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# Mathematical Difficulties: Does early intervention enhance mathematical performance?

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**Chapter 1:**

## Introduction

Fleischner and Manheimer (1997) indicated in a study that about 6% of children have mathematical learning difficulties. Educators have a tremendous task in teaching children many subjects. Teachers seek to engage the children in activities that stimulate their minds to explore different strategies in completing each task. Mathematics is one subject that requires the student to engage in the learning process in a variety of ways and potentially face some difficulties. Children learn in a variety of ways and seek the teacher's guidance in learning and processing different approaches to mathematics.

Gersten, Jordan and Flojo (2005) noted that the need for an early detection and intervention in mathematics is greatly needed. This would allow the young child to approach number sense, computation skills and problem solving with multiple strategies. The task for the teacher begins in identifying which intervention methods are most effective to enhance the student's mathematical performance.

## Problem Statement - Abstract

Educators seek to equip students with the knowledge to succeed in life. It is the mission of the educator to ensure that the students fully comprehend what is being taught. This may not be occurring in all classroom settings. The teachers use various tests and exercises to gauge the student's comprehension of the material and concepts presented. There are times when students do not grasp the concepts presented by the teacher as quickly as the teacher desires. There are some instances when the students have difficulty in bridging concepts. The instructional method presented by the teacher at that time was not an approach that the child could easily identify or follow. Mathematics is one subject that some students face difficulty and many challenges.

Early intervention with math difficulty is desperately needed in the education system. It is pertinent that the educator pursues several techniques to reach and engage the student to empower them with the knowledge of basic mathematical computation skills.

## Elements of the Problem

In this researcher's professional experience, some educators might determine that the student may have a learning disability as a result of the lapse of time from the introduction of concept, the retention of the data presented and the application of that information. Is this really the way to properly approach the situation? Does the child really have a learning disability? Or does the student need another method of instruction to understand the concepts presented?

Jordan and Hanich (2000) observed that number facts, place value, story problems and written calculation are normally taught in early elementary school and are used to determine if the student has some weakness in mathematical cognition. These are considered the basics for mathematical computation. These researchers cited Naglieri and Gottling (1997) who note that children who have different cognitive characteristics react differently to instruction designed for mathematical planning. This is very important because this influences the training that the child receives.

Kaufman, Handl and Thony (2003) discuss that mathematics is a very complex subject that encompasses many basic skills including number processing, counting and complex calculation skills. The researchers indicate that the teacher must distinguish between the student's procedural (knowing how to) and cognitive (knowing why) knowledge. Dyscalculia is defined as a mathematical learning disability. The researchers describe dyscalculia as a condition for those with difficulty in grasping simple numerical concepts and comprehending the procedures for basic mathematical computation.

Van Luit and Schopman (2000) noted that early numeracy is essential for the learning and development of basic mathematical skills. This is the foundation for further knowledge of mathematics. It is essential that the students understand the basic concepts of early numeracy, the procedures for problem solving and when to apply this knowledge. In the teaching process, the teacher needs to discover which method of instruction is best for each child. Teachers must adapt their instructions to the individual child. The process of learning by doing would seem to be useful for encouraging the student to realize strategies for problem solving.

Ames (1992) indicated that the instructional practices of teachers contribute to a student's perception of goal structures. Each child learns through a variety of instructional methods. Some are visual and make a connection immediately upon seeing 4 + 1 = 5. Others are hands on and need manipulatives to group or organize the two sets of numbers and their combined total.

It should be the responsibility of the instructor to identify the methods that are most effective with their student population. Once a student's need for assistance is recognized, the early intervention can take place. The implementation of early intervention is another approach to engage the student in the learning process and stimulate their interest in mathematics and result in greater mathematical achievement. Researchers have studied many techniques of teaching mathematics as a means of early intervention. This research will examine approaches of early intervention for students with mathematical difficulty. The constructs that will be observed with this study will be:

1. Early Numeracy
2. Incremental Rehearsal (IR)
3. Numeracy Intervention Program – Conceptual Knowledge
4. Computer Assisted Drill Practice

5. PASS Cognitive Process (PASS)
6. Constant Time Delay (CTD)
7. Computer-Assisted Instruction vs. Teacher-Directed Instruction (CAI vs. TDI)
8. Fluency Instruction and Mastery Instruction Maintenance
9. Process Mnemonic Learning (PM)
10. Schema-based Transfer Instruction (SBTI)

## Purpose of Study

The need to ask educators about their opinions on the subject to what extent early intervention methods enhance mathematical performance is long overdue. The purpose of this quantitative research is to examine the extent to which teachers agree that early intervention methods enhance the mathematical performance of students with mathematical difficulty. The study will examine the educators' opinions on input on early intervention for enhancing the student's mathematical performance.

## Definition of Terms

To allow all readers to be on one accord, in this study, this researcher chooses to use the following description of the variables as explained by previous researchers:

1. *Early Numeracy* - an intervention method that includes concrete objects, semiconcrete presentations of objects and abstract representations of objects.
2. *Incremental Rehearsal (IR)* - a drill practice method which uses a gradually increasing ratio of known to unknown items to increase fluency of multiplication facts with students as a method of mathematical intervention.
3. *Numeracy Intervention Program/Conceptual Knowledge* – a pilot study on the basic numerical processing and conceptual knowledge. This program included of counting,

understanding and using written mathematical symbols, memorization of numbers that equal ten, addition and subtraction inversion problems and solving complex written calculations.

4. *Computer Assisted Drill Practice* – this method of intervention uses software drill and practice instruction and stimulate the memorization of information using gradual recall.
5. *PASS Cognitive Process (PASS)* – an instructional method of teaching mathematics through a cognitive approach of strategically planning each stage of the problem solving process.
6. *Constant Time Delay (CTD)* – a method of intervention in which teacher directed instruction with verbal praise was taught with continuous student response time.
7. *Computer-Assisted Instruction vs. Teacher-Directed Instruction (CAI vs. TDI)* – an instructional approach that measures fact automaticity comparing computer drill and practice methods with teacher directed instruction
8. *Fluency Instruction and Mastery Instruction Maintenance* – an intervention method used to determine if fluency instruction or mastery instruction is maintained by the student.
9. *Process Mnemonic Learning (PM)* – an instructional method using rhymes to assist in remembering rules, principles and procedures to solve mathematical problems using rehearsed drills
10. *Schema-based Transfer Instruction (SBTI)* – this instructional method of expanding the knowledge of the student to increase problem solving instruction, interpretation of the vocabulary and line of questioning and altering the appearance of the question.

## Research Questions

Based on the previous research on mathematical difficulties and teaching methods, the primary research questions are:

- "To what extent do teachers' agree that these early intervention methods enhance the student's mathematical performance?"
- "Which methods of intervention are most effective in teaching children with mathematical difficulties?"

**Chapter II:**

## Literature Review

### Introduction

This chapter will review the literature of several researchers who have studied methods of teaching students with learning difficulties in mathematics. These students display a deficit with the basic computation skills necessary to complete the mathematical problems with accuracy, fluency and efficiency. Researchers have provided information regarding the early intervention methods that would be beneficial to students with mathematical difficulties.

*Early Numeracy*

Van Luit and Schompman (2000) studied improving early numeracy in young children with special needs. Their research results in findings very similar to other researchers who study mathematical difficulties. 124 Dutch kindergarten students participated in this study. These students were identified as being very weak or mediocre in counting skills based on a standardized early numeracy test. They were divided into two groups (62 in each group- one is the control and one is the experimental group). The Chi-Square statistics method was used to measure comparison between the two groups. The intervention consisted of 20 lessons with instructions and supplementary material. The numbers 1 through 15 were the focus. The program involved introducing the numbers to the students and transferring the information about the numbers to the information obtained to new mathematical problems. The instructional methods included concrete objects (orange), semiconcrete presentations of objects (flashcard with object on it) and abstract representations of objects (written numbers). Students were then asked to examine how this knowledge could be applied to other situations. The students took this information and explored different counting procedures, math problems and skip counting.

The children were tested in several areas: early numeracy test and the transfer test. The intervention was for six months with two half hour sessions per week. The results indicated that the experimental group increased their early numeracy by several levels. This method was very effective. There was no significant difference between the control and experimental group when considering the transfer test performance level. The early math intervention program may be beneficial for those young children who are developmentally delayed. The important factor to keep in mind is the instructional method of the child; using a variety of instructional materials and applying reality based situations for the students to examine produced favorable responses.

*Incremental Rehearsal (IR)*

Burns (2005) explored the practice of Incremental Rehearsal (a drill practice method) which uses a gradually increasing ratio of known to unknown items to increase fluency of multiplication facts with children as a method of mathematical intervention. The researcher attempts to teach single-digit multiplication facts to three elementary students. The experimental treatment of identifying known (answered in 2 seconds) and unknown (no answer, delay greater than 2 seconds) single-digit multiplication facts on flash cards was administered twice a week with a one-on-one format in a 10 to 15 minute timeframe. The unknown facts were presented to the student with a verbal answer given by the student researcher; the child repeats the multiplication fact. The first unknown fact is now considered the first known fact and a new known fact is introduced. The unknown fact is repeated ten times in a sequence of 10 cards (first unknown fact and nine known facts) in a gradual progression process. The posttest data suggests that all three students showed immediate improvements in performance after beginning the treatment and continuous improvement during the treatment. The findings indicated that the effect size (the subtracting of their pretreatment data and their post-treatment data divided by the

standard deviation of the pretreatment test) for each student was profound – Student 1 – 17.00; Student 2 - 3.42 and Student 3 – 4.79. This study's results imply that uniform and steadfast treatment effects in single-subject research does effect the student's ability to retain the information taught.

*Numeracy Intervention Program - Conceptual Knowledge*

Kaufmann, Handl and Thony (2003) conducted a pilot study on the basic numerical processing and conceptual knowledge with six third grade students who had been diagnosed by a psychologist with developmental dyscalculia. These students were compared to a group of eighteen students without learning disabilities who were in the control group. The intervention was conducted three times a week for six months during school hours; each session was 25 minutes with no individual attention. This program included of counting, understanding and using written mathematical symbols, memorization of numbers that equal ten, addition and subtraction inversion problems and solving complex written calculations. These areas were identified in the study as basic numerical knowledge, arithmetic fact knowledge, procedural knowledge and conceptual knowledge. The Wilcoxon test was the measure used to analyze the data. The results indicated that the control group surpassed the experimental group on all components of number processing and arithmetic prior to intervention. Once the intervention program was administered to the experimental group, the effects were significant. This is an indication that the students showed improvement in the processing of quantity information. The basic numerical knowledge for both groups, however, did not reach the magnitude expected for either group. The conceptual knowledge increased significantly in the control group. Overall, the experimental group's performance increased in the arithmetic fact, procedural and conceptual knowledge areas. The researcher did note that the experimental group's performance increase

was not profound because these skills should have been mastered long before their currently level in school.

*Computer Assisted Drill Practice*

Howell, Sidorenko and Jurica (1987) conducted two studies on a 16 year old 10th grade male that has been in special classes since first grade. The intervention included the use of an Apple IIe computer for scheduled 45 minute blocks with multiplication problems. The instruction included a combination of textbook and worksheet activities. The portion of the study used the software drill and practice mathematical program called "Galaxy Math" (Random House, Inc., 1984) in which the student races the time to answer multiplication problems. Howell's et. al (1987) observation was based on the number of errors for 20 randomly selected problems and the average amount of time to complete the problems was recorded. The second study involved the intervention of a tutorial-based software program called "MemorEase" (Mind Nautilus Software, 1985) that was designed to stimulate the memorization of information using gradual recall. The student would be presented with a stimulus and asked to either say it aloud or to himself; then the student is allowed to modify the number of stimulus elements visible at any time on the screen. The second portion of this study involved teacher instruction using "The Rule of Nines" with drill and practice software as reinforcement and maintenance. The student was observed on the number of errors for multiplication problems with timed and untimed conditions. The results indicated that the number of errors decreased to one by session 6. The student was able to implement the new approach and rely less on the ineffective strategy. This was very beneficial because the software used prompt fading to give the student more opportunities to respond. The researcher noted that this method of intervention had an initial, but brief effect upon the amount of errors and time to complete the facts successfully. The findings

indicated that the rate of improvement resulted from the combination of the software and teacher intervention.

*PASS Cognitive Process (PASS)*

Kroesbergen, Johannes, VanLuit and Naglieri (2003) studied 267 Dutch students with mathematical learning disabilities (MLD) who ranged in age from 5 -17. The students were given tests before, during and after intervention regarding their planning, attentional, simulateneuous and successive (PASS) cognitive theory process. The students were assessed on their ability to complete basic multiplication facts, automatic processing of these facts, and word problem-solving skills. The results indicated that the students with mathematical learning disability had a cognitive weakness in planning or successive processing (24%). This is significant because planning is important in the cognition process of mathematics. The group of students with MLD improved due to the intervention (Basic skills - +2.9%, Automaticity - +10.5% and Word Problems - + 3.9%). Students with difficulties in the automaticity of basic facts showed problems with successive processing, planning and attention. Students showing difficulty with word problems displayed weak attention and successive processing, which are important in reading and strong planning and simultaneous processing.

*Constant Time Delay (CTD)*

Koscinski and Gast (1993) studied the use of constant time delay to teach multiplication facts to children with learning disabilities. Three males and two female students, who were 9 to 12 years old, participated in the study. These students received the intervention from the teacher in the classroom facing away from the other students (20 students in the classroom). The intervention was administered one session a day for four days a week. The five students were shown index cards with multiplication facts; screening identifying 100 unknown facts was

necessary to determine a method of gauging improvement in each session. Verbal praise and checks on a behavior point card were used. These points were redeemed for gum and other special prizes. Each student was pretested to determine their baseline level of knowledge.

The constant time delay method involved the teacher reading the math fact out loud. The teacher would instruct the child to provide the answer if they do know it or if they are not sure, wait, and the teacher would provide the answer. Finally, the student would read the problem and the answer. The first trial involved a zero-second delay with the teacher giving the child the answer. The remaining trail would add on one second up to 4 seconds of delay before the teacher gives the answer. The verbal praise and encouragement was an added bonus of reinforcement for the students. The children were tested after the intervention to observe their progress. The student's reliability and effectiveness from instructional period increased dramatically. Each participant's efficiency through reinforcement from verbal and visual feedback and generalization through problem solving resulted in an accelerated trend and was consistent across all of the students. This is profound considering that the students have spent several months to two years studying strategies. This method proved to be very effective.

*Computer-Assisted Instruction vs. Teacher-Directed Instruction (CAI vs. TDI)*

Wilson, Majsterek and Simmons (1996) conducted a study with four elementary students (three boys and one girl) from northwest Ohio with learning disabilities comparing computer-assisted and teacher-direction instruction in multiplication. The study compared the fact automaticity of the CAI and TDI methods which were taught in two separate lessons. The students received an hour of intervention per day each week. The students were observed in the following areas: facts answered correctly within 3 seconds, facts crossed out, answered correctly in more than 3 seconds and facts answered incorrectly. The CAI treatment involved a computer

software program called Math Blaster in which the teachers select the math facts studied by the student. The student would be presented with five facts on the screen, first with answers and then without answers. The student would be given 3 to 10 seconds to respond. The students progressed to practice of methods through a video review game. The TDI treatment used flashcards to measure automaticity and the teacher would say the fact and the answer. The teacher and student would say the fact and answer alone. The next phase involved developing accurate and fast responses through reviewing flashcards without answers. The final phase involved a time period in which the student would attempt to beat their own time for responding correctly**.** The intervention lasted for 30 minutes with both methods. The results showed that the students mastered more facts during the TDI. In addition, the students had more than two to four opportunities to respond with the TDI than the CAI. In the TDI setting, the students had two to four additional opportunities to view facts and answers, respond the problems and get feedback.

*Fluency Instruction vs. Mastery Instruction Maintenance*

Singer-Dudek and Greer (2005) examined the relationship between fluency and mastering skill maintenance of complex math skills. A matched simultaneous research design was used. Two experiments were studied. Four students with developmental disabilities and disorders in behavior were studied. Pretests were administered prior to study testing their place value skills, identifying sight words in problems and analyzing sight words related to mathematics. During the study, the student's component skill instruction was managed covering fluency and mastery responding using addition facts during a nine month period. Fluency instruction was provided through the instructors provided prompting and coaching to encourage correct responses. The Mastery instruction was provided without any verbal strategies offered

for problem solving. When the students saw the problems, they immediately began to write the answers without hesitation. They were timed and only correct responses were reinforced. One and two month maintenance probes were given to assess the maintenance of the strategy taught. The findings revealed that the students who receive mastery instruction required fewer learning units to meet the appropriate responding criteria. This study indicated that the students receiving fluency instruction did not acquire mathematical computation skills easier or faster than the mastery instruction group.

*Process mnemonic learning (PM)*

Manalo, Bunnell and Stillman (2000) investigated the effects of mnemonic instruction using rhymes to teach students with mathematical difficulties. The researchers used a single subject, multiple-baseline research design. Process mnemonics uses rhymes to assist in remembering rules, principles and procedures. This study will present numbers as characters and the operations as stories. In the two studies students were randomly assigned to one of four instructional groups: PM, study skills (SS), demonstration-imitation (DI) and no instruction (NI). Experiment 1 involved 29 New Zealand eighth grade equivalent students (23 were females and 6 were males). This study had two components: Phase 1 was addition and subtraction, while Phase 2 dealt with multiplication and division. The students were arbitrarily reassigned for Phase 2. The instruction factors were PM and DI approaches. The DI approach requires the students to model the teacher demonstrated steps in problem solving. There were two control groups in this experiment: SS and NI. The intervention was for 25 minutes twice a week. The findings indicated that the PM instruction resulted in significant progress and were maintained over time. The DI instruction showed noticeable improvement, but was not preserved over time.

In Experiment 2, 28 New Zealand eighth grade equivalent students were assigned to PM, DI or NI groups. This experiment was a duplicate of Experiment 1 and varied from the other study in the instructors providing the intervention. There were two instructors in this experiment who were given seven hours of PM and DI instruction. The assessments were given during the fifth instructional session, four weeks and eight weeks after intervention. The same analyses were administered. The results were very similar to Experiment 1. This is an indication that the PM instructional method was very effective. The researchers feel that this study supports process mnemonics speak to problems with mathematical difficulties.

*Schema-based transfer instruction (SBTI)*

Fuchs, Fuchs, Finelli, Courey and Hamlett (2004) examined the intervention method of expanding the student's schema to assist in the solving of real-life mathematical problems. This randomized controlled study explored the self-regulation of learning strategies beyond schema based instruction. The instructions were used to expand the knowledge of the student to increase problem solving strategies. The SBTI intervention involved four transfer levels: rules dealing with problem solving instruction, interpretation of the vocabulary and line of questioning, modifying the appearance or vocabulary of the multiplication facts and real-life problem solving differing from the problems presented in previous instruction. An expanded SBTI was administered that consisted of: a) the inclusion of unrelated information, b) combining two types of problems and c) modifying the appearance or vocabulary of the question. The intervention was administered to 24 third-graders in seven schools who volunteered to participate. They were placed in three groups: the control group, the SBTI and the expanded SBTI. The intervention lasted for 16 weeks with 34 lessons on problem solving in the natural classroom. The students were given problems related to shopping, the purchase of half of a given quantity, purchases with

mixed quantities and pictographs. A two-factor mixed model ANOVA was conducted on each problem-solving measure. The results indicated that the expanded SBTI group showed a great improvement in their problem-solving skills. The control group did not improve as well as the SBTI group or the expanded SBTI in the transferring of knowledge from rules of problem-solving to the interpretation of the vocabulary used in the word problems. The expanded SBTI and SBTI groups performed significantly better than the control group in the modification of the vocabulary and the appearance of the multiplication word problems. The expanded SBTI group exceeded the SBTI and the control group in accuracy in real life problem solving word facts. Overall, the expanded SBTI group exceeded the other groups in the transfer of schema from one phase to the next. This research suggests that the expanded SBTI approach may benefit a wide range of third-graders in enhancing mathematical problem solving.

## Conclusion

Many teachers struggle with strategies in approaching the intervention process to increase the fluency, accuracy and efficiency of the students. Based on the review of literature, it can be concluded that educators can pursue several methods of intervention to improve mathematical difficulties in multiplication. Based on the findings and literature, the need for a quantitative study on most effective and practical methods for teachers is necessary to enhance the mathematical skills of students.

## Chapter III: Methodology

### Research Design

For the purpose of this quantitative research design, the researcher will use a Likert scale survey to conduct the proposed action research study. It must be clearly noted that this anticipated research project will involve descriptive statistics and will not apply a theory to describe, explain, predict or control the data. The Likert scale survey (opinionnaire) is a measure to examine the attitude, interests, characteristics, and values of the participant's agreement or disagreement with a particular topic. The opinionnaire will be used as a guide to clarify to what extent early intervention methods are most effective in increasing mathematical performance in children with difficulties. The opinionnaire will be effective in determining which early intervention methods are most useful in enhancing mathematical performance. The researcher will further examine which methods enhanced mathematical performance. The instructional methods that the educators indicate will be an excellent source of information that would be very helpful in the development of basic mathematical computation skills in students.

### Sampling

The researcher will conduct a fixed-effects model from a Mid-Western school district. The fixed- effects model of analysis assumes that the data come from a normal populations which only differs in their means. A total of 25 highly qualified teachers will be surveyed in the proposed study. The researcher will survey elementary school teachers to examine to what extent early intervention enhances mathematical performance. This volunteer sample will be solely based on the individual's willingness to participate in the study. Each participant in this study will be assigned a number. The number in each opinionnaire will correspond with the participant's assigned number for consistency. It must be noted that the population validity will

be restricted by the fixed effects model development used in this study. No student will be involved in the opinionnaire process. Once 70 percent or greater of the opinionnaires are returned, the sample will be considered valid.

## Variables

The variables under consideration will be: Early Numeracy, Incremental Rehearsal (IR), Numeracy Intervention Program – Conceptual Knowledge, Computer Assisted Drill Practice, PASS Cognitive Process (PASS), Constant Time Delay (CTD), Computer-Assisted Instruction vs. Teacher-Directed Instruction (CAI vs. TDI), Fluency Instruction and Mastery Instruction Maintenance, Process Mnemonic Learning and Schema-based Transfer Instruction. Several methods of intervention will be examined to determine to what extent these variables influence a student's mathematical achievement. This research does not plan to infer or predict the outcome, therefore, there is no need to identify dependent or independent variables.

## Methods of Data Collection

The data will be generated using an opinionnaire on a four point Likert scale survey to gain the insight of teachers, which will use a scale of strongly agree, agree, disagree and strongly disagree. This opinionnaire will be mailed to each participant. The following number scale will be assigned for each category: strongly disagree = 1, disagree = 2, agree = 3 and strongly agree = 4. Each participant will complete an opinionnaire regarding the Early Intervention Methods Preference. All mechanisms will be maintained for confidentiality of participants.

## Data Analysis Procedures

The researcher will consider data return generation of 70% as valid. Upon completion of generating the data, the researcher will complete a descriptive statistical analysis report using Excel. The data displayed on a table with explanative narratives to measure the teacher's

preferences on each intervention method enhancing mathematical performance. This type of Likert scale will be useful in studying to what extent the teachers' preferred various early intervention methods enhance the student's mathematical performance. The report will detail which methods were found to be most and least preferred by the instructors as intervention for those with mathematical difficulty.

## Ethics and Human Relations

All participants will be notified that there are some risks involved. The researcher will take the necessary precautions to safeguard all participants in the study and minimize the risks. The individuals will be assured their responses will be kept confidential. No names will be used on this report. The participants will be informed that they can terminate participation at any time. The participant's personal responses will not be shared with others. Permission will be obtained by the Human Subjects Review Committee at Marygrove College in Detroit, Michigan. All necessary precautions will be taken for the protection of Human Rights for all participants.

## Timeline

This opinionnaire will be mailed to each participant. The proposed study will be conducted within a one month period for the completion of the opinionnaire. The researcher will allow one month for the return of the opinionnaire with the appropriate follow up.

## Summary

Based on the review of literature, the researcher will investigate to what extent that teachers agree that early intervention will enhance mathematical performance. Students need clear teaching instruction that will allow them to understand the basic concepts, procedures and application of mathematics. This will allow the students to utilize various strategies to enhance problem solving skills. Researchers have attempted to examine early intervention methods to

assist children with mathematical difficulties. This proposed research will provide teachers will a variety of instructional methods that can be utilized to individualize the children's learning process to enhance mathematical performance.

## Chapter IV: Data Analysis

### Introduction

Previous research has indicated a need for early intervention methods to give students multiple approaches for computation skills and problem solving strategies. The methods of early intervention for students with mathematical difficulty preferred by educators were studied by the researcher to see which techniques were deemed most effective by teachers. This research will be effective guide in determining which early intervention methods are most useful in enhancing mathematical performance. The results will be a guide to determine the following questions:

- "To what extent do teachers' agree that these early intervention methods enhance the student's mathematical performance?"
- "Which methods of intervention are most effective in teaching children with mathematical difficulties?"

The opinionnaire was given to the principal who was contacted and presented with an overview of the study. Upon approval of the principal, the Likert scale surveys were distributed to 25 certified teachers. The results of these preferences were studied from a ten question opinionnaire (see Appendix C), completed by 21 teachers in a Mid-Western public school system.

*Summary*

This researcher provided each volunteer with informed consent forms explaining the study, acknowledgement and consent forms and opinionnaire forms for the study on October 16, 2006. On October 30, 2006 this researcher collected the opinionnaires from the Mid-Western public school system. The researcher collected a total of 21 completed opinionnaires.

## General Statistics

The 25 Mid-Western school district teachers were asked to answer ten questions on the opinionnaire and responded with the following answers: strongly disagree, disagree, agree or strongly agree. The data presented in Tables 1-10 summarizes the responses to the opinionnaires.

**Tables 1A & 1B**

Table 1A & 1B were utilized to clarify *to what extent does the* **Early Numeracy Method** *(a method of mathematical instruction that includes using concrete objects presentations of objects and abstract representations of objects)* will be helpful in the development of basic mathematical computation skills in students.

**Question 1 - Early Numeracy Method**

| Response | Percent | Number |
|---|---|---|
| Strongly Agree | 57% | N=12 |
| Agree | 43% | N=9 |
| Disagree | 0% | N=0 |
| Strongly Disagree | 0% | N=0 |

**Table 1A**

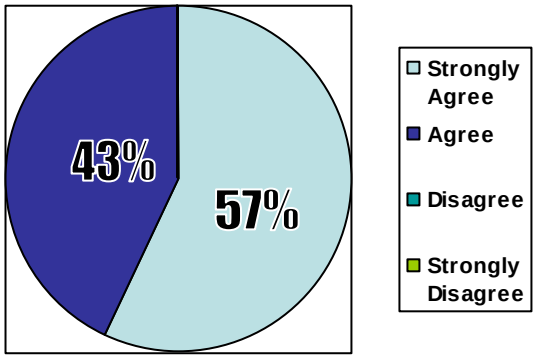


**Table 1B**

Question one received twelve strongly agree (57%), nine agree (43%), zero disagree (0%) and zero strongly disagree (0%) responses. The responses indicate that more than half of the teachers feel that this method of instruction would be an effective instructional method for enhancing the skills of a student experiencing mathematical difficulty.

**Tables 2A & 2B**

Tables 2A & 2B were utilized to clarify *to what extent that* **Incremental Rehearsal** *(a drill practice method of mathematical instruction which uses a gradually increasing ratio of known to unknown items to increase fluency of mathematical facts)* will be helpful in the development of basic mathematical computation skills in students.

**Question 2 – Incremental Rehearsal Method**

| Response | Percent | Number |
|---|---|---|
| Strongly Agree | 57% | N=12 |
| Agree | 29% | N=6 |
| Disagree | 14% | N=3 |
| Strongly Disagree | 0% | N=0 |

**Table 2A**

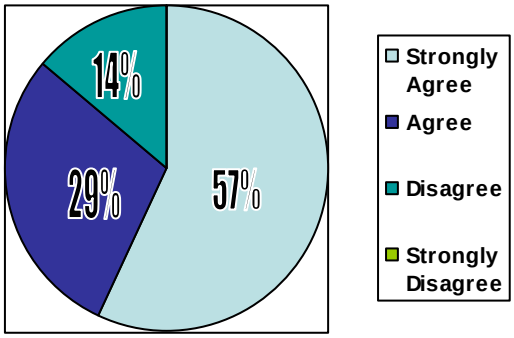


**Table 2B**

Question two received twelve strongly agree (57%), six agree (29%), three disagree (14%) and zero strongly disagree (0%) responses. The responses from the teachers reflect that the Incremental Rehearsal Method is an effective method for early intervention for a student experiencing challenges in math.

**Tables 3A & 3B**

Tables 3A & 3B were utilized to clarify *to what extent that* **Numeracy Intervention Program – Conceptual Knowledge** *(method basic numerical processing that involves counting, understanding and using written mathematical symbols, memorization of numbers that equal ten,*

*addition and subtraction inversion problems and solving complex written calculations)* will be helpful in the development of basic mathematical computation skills in students.

**Question 3 – Numeracy Intervention Program – Conceptual Knowledge Method**

| Response | Percent | Number |
|---|---|---|
| **Strongly Agree** | **38%** | **N=8** |
| **Agree** | **62%** | **N=13** |
| **Disagree** | **0%** | **N=0** |
| **Strongly Disagree** | **0%** | **N=0** |

**Table 3A**

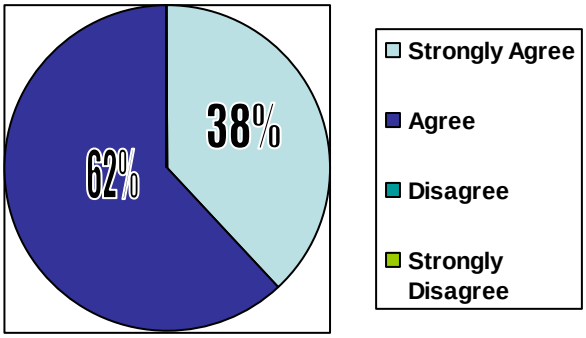


**Table 3B**

Question three received eight strongly agree (38%), thirteen agree (62%), zero disagree (0%) and zero strongly disagree (0%) responses. The teachers have indicated that that agree that basic numerical processing may be helpful to students with mathematical difficulty.

**Tables 4A & 4B**

Tables 4A & 4B were utilized to clarify *to what extent that* **Computer Assisted Drill Practice method** *(the use of multiple software programs with drill and practice mathematical programs and stimulate the memorization of information using gradual recall)* will be helpful in the development of basic mathematical computation skills in students.

**Question 4 – Computer Assisted Drill Practice Method**

| Response | Percent | Number |
|---|---|---|
| Strongly Agree | 57% | N=12 |
| Agree | 38% | N=8 |
| Disagree | 5% | N=1 |
| Strongly Disagree | 0% | N=0 |

**Table 4A**

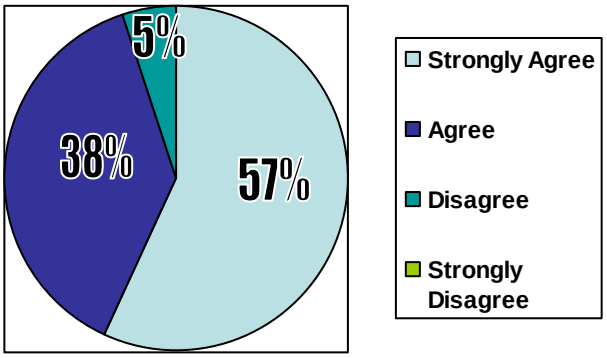


**Table 4B**

Question four received 12 strongly agree (57%), eight agree (38%), one disagree (5%) and zero strongly (0%) disagree responses. The teachers have expressed that the Computer Assisted Drill Practice Method would be beneficial to instruct students with challenges in math.

**Tables 5A & 5B**

Tables 5A & 5B were utilized to clarify *to what extent that* **PASS Cognitive Process** *(an instructional method of teaching mathematics through a cognitive approach of strategically planning each stage of the problem solving process)* will be helpful in the development of basic mathematical computation skills in students.

**Question 5 – PASS Cognitive Process Method**

| Response | Percent | Number |
|---|---|---|
| Strongly Agree | 29% | N=6 |
| Agree | 66% | N=14 |
| Disagree | 5% | N=1 |
| Strongly Disagree | 0% | N=0 |

**Table 5A**

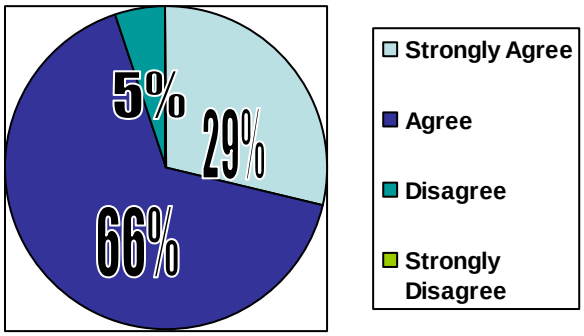


**Table 5B**

Question five received six strongly agree (29%), fourteen agree (66%), one disagree (5%) and zero strongly disagree (0%) responses. These responses reflect that a large majority of the teachers do feel that this method might be helpful when instructing a student with mathematical challenges.

**Tables 6A & 6B**

Tables 6A & 6B were utilized to clarify *to what extent that* **Constant Time Delay (CTD) method** *(a teaching method of teacher directed instruction with verbal praise was taught with continuous student response time)* will be helpful in the development of basic mathematical computation skills in students.

**Question 6 – Constant Time Delay Method**

| Response | Percent | Number |
|---|---|---|
| Strongly Agree | 47% | N=10 |
| Agree | 24% | N=5 |
| Disagree | 29% | N=6 |
| Strongly Disagree | 0% | N=0 |

**Table 6A**

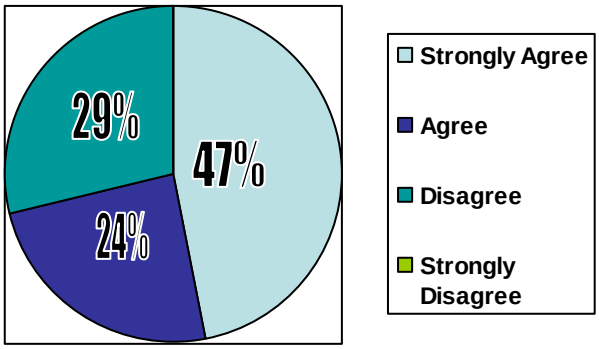


**Table 6B**

Question six received ten strongly agree (47%), five agree (24%), six disagree (29%) and zero strongly disagree (0%) responses. The Constant Time Delay Method has been indicated as a possible instructional method to assist students when they experience mathematical difficulty.

**Tables 7A & 7B**

Tables 7A & 7B were utilized to clarify *to what extent that* **Computer-Assisted Instruction and Teacher-Directed Instruction** *(an instructional approach that measures fact automaticity comparing computer drill and practice methods with teacher directed instruction)* will be helpful in the development of basic mathematical computation skills in students?

**Question 7 – Computer Assisted Instruction and Teacher-Directed Instruction Method**

| Response | Percent | Number |
|---|---|---|
| **Strongly Agree** | **47%** | **N=10** |
| **Agree** | **43%** | **N=9** |
| **Disagree** | **10%** | **N=2** |
| **Strongly Disagree** | **0%** | **N=0** |

**Table 7A**

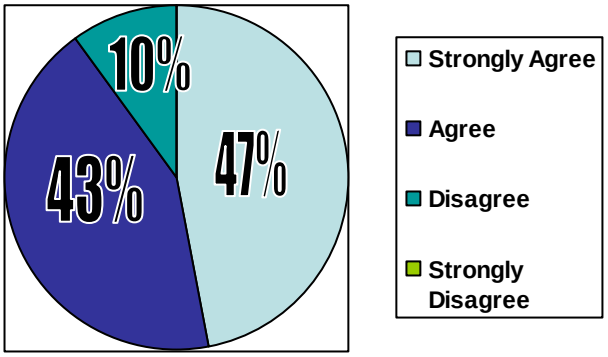


**Table 7B**

Question seven received 10 strongly agree (47%), nine agree (43%), two disagree (10%) and zero strongly disagree (0%) responses. The combination of computer assistance accompanied with the teacher's guidance was very favorable among the educators.

**Tables 8A & 8B**

Tables 8A & 8B were utilized to clarify *to what extent that* **Fluency Instruction and Mastery Instruction Maintenance method** *(an instructional approach of fluency by prompting and coaching students to encourage correct responses and lead to mastery through non-verbal strategies to build automaticity)* will be helpful in the development of basic mathematical computation skills in students.

**Question 8 – Fluency Instruction and Mastery Instruction Maintenance Method**

| Response | Percent | Number |
|---|---|---|
| Strongly Agree | 52% | N=11 |
| Agree | 24% | N=5 |
| Disagree | 24% | N=5 |
| Strongly Disagree | 0% | N=0 |

Table 8A

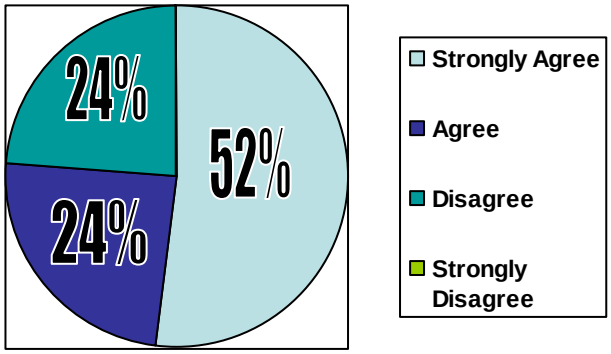


Table 8B

Question eight received eleven strongly agree (52%), five agree (24%), five disagree (24%) and zero strongly disagree (0%) responses. This prompting and coaching method was viewed as favorable by more than three-fourths of the teachers who completed the opinionnaire.

**Tables 9A & 9B**

Tables 9A & 9B were utilized to clarify *to what extent that* **Process Mnemonic Learning (PM)** *(an instructional method using rhymes to assist in remembering rules, principles and procedures using rehearsed drills)* will be helpful in the development of basic mathematical computation skills in students.

**Question 9 – Process Mnemonic Learning Method**

| Response | Percent | Number |
|---|---|---|
| Strongly Agree | 71% | N=15 |
| Agree | 24% | N=5 |
| Disagree | 5% | N=1 |
| Strongly Disagree | 0% | N=0 |

Table 9A

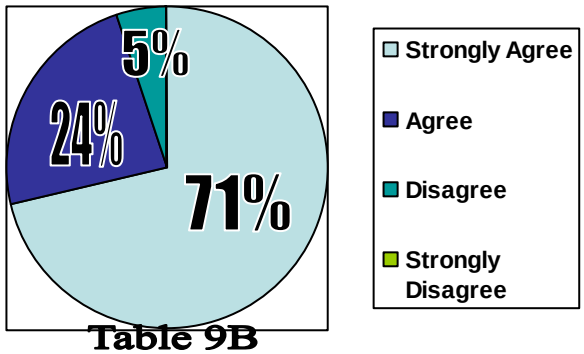


Table 9B

Question nine received fifteen strongly agree (71%), five agree (24%), one disagree (5%) and zero strongly disagree (0%) responses. These educators felt that the use of rhymes for remembering rules and principles is extremely beneficial to a student facing challenges in math.

**Tables 10A & 10B**

Tables 10A & 10B were utilized to clarify *to what extent that* **Schema-based Transfer Instruction (SBTI)** *(a method of expanding the knowledge of the student to increase problem solving instruction, interpretation of the vocabulary and line of questioning and altering the appearance of the question)* will be helpful in the development of basic mathematical computation skills in students?

**Question 10 – Schema-Based Transfer Instruction Method**

| Response | Percent | Number |
|---|---|---|
| Strongly Agree | 43% | N=9 |
| Agree | 52% | N=11 |
| Disagree | 5% | N=1 |
| Strongly Disagree | 0% | N=0 |

**Table 10A**

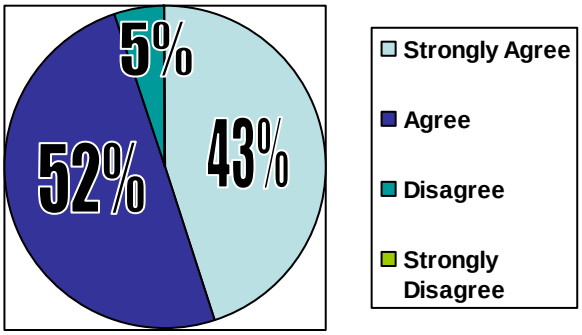


**Table 10B**

Question ten received nine strongly agree (43%), eleven agree (52%), one disagree (5%) and zero strongly disagree (0%) responses. The responses indicate that more than half of the teachers feel that the Schema-based Transfer Instruction Method would be an effective

instructional method for enhancing the skills of a student experiencing mathematical difficulty

## Summary

Many researchers have indicated a great need for early intervention methods to aid students experiencing challenges in math. This study focused on which methods of early intervention teacher feel would enhance a student's performance if they were experiencing mathematical difficulty. Twenty-one teachers in a Mid-Western school district answered the ten question opinionnaire. This Likert-scale survey has given the teachers the opportunity to express which methods they feel are most effective in improving mathematical performance. The data collected indicated many Mid-Western school teachers agree on several methods of early intervention.

Twenty-one teachers (100%) strongly agree or agree that the Early Numeracy Method will be helpful in the development of basic mathematical computation skills in students. Eighteen teachers (86%) strongly agree or agree that the Incremental Rehearsal Method is helpful in assisting children with basic mathematical computation skills. Twenty-one teachers (100%) strongly agree or agree that the Numeracy Intervention Program – Conceptual Knowledge Method will be helpful in the development of basic mathematical computation skills in students. Twenty teachers (95%) strongly agree or agree that the Computer Assisted Drill Practice Method will assist a student with the development of basic mathematical computation skills. Twenty teachers (95%) strongly agree or agree that the PASS Cognitive Process Method will be helpful in the development of basic mathematical computation skills in students. Fifteen teachers (71%) strongly agree or agree that the Constant Time Delay Method will assist a student with the development of basic mathematical computation skills. Nineteen teachers (90%)

strongly agree or agree that the Computer Assisted Instruction and Teacher-Directed Instruction Method will be helpful in the development of basic mathematical computation skills in students.

Sixteen teachers (76%) strongly agree or agree that the Fluency Instruction and Mastery Instruction Maintenance Method will aid a student with basic mathematical computation skills. Twenty teachers (95%) strongly agree or agree that the Process Mnemonic Learning Method will be helpful in the development of basic mathematical computation skills in students. Twenty teachers (95%) strongly agree or agree that the Schema-Based Transfer Instruction Method will aid a student with basic mathematical computation skills. All of the responses indicate that teachers believe several methods of early intervention are great aids in enhancing the performance of students experiencing mathematical difficulty.

Tables 11 and 12 illustrate total responses and total percentages for each of the ten questions in the opinionnaire (Appendix C) respectively.

**Table 11**

| **Response Totals** | **Questions** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **#1** | **#2** | **#3** | **#4** | **#5** | **#6** | **#7** | **#8** | **#9** | **#10** |
| **Strongly Agree** | **12** | **12** | **8** | **12** | **6** | **10** | **10** | **11** | **15** | **9** |
| **Agree** | **9** | **6** | **13** | **8** | **14** | **5** | **9** | **5** | **5** | **11** |
| **Disagree** | **0** | **3** | **0** | **1** | **1** | **6** | **2** | **5** | **1** | **1** |
| **Strongly Disagree** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |

**Table 12**

| Responses as Percentages | Questions | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | #1 | #2 | #3 | #4 | #5 | #6 | #7 | #8 | #9 | #10 |
| Strongly Agree | 57% | 57% | 38% | 57% | 29% | 47% | 47% | 52% | 71% | 43% |
| Agree | 43% | 29% | 62% | 38% | 66% | 24% | 43% | 24% | 24% | 52% |
| Disagree | 0% | 14% | 0% | 5% | 5% | 29% | 10% | 24% | 5% | 5% |
| Strongly Disagree | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |

Questions two, four, seven and nine of the opinionnaire requested the participants to assess if drill practice methods are effective in teaching children with mathematical difficulties. As the table above displays, responses to questions two, four, seven and nine are as follows:

2. Using the Incremental Rehearsal method of gradually increasing the ratio of known to unknown math facts is an effective way of teaching children with mathematical difficulties. 86% of the teachers strongly agreed or agreed with this method.
4. Using the Computer Assisted Drill Practice method with multiple software programs using drill and practice math programs to stimulate memorization of information is an effective way of teaching children with mathematical difficulties. 95% of the teachers strongly agreed or agreed with this method.
7. Using the Computer-Assisted Instruction and Teacher-Directed Instruction method of measuring mathematical fact automaticity comparing the computer drill & practice methods with teacher directed instruction is an effective way of teaching children with

mathematical difficulties. 90% of the teachers strongly agreed or agreed with this method.

9. Using Process Mnemonic Learning method of using rhymes to assist in remembering rules, principles and procedures using rehearsed drills is an effective way of teaching children with mathematical difficulties. 95% of the teachers strongly agreed or agreed with this method.

Questions six, eight and ten of the opinionnaire requested the participants to assess if verbal stimulated methods are effective in teaching children with mathematical difficulties. As the table above displays, responses to questions six, eight and ten are as follows:

6. Using the Constant Time Delay method of teacher directed instruction with verbal praise with continuous student response time is an effective way of teaching children with mathematical difficulties. 71% of the teachers strongly agreed or agreed with this method.
8. Using the Fluency Instruction and Mastery Instruction Maintenance method of prompting and coaching students to encourage correct responses and lead to mastery through non-verbal strategies to build automaticity is an effective way of teaching children with mathematical difficulties. 76% of the teachers strongly agreed or agreed with this method.
10. Using the Schema-based Transfer Instruction method of increasing problem solving instruction, interpretation of the vocabulary & line of questioning and altering the appearance of the question is an effective way of teaching children with mathematical difficulties. 95% of the teachers strongly agreed or agreed with this method.

Questions one, three and five of the opinionnaire requested the participants to assess if **non-related** methods are effective in teaching children with mathematical difficulties. As the table above displays, responses to questions one, three and five are as follows:

1. Using the Early Numeracy method of using concrete objects presentations of objects and abstract representations of objects is an effective way of teaching children with mathematical difficulties. 100% of the teachers strongly agreed or agreed with this method.
3. Using the Numeracy Intervention Program – Conceptual Knowledge method of counting, understanding and using written mathematical symbols, memorization of numbers to problem solve complex written calculations is an effective way of teaching children with mathematical difficulties. 100% of the teachers strongly agreed or agreed with this method.
5. Using the PASS Cognitive Process method through a cognitive approach of strategically planning each stage of the problem solving process is an effective way of teaching children with mathematical difficulties. 95% of the teachers strongly agreed or agreed with this method.

Many of the teachers felt that the drill practice methods & the **non-related** would be very effective in enhancing the performance of students with mathematical difficulties. It was very interesting to note that the Constant Time Delay method & the Fluency Instruction and Mastery Instruction Maintenance method received the lowest responses with 71% & 76% respectively of the teachers strongly agreed or agreed with these methods.

## Chapter V: Summary, Conclusions and Recommendations

### Introduction

The purpose of this research study is to ask educators to what extent to which teachers agree early intervention methods enhance mathematical performance. In addition, which methods they agreed were most effective. The following information will summarize, conclude and make recommendations based on the completed research study "Mathematical Difficulties: Does early intervention enhance mathematical performance?"

### Summary

Ten methods of early intervention were researched throughout the literature review to explore to what extent to which teachers agree early intervention methods enhance mathematical performance. Early Numeracy, Incremental Rehearsal, Numeracy Intervention Program, Computer Assisted Drill Practice, PASS Cognitive Process, Constant Time Delay, Computer Assisted Instruction and Teacher Directed Instruction, Fluency Instruction & Mastery Instruction Maintenance, Process Mnemonic Learning & Schema-based Transfer Instruction methods were all explored and researched. Twenty-one teachers from a Mid-Western school district participated in the ten question opinionnaire on early intervention methods. Both the literature review and the data generated from this study were used to study the following questions:

- "To what extent do teachers' agree that these early intervention methods enhance the student's mathematical performance?"
- "Which methods of intervention are most effective in teaching children with mathematical difficulties?"

*Early Numeracy*

The Early Numeracy method is an intervention method that includes concrete objects, semiconcrete presentations of objects and abstract representations of objects. The literature revealed that the students increased their early numeracy skills by several levels. Using a variety of instructional materials an applying reality based situations produced favorable responses. The data revealed that 100% of the participants agreed that this method of early intervention would be very effective in teaching children with mathematical difficulties.

*Incremental Rehearsal (IR)*

The Incremental Rehearsal is a drill practice method which uses a gradually increasing ratio of known to unknown items to increase fluency of multiplication facts with students as a method of mathematical intervention. The literature revealed that the effect size (the subtracting of their pretreatment data and their post-treatment data divided by the standard deviation of the pretreatment test) for each student was profound. The data revealed that 86% of the participants agreed that this method of early intervention is effective for a student experiencing challenges in math.

*Numeracy Intervention Program/Conceptual Knowledge*

The Numeracy Intervention Program – Conceptual Knowledge method is a pilot study on the basic numerical processing and conceptual knowledge. This program included of counting, understanding and using written mathematical symbols, memorization of numbers that equal ten, addition and subtraction inversion problems and solving complex written calculations. The literature revealed that the experimental group's performance increased in the arithmetic fact, procedural and conceptual knowledge areas. The data revealed that 100% of the participants

agreed that this method of early intervention is an effective method for assisting students experiencing mathematical difficulties.

*Computer Assisted Drill Practice*

The Computer Assisted Drill Practice method of intervention uses software programs using drill and practice instruction to stimulate the memorization of information using gradual recall. The literature revealed that the students were able to implement the new approach and rely less on the ineffective strategy. This was very beneficial because the software used prompt fading to give the student more opportunities to respond. The data revealed 95% of the participants agreed that this early intervention method would be effective to assistance students who are experiencing challenges with mathematics.

*PASS Cognitive Process (PASS)*

The PASS Cognitive Process method is an instructional method of teaching mathematics through a cognitive approach of strategically planning each stage of the problem solving process. The literature revealed that students showing difficulty with word problems displayed weak attention and successive processing, which are important in reading and strong planning and simultaneous processing. The data revealed that 95% of the participants agreed that this method of early intervention is an effective method for assisting students experiencing mathematical difficulties.

*Constant Time Delay (CTD)*

The Constant Time Delay method of intervention involves teacher directed instruction with verbal praise was taught with continuous student response time. The literature revealed that the student's reliability and effectiveness from instructional period increased dramatically. The

data revealed that 71% of the participants agreed that this early intervention method would be effective to assistance students who are experiencing challenges with mathematics.

*Computer-Assisted Instruction vs. Teacher-Directed Instruction (CAI vs. TDI)*

The Computer-Assisted Instruction vs. Teacher-Directed Instruction method is an instructional approach that measures fact automaticity comparing computer drill and practice methods with teacher directed instruction. The literature revealed that the students mastered more facts during the Teacher-Directed Instruction. In addition, the students had more than two to four opportunities to respond with the Teacher-Directed Instruction than the Computer-Assisted Instruction. The data revealed 90% of the participants agreed that this method of early intervention is an effective method for assisting students experiencing mathematical difficulties.

*Fluency Instruction and Mastery Instruction Maintenance*

The Fluency Instruction and Mastery Instruction Maintenance method of intervention used to determine if fluency instruction or mastery instruction is maintained by the student. The literature revealed that the students who receive mastery instruction required fewer learning units to meet the appropriate responding criteria. The data revealed that 76% of the participants agreed that this early intervention method would be effective to assistance students who are experiencing challenges with mathematics.

*Process Mnemonic Learning (PM)*

The Process Mnemonic Learning method is an instructional method using rhymes to assist in remembering rules, principles and procedures to solve mathematical problems using rehearsed drills. The literature revealed that this method was extremely effective and speaks to problems with mathematical difficulties. The data revealed 95% of the participants agreed that

this method of early intervention is an effective method for assisting students experiencing mathematical difficulties.

*Schema-based Transfer Instruction (SBTI)*

The Schema-based Transfer Instruction method is an instructional method of expanding the knowledge of the student to increase problem solving instruction, interpretation of the vocabulary, line of questioning and altering the appearance of the question to aid in the program solving process. The literature revealed that this approach may benefit a wide range of third-graders in enhancing mathematical problem solving. The data revealed that 95% of the participants agreed that this early intervention method would be effective to assistance students who are experiencing challenges with mathematics.

## Conclusions

The data revealed that the literature was in direct contrast with the teachers' opinions on the PASS Cognitive Process method. The previous research revealed that this method did have some weaknesses, yet the participants of this study agreed (95%) that this approach would be very effective. All participants surveyed recognized the great need for effective early intervention methods to increase a student's mathematical performance.

90-100% of the twenty-one participants strongly agreed or agreed on seven of the methods including Early Numeracy, Numeracy Intervention Program, Computer Assisted Drill Practice, PASS Cognitive Process, Computer Assisted Instruction and Teacher Directed Instruction, Process Mnemonic Learning and Schema-based Transfer Instruction methods would enhance a student's performance who is experiencing mathematical difficulty. 14-29% of the twenty-one participants disagreed that the Incremental Rehearsal, Constant Time Delay and the

Fluency Instruction and Mastery Instruction Maintenance methods would not be very beneficial to the students to aid in the enhancing their mathematical performance.

Based on previous research and the results of this survey regarding early intervention methods for students experiencing mathematical difficulties, several method of early intervention have been studied that offer several methods of instructions for teachers to assess to aid students who are experiencing mathematical difficulties. In addition, the data provides support for specific methods that educators assess would be most helpful to enhance the mathematical computation skills accessible for students to utilize with faced with math problems.

## Recommendations

Based on the literature review, the need for various instructional methods in mathematics is vital. Many students are faced with challenges when faced with problem solving techniques. As Gersten, Jordan and Flojo (2005) has clearly stated methods of early intervention must be identified and presented to the students to assist them in various approaches to mathematical computation. The results of this research indicate several early intervention methods that educators have viewed as beneficial to students who are seeking a variety of approaches to problem solving and computation skills. Some educators might not be aware of such early intervention methods to aid the children. Informative workshops on such techniques would be one approach to empower the educators and enrich the children's lives. The more resources that the educator has accessible to them, the more inclined they will be to instruct the students to use a variety of resources. These resources can reach and equip the children to use a range of mathematical computations skills when faced with mathematical problems.

Appendix A

***Mathematical Difficulty: Early Intervention***

Informed Consent Form

To:_____

My name is Jennifer Graham and I am a graduate student in the TASC (Teaching As a Second Career) Program in the College of Education at Marygrove College in Detroit, Michigan. I have asked you to agree to be a volunteer in a research project I plan to conduct. Before I can accept your consent, I want to inform you about my project.

The purpose of this study is to determine the views of teachers on the subject to what extent early intervention methods enhance mathematical performance is long overdue. The purpose of this quantitative research is to examine the extent to which teachers agree that early intervention methods enhance the mathematical performance of students with mathematical difficulty. The study will examine the educators' opinions on input on early intervention for enhancing the student's mathematical performance. The Institutional Review Board at Marygrove College has approved this study and its procedures.

The study's procedures will involve no foreseeable risks or harm to you or your family. I have considered all aspects of the proposed project and determined that the procedures indicated above are the best procedures to be used in achieving the research goal intended. The procedures include: 1) responding to a survey about methods of early intervention for children experiencing mathematical difficulty and 2) completing an acknowledgement and consent form. I hereby, offer to answer any questions you may wish to ask concerning the procedures used in this research project. You may e-mail me at starmission1@hotmail.com if you have any questions regarding your rights as a volunteer research participant.

Your participation in this study will be voluntary. You will be under no obligation to participate, and you will be free to withdraw your consent and discontinue participation at any time without prejudice. All participants must be at least 18 years old to participate. Your identity will not be revealed while the study is being conducted or when the study is reported or published.

The confidentiality of the records will be maintained unless the law requires disclosure. Confidentiality of records will be maintained by Marygrove College, Department of Education and stored in a secured place, and not shared with any other person without your permission. If any significant new findings arise during the course of this research that may relate to your willingness to continue to participate, such new findings will be provided to you.

Appendix B

ACKNOWLEDGEMENT AND CONSENT

I, _____of_____
Full Name Street Address

_____ hereby state:
City, State, Zip Code

1. I have read all of the statements above pertaining to the study entitled, "Mathematical Difficulty: Early Intervention"
2. I have been given the opportunity to ask questions I wish concerning this study, and I understand them.
3. I have been given a full copy, with signatures, of this document.
4. I hereby consent to be a participant in this study.
5. I understand that the data collected from this study will be archived with this researcher for future reference/use.

_____
Full Signature of Prospective Participant Date

**WITNESS:**

_____
Full Signature of Witness Date

As the investigator in this study entitled "Mathematical Difficulty: Early Intervention". I hereby state to the best of my knowledge and belief all of the statements made in the above consent form are true and that in consenting the prospective participant exercised free power of choice without undue inducement or any element of fraud, deceit, duress or any other form of constraint or coercion. In addition to participation being voluntary, the participant has been advised that he or she may discontinue participation at any time without penalty or loss of benefits to which the participant may be entitled.

_____
Full Signature of Investigator Date

Appendix C

Please respond in terms of how you feel at the present time. Circle the number that best describes your experience on a scale from 1 to 4, with 1 = strongly disagree and 4 = strongly agree. Record only one answer per question.

## Early Intervention Methods Opinionnaire

| Scale | 1 strongly disagree | 2 disagree | 3 agree | 4 strongly agree |
|---|---|---|---|---|
| 1. Do you feel that the **Early Numeracy** method *(a method of mathematical instruction that includes using concrete objects presentations of objects and abstract representations of objects)* will be helpful in the development of basic mathematical computation skills in students? | ⬭ | ⬭ | ⬭ | ⬭ |
| 2. Do you feel that **Incremental Rehearsal** *(a drill practice method of mathematical instruction which uses a gradually increasing ratio of known to unknown items to increase fluency of mathematical facts)* will be helpful in the development of basic mathematical computation skills in students? | ⬭ | ⬭ | ⬭ | ⬭ |
| 3. Do you feel that the **Numeracy Intervention Program – Conceptual Knowledge** *(method basic numerical processing that involves counting, understanding and using written mathematical symbols, memorization of numbers that equal ten, addition and subtraction inversion problems and solving complex written calculations)* will be helpful in the development of basic mathematical computation skills in students? | ⬭ | ⬭ | ⬭ | ⬭ |
| 4. Do you feel that the **Computer Assisted Drill Practice method** *(the use of multiple software with drill and practice mathematical programs and stimulate the memorization of information using gradual recall)* will be helpful in the development of basic mathematical computation skills in students? | ⬭ | ⬭ | ⬭ | ⬭ |
| 5. Do you feel that the **PASS Cognitive Process** *(an instructional method of teaching mathematics through a cognitive approach of strategically planning each stage of the problem solving process)* will be helpful in the development of basic mathematical computation skills in students? | ⬭ | ⬭ | ⬭ | ⬭ |
| 6. Do you feel that the **Constant Time Delay (CTD) method** *(a teaching method of teacher directed instruction with verbal praise was taught with continuous student response time)* will be helpful in the development of basic mathematical computation skills in students? | ⬭ | ⬭ | ⬭ | ⬭ |

| | | | | |
|---|---|---|---|---|
| 7. Do you feel that **Computer-Assisted Instruction and Teacher-Directed Instruction** *(an instructional approach that measures fact automaticity comparing computer drill and practice methods with teacher directed instruction)* will be helpful in the development of basic mathematical computation skills in students? | ⬭ | ⬭ | ⬭ | ⬭ |
| 8. Do you feel that the **Fluency Instruction and Mastery Instruction Maintenance method** *(an instructional approach of fluency by prompting and coaching students to encourage correct responses and lead to mastery through non-verbal strategies to build automaticity)* will be helpful in the development of basic mathematical computation skills in students? | ⬭ | ⬭ | ⬭ | ⬭ |
| 9. Do you feel that **Process Mnemonic Learning (PM)** *(an instructional method using rhymes to assist in remembering rules, principles and procedures using rehearsed drills)* will be helpful in the development of basic mathematical computation skills in students? | ⬭ | ⬭ | ⬭ | ⬭ |
| 10. Do you feel that **Schema-based Transfer Instruction (SBTI)** *(a method of expanding the knowledge of the student to increase problem solving instruction, interpretation of the vocabulary and line of questioning and altering the appearance of the question)* will be helpful in the development of basic mathematical computation skills in students? | ⬭ | ⬭ | ⬭ | ⬭ |

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