



## Enhancing Mathematical Computational Skills of Primary School Pupils in Selected Public Schools in Uyo Using Touchmath Multisensory Program

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### Abstract

The research was conducted to examine the impact of the TouchMath multisensory program on mathematics computational skills of primary two pupils in some schools in the Uyo Local Government Area. This was done by formulating three research questions and three null hypotheses to inform the study. The study was conducted using a quasi-experimental design. The researchers sampled 120 students of six intact classes. The study employed a simple random sampling method to get a representative sample. The data collection instrument was Mathematical Computational Skills Achievement Test" (MCSAT). The tool was confirmed by professionals in the field. The internal consistency of the Mathematical Computational Skills Achievement Test" (MCSAT,  $\alpha = .81$ ) was determined using Kuder Richardson Formula 20. Research questions were answered using the mean and the standard deviation and ANCOVA were employed in testing the hypotheses with the 0.05 level of significance. The findings showed that there was a significant difference in the counting and multiplication skills of pupils when they were taught using TouchMath Multisensory Program and that there was no significant difference in the counting and multiplication achievement skills of pupils when taught by using TouchMath Multisensory Program as a result of gender in the Uyo Local Government Area. It was suggested among others that teachers should be advised to use TouchMath Multisensory Program when imparting mathematical computational skills in lower basic education.

**Keywords:** Multisensory Program, Touchmath Multisensory Program, Counting, Multiplication operation, Basic Mathematical Computation Skills

### Introduction

Mathematics is one of the most important subjects in formal education. Developing mathematical skills is one of the most important skills for a child. This is because it forms the bedrock for further scientific and technological reasoning and understanding. Proficiency and fluency in basic operations in mathematics skills are foundational to understanding subjects such as physics, chemistry, etc. Basic mathematics skills are needed to cope with day-to-day life. Mathematics is the mother science of the abstract world (Okoye, 2021). Mathematics is one of the core subjects in both the primary and secondary school education systems in Nigeria, which requires effective teaching and learning to acquire skills that are useful in science, technological activities, and nation-building (Ibok & Unoh 2019). Every individual need knowledge of mathematics to function intelligently and efficiently because the subject is an integral part of human life (Ibok & Unoh, 2019).

Mathematics is globally appreciated as a subject that everyone must learn to acquire a range of mathematical skills applicable to various sectors of life (Anjum, 2015).

Despite the relevance of this subject, many pupils see it as a nightmare. It has been observed that mathematics records a major failure in the first school leaving certificate examination. This has continued for many years and has raised several concerns for both researchers and other stakeholders in the field of primary education (Mba, 2019). The cause of this failure has been attributed to poor teaching methods (Ukwueze, 2024). Most teachers do not use good teaching methods to teach basic mathematical concepts. As a result of this, mathematics is presented to the pupils as a difficult and completely abstract concept. The conventional teaching methods are not engaging, and they do not provide fun, effective participation, or

involvement of the senses. Many studies carried out locally support the use of manipulatives as one of the finest methods for teaching mathematics (Alolga & Essel, 2021). Researchers have found that students who use manipulatives in mathematics are more likely to succeed than those who do not have access to manipulatives. (Amo-Asante *et al.*, 2023).

The National Council of Supervisors of Mathematics (NCSM) suggests that the implementation of the use of manipulatives in classroom education increases student achievement (Berger, Mackenzie & Holmes, 2020). Irrespective of the grade, the statement argues that teachers have to intentionally incorporate the use of both tangible and digital manipulatives in their lessons (Moore, 2014). This was done so as to ensure that all students could learn to be efficient in mathematics. Using manipulatives, teachers can offer learners an opportunity to engage, practice and maneuver objects and materials in an attempt to solve problems (Larbi and Mavis, 2016). Nonetheless, the performance of the pupils as far as the computational skills are concerned remains low even with all these reports. In addition, all these studies have not been conducted in the Uyo Local Government, thus, the necessity of the current study.

Asodike and Ikpitibo (2014) regard primary education as the base of formal education. It is the time of making a preparation for advanced education. At this stage, education is aimed at making children acquire the necessary learning skills and offering them the simplest learning material (Jimba, 2015). It helps in the child development in all areas like cognitive development, emotional, social, moral, psychomotor and aesthetic development and acquisition of skills that help in their lives and the proper attitudes and values. (Anero, 2014). Mba (2019) asserted that a good primary school education under proposes all the vocational and technical skills acquired in secondary and higher institutions of learning. These skills are not just vital to the child but also critical to the development of a nation 's economy. Despite the importance of primary education, it has been observed that most children are subjected to teaching content far above their mental age, attention, concentration, and comprehension. During the primary years, the basics of reading, writing, speaking, and mathematics are acquired. Deficiencies from this period usually have long-term consequences throughout life. Achievements at the secondary and tertiary levels of education are usually dependent on the kind of foundation laid during the primary years. This

is the reason many nations in the world have made primary education not only free but compulsory.

The objectives of primary education, among others, are the inculcation of permanent literacy, numeracy, and the ability to communicate effectively; laying a solid basis for scientific, critical, and reflective thinking; and developing opportunities for children to develop life-manipulative skills that will enable them to function effectively in society within the limits of their capabilities. Numeracy refers to one's ability to represent, store, and accurately process mathematical operations (Peters, 2012). Numeracy is the application of mathematics to solve real-life problems (Grootenboer & Marshman, 2016). Developing life manipulative skills starts with the child's ability to count numbers and numerals and perform some basic operations at their early stages of life.

This corroborates previous research whereby early mathematical knowledge is a strong predictor of later school success (Claessens & Engel, 2013). Children may be vulnerable to underachievement throughout their education if they have not developed early mastery in mathematics (Anero, 2014). Basic mathematics skills consist of analyzing, problem solving, addition, subtraction, multiplication, division, fractions, decimal processing, etc. (Hayes, 2005). The four fundamental operations addition, subtraction, multiplication and division, and the counting of numbers are basic mathematical concepts to be taught at primary education level (Tessema, 2018). This means that the acquisition of basic mathematical computation skills leads to the ability to solve more complex math problems. Due to this fact, there is need to investigate a teaching approach that can appeal to the senses of pupils at their early stage of primary school. This prompted the present study as it focuses on the effect of TouchMath Multisensory Program on Mathematical Computational Skills of Primary Two Pupils in Selected Public Schools in Uyo Local Government Area.

TouchMath uses a multisensory approach to help children associate numerals with real values (TouchMath.com, 2014). Learners see the numerals, touch the touchpoints, say the numbers, and hear the problems as they say them aloud. TouchMath counting is the most basic math skill and is connected to every mathematical domain area in elementary and middle school. TouchMaths is the only curriculum program that uses a numeral as a manipulative, instantly turning a potentially daunting abstract concept into real and concrete action (TouchMath.com, 2014; Bergman, 2014). This multi-sensory approach allows students to

engage in mathematics visually, tactically, and kinesthetically. Good mathematics teachers typically use visuals, manipulatives, and motion to enhance students' understanding of math concepts. (Boaler, 2018). TouchMath has the potential of filling the void between concrete and representational math. The program takes into account the academic and cognitive capabilities and inadequacies of students and improves the concept and the computation. In the TouchMath system, Bergman (2014) stated that each digit between one and nine bears dots on it. These dots act as visual reminders to students on how to correctly solve a math problem, by counting. It is part of the program to memorise the where and the number of the touch points of each number, to remember the multiples of numbers (to multiply them), and counting backwards (to subtract). The program aims at the student ultimately internalizing the points to a point where they will not be required any longer to solve math problems (Bergman, 2014). This approach could be used in enhancing the mathematics computational skills of pupils in the classroom.

Gender imbalances in mathematics are likely to be minimized through learner-centred approach to teaching. The issue of gender inequalities that originates in the teaching activities of teachers needs a gender-responsive pedagogy (Mwakabenga & Komba, 2021). Since the positive results of mathematics can be significant, the issue of gender differences in mathematics is something that requires an intervention approach. It is argued that culture was a dominant factor in the unequal education between genders in Nigeria. The poor performance of students in mathematics has been attributed to several factors. There are also noticeable differences in the beliefs held by boys and girls. Girls tend to show a negative attitude and have a lower mathematical self-concept than boys. Amo-Asante et al. (2023) observed that, when compared with boys, "girls lacked confidence, had debilitating causal attribution patterns, perceived mathematics as a male domain, and were anxious about mathematics." Research has shown that boys perform better when taught with an instructional approach, while girls perform better in a cooperative learning environment. Gender differences are a recurrent theme throughout literature in academic studies in general and in mathematics studies in particular. It is therefore important to use an effective teaching method that will reduce this disparity (Ukwueze, 2024). Since the existing and frequently used conventional methods do not help pupils effectively acquire basic skills in

mathematics in a fun and engaging way that enhances their computation achievement skills, there is a need to explore new teaching methods and strategies. It is on this premise that the researcher decided that it was necessary to carry out a study on the effect of TouchMath Multisensory Program on Mathematical Computational Skills of Primary Two Pupils in Selected Public Schools in Uyo Local Government Area.

### Research Questions

The following research questions were answered in this study.

- i. What is the difference in the mean counting achievement scores of pupils taught with TouchMath multisensory program and those taught with conventional teaching method?
- ii. What is the difference in the mean multiplication achievement of pupils taught with TouchMath multisensory program and those taught with conventional teaching method?
- iii. What is the difference in the mean counting and multiplication scores of boys and girls taught with TouchMath Multisensory Program?

### Research Hypotheses

The following hypotheses were tested at .05 level of significance.

- H0<sub>1</sub>: There is no significant difference in the mean counting achievement scores of pupils taught with TouchMath multisensory program and those taught with conventional teaching method.
- H0<sub>2</sub>: There is no significant difference in the mean multiplication achievement scores of pupils taught with TouchMath multisensory program and those taught with conventional teaching method.
- H0<sub>3</sub>: There is no significant difference in the mean counting and multiplication achievement scores of boys and girls taught with TouchMath Multisensory Program.

### Methods

Ethical consideration Permission was granted by the ethical committee of the University of Uyo, Uyo Akwa Ibom State to conduct this study. This study adopted a quasi-experimental research design. It specifically adopted a pretest-post-test non-equivalent control group design. According to Ezech (2015), a quasi-experimental design is one in which random

assignment of subjects to treatment and control groups is not possible.

The population of this study was all the primary two (2) pupils in the 47 public primary schools in the study area, giving a total of 11,180 (Males= 5361; Females = 5819). A sample size of 120 (Males = 50; Females = 70) pupils from six (6) intact classes in six (6) schools was used for this study. Three for experimental group numbering 67 (Males = 32; Females = 35) and three for control group numbering 53 (Males = 18; Females = 35). A random sampling technique was adopted to obtain a sample of pupils in six schools.

The researcher developed Mathematical Computational Skills Achievement Test (MCSAT) which was used for the study. The instrument had two sections. Section A elicited information on the pupil's personal data, while Section B contained 20 mathematics questions, scored 5 mark each making a total of 100%. This instrument was used for the pretest as well as the posttest. The researcher also developed lesson plans for both the experimental and control groups, which served as treatment packages for the study. The instruments were subjected to face-to-face and content validity by an expert in the Early Childhood and Special Education Department, an expert from the Educational Foundations faculty of education, Uyo, a primary two teacher in a public school, and the head teacher in a public primary school. The Mathematical Computational Skills Achievement Test (MCSAT) was subjected to pilot testing on 24 public primary school pupils within the study area who are not part of the main study but are equivalent in all aspects to the pupils in the main study. Kuder Richardson formula 20 was used to determine the internal consistency of the instrument, which yielded a reliability of coefficient indices of 0.91. As a result, the instrument was considered reliable and suitable for the study.

The researcher wrote introductory letters to the head teachers of the six sample schools. Permission was granted by the sampled schools chosen to carry out the study. The researcher trained and worked with five

research assistants. Adherence to the principle of voluntary and informed consent to participate in this study will be highly esteemed and upheld throughout this research work. The Mathematical Computational Skills Achievement Test" (MCSAT) was administered to all the pupils in both the experimental and control groups as pretests. The treatment packages for the experimental group were taught by the research assistants using TouchMath Multisensory. The concepts were counting numbers, and multiplication of two-digit numbers. Week one started with counting numbers, recognizing numerals, and writing two-digit numbers. Children were encouraged to touch each point with their pencils and count. They did this repeatedly for mastery. Week two started with multiplication of single digit numbers. Week three started multiplication of two-digit numbers. Week four was consolidation of the previous weeks on using TouchMath Multisensory Program on teaching basic mathematical operations. The research assistants during the treatment packages have the lesson plans as road map or guide for the entire week's work. For the control group the treatment package was done using the Talk and Chalk method by the research assistants. The treatment period lasted for four weeks. At the end of the program, the Mathematical Computational Skills Achievement Test (MCSAT) was re-shuffled and administered as a posttest to both the experimental and control groups

Data were analysed using SPSS version 20 to get the results of mean and standard deviation which were used in answering the research questions, while analysis of covariance (ANCOVA) was used to test the hypotheses at the 0.05 level of significance. The pretest scores were used as covariates for the posttest scores. The ANCOVA was used because it is a statistical method used to control extraneous variables where randomization is not possible and to remove the effect of extraneous variables with covariates in the dependent variables. It is used because equivalent groups were achieved and intact classes were used, as well as to point out the initial difference between groups

## Results

**Table 1: Mean Standard Deviation and mean difference in the counting achievement of pupils taught with TouchMath multisensory program and those taught with conventional teaching method**

Groups	n	Pre-test $\bar{X}$	SD	Post-test $\bar{X}$	SD	Mean Difference
TouchMath Multisensory Program	67	2.62	1.763.82	1.36	1.20	
Conventional Teaching Method	53	2.62	1.50 2.28	0.79	- 0.34	

The results in Table 1 revealed the pretest and posttest means of the experimental group (TouchMath Multisensory Program) of 2.62 and 3.82 with their respective standard deviations of 1.76 and 1.36. The result further shows the pretest and post-test means of the control group (those taught with conventional teaching methods) of 2.62 and 2.28 and their respective standard deviations of 1.50 and 0.79. Comparing the mean differences of those in the experimental group

with those in the control group implies there is a difference in the counting achievement of pupils taught with the TouchMath multisensory program and those taught with conventional teaching methods in favor of the experimental group (TouchMath multisensory program). This implies that the TouchMath multisensory program increases the counting achievement of pupils.

**Table 2: Result of Analysis of Covariance (ANCOVA) of the significant difference in the in the counting achievement of pupils taught with TouchMath multisensory program and those taught with conventional teaching method**

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	81.916 <sup>a</sup>	2	40.958	33.123	.000
Intercept	218.639	1	218.639	176.815	.000
Pretest	11.930	1	11.930	9.648	.002
Methods of teaching	69.912	1	69.912	56.538	.000
Error	144.676	117	1.237		
Total	1411.000	120			
Corrected Total	226.592	119			

a. R Squared = .362 (Adjusted R Squared = .351)

The result in Table 2 shows that an F-ratio of 56.538 with an associated probability value of 0.000 was obtained with regards to the difference in the counting achievement of pupils taught with the TouchMath multisensory program and those taught with the conventional teaching method. Since the associated probability of 0.000 was less than .05, the null hypothesis, which states that there is no significant

difference in the counting achievement of pupils taught with the TouchMath multisensory program and those taught with conventional teaching methods, was rejected. This implies that there is a significant difference in the counting achievement of pupils taught with the TouchMath multisensory program and those taught with the conventional teaching method.



**Table 3: Mean Standard Deviation and mean difference in the multiplication achievement of pupils taught with TouchMath multisensory program and those taught with conventional teaching method**

Groups	n	Pre-test		Post-test		Mean Difference
		$\bar{X}$	SD	$\bar{X}$	SD	
TouchMath Multisensory Program	67	2.10	1.87	1.64	1.54	
Conventional Teaching Method	53	1.77	1.67	1.18	0.07	

The result in Table 3 revealed the pretest and posttest means multiplication scores of the experimental group (TouchMath Multisensory Program) of 2.10 and 3.64 with their respective standard deviations of 1.87 and 1.54. The result further shows the pretest, and post-test means of the control group (those taught with conventional teaching methods) of 1.77 and 1.84 and their respective standard deviations of 1.67 and 1.18.

Comparing the mean differences of those in the experimental group with those in the control group implies there is a difference in the multiplication achievement of pupils taught with the TouchMath multisensory program and those taught with conventional teaching methods in favor of the experimental group (TouchMath multisensory program).

**Table 4: Result of Analysis of Covariance (ANCOVA) of the significant difference in the multiplication achievement of pupils taught with TouchMath multisensory program and those taught with conventional teaching method**

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	152.882	2	76.441	46.002	.000
Intercept	214.470	1	214.470	129.068	.000
Pretest	57.778	1	57.778	34.771	.000
Methods of teaching	81.170	1	81.170	48.848	.000
Error	194.418	117	1.662		
Total	1322.000	120			
Corrected Total	347.300	119			

a. R Squared = .440 (Adjusted R Squared = .431)

The result in Table 4 shows that an F-ratio of 48.848 with an associated probability value of 0.009 was obtained with regards to the difference in the multiplication achievement of pupils taught with the TouchMath multisensory program and those taught with the conventional teaching method. Since the associated probability of 0.000 was less than .05, the null hypothesis 4, which states that there is no

significant difference in the multiplication achievement of pupils taught with the TouchMath multisensory program and those taught with conventional teaching methods, was rejected. This implies that there is a significant difference in the subtraction achievement of pupils taught with the TouchMath multisensory program and those taught with the conventional teaching method.

**Table 5: Mean Standard Deviation and mean difference in the mathematics computational skills of boys and girls taught with TouchMath Multisensory Program**

Gender	N	Pre-test		Post-test		Mean Difference
		$\bar{X}$	SD	$\bar{X}$	SD	
Boys	35	7.65	4.89	12.08	4.41	4.43
Girls	32	9.00	4.00	13.12	3.39	4.12

The result in Table 5 revealed the pretest and posttest means of boys of 7.65 and 12.08 with their respective standard deviations of 4.89 and 4.41. The result further shows the pretest, and post-test means of girls of 9.00 and 13.12 and their respective standard deviations of

4.00 and 3.39. Comparing mean differences, boys had a slightly higher mean difference than their female counterparts. This implies that both boys and girls benefited from the TouchMath multisensory program.

**Table 6: Result of Analysis of Covariance (ANCOVA) of the significant difference in the mathematics counting and multiplication skills achievement of boys and girls taught with TouchMath Multisensory Program**

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	318.249	2	159.125	14.143	.000
Intercept	1097.865	1	1097.865	97.581	.000
Pretest	300.193	1	300.193	26.682	.000
Methods of teaching	2.581	1	2.581	.229	.634
Error	720.049	64	11.251		
Total	11645.000	67			
Corrected Total	1038.299	66			

a. R Squared = .307 (Adjusted R Squared = .285)

The result in Table 6 shows that an F-ratio of 0.229 with an associated probability value of 0.634 was obtained with regards to the difference in the mathematics computational skills achievement of boys and girls taught with the TouchMath Multisensory Program. Since the associated probability of 0.634 was greater than .05, null hypothesis 5, which states that there is no significant difference in the mean mathematics computational scores achievement of boys and girls taught with TouchMath Multisensory Program, was accepted. This implies that there is no significant difference in the mean mathematics computational scores achievement of boys and girls taught with the TouchMath Multisensory Program.

### Discussion of the Findings

The result showed that pupils instructed using the TouchMath Multisensory Program had higher mean

achievement in counting than pupils exposed to the traditional approach. The counting performance of the pupils that was taught by using TouchMath multisensory program and those taught by the traditional teaching method varied significantly. This observation is consistent with the study conducted by Upadhyay and Prakash (2017) to determine the efficacy of the touch math technique in assisting children with number troubles in learning numbers between 1 and 10. The conclusions of the research restate the undoubted facts that the touch math approach is the most suitable tool of teaching young children, particularly those who have a problem with numbers. The discovery also reinforced the theory of Jerome Bruner (1915-2016) about the development of mental processes according to which there are three stages of mental development: concrete, pictorial, and symbolic. During early years and at the onset of learning, we acquire by manipulative

learning (Bruner, 1966). When we have perfected this level, we can advance to the level of using pictures, and then, lastly, we can turn to the usage of symbols to designate the pictures and objects. It is also the most appropriate way of learning a concept or a procedure, regardless of the level of age. Tangible (real-life) materials are referred to as manipulatives and children are induced to learn using their senses. Similarly, the results support the pictorial stage since it is linked to the learning that children between the ages of two and seven can portray because they can create and apply various forms of mental images. At this age, a child understands that a picture may be an object or something that can be manipulated. This phase is the most similar to the preoperational stage of Piaget. The same learner seven years and above can and should grasp concepts and skills through mental images and pictorial representation. In understanding, it is a thousand words with a picture. The most developed one is the symbolic phase that is closest to the later concrete operational phase of Piaget and the formal operations phase. This is experienced by learners at the age of 7 and above. Items at this stage involve the application of symbols e.g. numerals (1, 2, 3, etc.), alphabetical characters (a,b,c, etc), and operation signs( +, -, x, ÷, =). Each of the symbols is a picture, object or action of the preceding stages. TouchMath comes right after this research because children can solve computation problems with the use of manipulatives.

The results obtained revealed that students being taught using TouchMath Multisensory Program had a better multiplication achievement when compared to students who were taught using the traditional approach. The subtraction performance of the pupils instructed using the TouchMath multisensory program and those using the conventional teaching strategy showed a big variation. The finding concurs with Khalifa and Saad (2021), who conducted a research on the efficiency of touch math in enhancing the early mathematics competence of kindergarten children with mild to borderline intellectual functioning under an inclusion classroom. It was found that, Touchmath demonstrated positive effects on an instructional basis of a direct teaching method that enhances the early mathematics aptitude of kindergarten learners with mild to borderline intellectual functioning as well as their typically developing counterparts in an inclusion classroom as an efficient, sustainable, generalisable and socially acceptable teaching fundamental addition skills to the students with mild intellectual disability in general education classes. Ullrich (2014) discovered

that the students had a higher capacity to add fast and precisely after mathematics instruction which included the TouchMath program. The findings indicate that instructing students in particular touchpoints of numerals improve its ability to add fluently and that is not dependent on gender, first tongue, and attendance status.

The results of the analysis summary showed that no significant difference in the mathematics computational skills achievement of girls and boys who were taught using the TouchMath Multisensory Program could be identified. This might be by virtue of the fact that boys had a mean difference slightly more than that of their female counterparts. This observation supports the study conducted by Kashefi et al. (2018), on gender disparities among Malaysian international school students in grade four on their performance in mathematics skills in higher-order thinking. The discovery gave a conclusion that the gender difference in mathematics performance is not significant in higher-order thinking, i.e. the application of skills, reasoning skills and both. Opposite to this result, Oribhabor (2020) conducted a study looking at how gender affects the academic performance of mathematics in senior secondary schools in Bayelsa State and discovered that the mathematics performance of the male students is significantly higher than that of the female students in favour of the former. Anjum (2015) also established a great disparity between the mathematics performance of girls and boys during the upper primary school level.

There were several limitations in the study, such as the head teachers' acceptance of the conduct of the experimental study. Finance was another limitation as effective teaching of the touch math program requires the purchase of touch math kits. However, the researcher was able to overcome the limitations by presenting an introductory letter to allow the primary two pupils and teachers to participate in the research and make improvisations for the TouchMath teaching aid. Furthermore, since no study has been carried out on TouchMath and Multiplication achievement, this study has made a significant contribution to show that TouchMath improves multiplication achievement. It was suggested that the same study can be carried out in other Local Government Area of the state of the nation to validate reliability of the findings of this study.

## Conclusion

Based on the findings of this study, it was concluded that TouchMath Multisensory Program has a significant effect on mathematical computational skills of pupils in



Uyo Local Government Area of Akwa Ibom State. There is no significant gender difference in mathematical computational skills that is counting, addition, subtraction and multiplication. It was suggested that the same study could be carried out at primary classes to know whether there will be level disparity in mathematical computational skills achievement when TouchMath Multisensory Program is used to teach mathematical computation.

### Recommendations

Based on the conclusion of the study the following recommendations were made:

The study established that TouchMath Multisensory Program was effective in promoting meaningful learning in mathematical computational skills. Therefore, there is need to promote the use of TouchMath Multisensory Program by the teacher in teaching mathematical computational skills.

The State and the Federal Government ought to hold workshops and seminars to primary teachers on the use of TouchMath Multisensory Program in the teaching and learning process.

There should be an equal opportunity to the pupils in TouchMath Multisensory Program in any level, as it is child friendly.

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