them to see their mistakes

	leaned it, the students were taught statements for addition. For example, to answer addition problems, the students were taught to say "I touch the large number, say its name, and continue counting." After they learned the statements, they were given worksheets with touch points on numbers. After they could answer	3+2=, the students would answer the problem by touching and counting points on both numbers and then write the answer. Then, the students would just touch points on small numbers. After the students learned it, the points would be removed and the students would then touch points with their pencil from memory. To answer 5+3=, they would touch							

	them, the touch points would be removed and the students could still touch the number to solve the problems.	and say the top number and then count the points on the small number.							
Scott, (1993)	First, teachers taught the students where the tough points are on each numbers (1-9). After they leaned it, the students were instructed statements for addition, subtractions, and regrouping.	Touch point method. This method requires students to touch points to solve addition problems. Numerals one through five have single points, but numerals six trough nine have double points. To answer 3+2=, the students	The percentage of correct responses for one, two, three-digit addition and subtraction problems with/without regrouping	24-problem worksheet	Performance on each set of math problems for each student improved. Student 1 improved from a mean of 4% correct to 93% correct. Student 2 improved from a mean of 11% correct to 97%	Some math skills (addition and subtraction) Include students with two types of disabilities	A small sample Teach students individually No detail information about social validity	The researcher implemented the intervention, so she did it correctly and completed	She did not conduct a survey to measure social validity, but she indicated that the students seemed to like using touch point method

	For example, to answer addition problems, the students were taught to say "I touch the large number, say its name, and continue counting." After they learned the statements, they were given worksheets with touch points on numbers. After they could answer them, the touch points would be removed and	would answer the problem by touching and counting points on both numbers and then write the answer. After the students learned the points' positions, the pointes will be removed and the students would then touch points with their pencil from memory. To answer 5-3=, they would touch and say the top number and then count backward on the points on the bottom			correct. Students 3 improved from a mean of 9% correct to 97% correct				

	students could still touch the number to solve the problems.	number.							
Simon & Hanrahan, (2004)	First, students were taught the points' positions on each number. To do that, the students first copy them, then drew the points on each number, and finally wrote the numbers with points. After they learned it, they were taught how to use it to solve addition problems	Touch points method. This method requires students to touch points to solve addition problems. Numerals one through five have single points, but numerals six trough nine have double points. To answer 3+2=, the students would answer the problem by touching and counting	The percentage of three-row, double-digit addition problems with regrouping completed correctly	12 addition problem worksheet	It enabled the students to answer the addition problems and generalized and retained the method. Student A improved from a mean of 47% correct to 82% correct. Student B improved from a mean of 1% correct to 93 correct. Student C improved	Include advanced skills (three-digit)	Uses it with just students with LD Takes place in not inclusive school Uses it to teach just addition	It appeared that the intervention was delivered as they planed	When they learned touch point method, they choose to use it when they were told that they could use any method to answer the problems.

		points on both numbers and then write the answer. After the students learned the points' positions, the pointes will be removed and the students would then touch points with their pencil from memory.			from a mean of 74 correct to 97 correct.				