RETENTION AND RHYTHMIC MOVEMENT IN ADDITIONAL MATH FACTS

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Acknowledgments

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Abstract

The purpose of this study is to find a significant connection between rhythmic movements in the retention of additional math facts. Therefore, my research question is: Is there a significant difference between rhythmic movement, general movement, and non-movement in the memorization and retention of addition facts. I performed a quantitative experimental design study, focused on three groups: non-movement, general movement and rhythmic movement. The results from my study indicated that rhythmic movement played a role in heightening recall memory, but movement in general had a significance impact in increasing scores from test one to test two. In Conclusion, recall memory and retention are significantly increased when general movement is used in additional math facts.

Retention and Rhythmic Movement in Additional Math Facts

Traditional methods of teaching include lecturing with dry erase boards, posters, charts and flash cards. Teachers continue to repeat the information from said lecture until some form of retention has occurred. While these traditional methods may get a large percentage of students to complete memorization, a small percent of the students continue to fall behind with little to no retention. Current trends in educational forums indicate that movement, specifically rhythmic movement, has increased the retention or recall memory of a student. The purpose of this study is to find a significant connection between rhythmic movements in the retention of additional math facts.

The main problem that is addressed throughout this study is the memorization of information rather than the understanding or retention of materials. The difference between memorization and retention is how long the information stays with the student. Memorization is categorized as a short-term absorption of facts and understanding whereas retention is understood to be complete understanding of a fact or concept for a great length of time. A student in a school play that is required to learn lines for an upcoming spring musical is an illustration of memorization. The student memorizes the lines, performs the show and within months after completing the production, forgets most, if not all of the lines the student was required to learn. An example of retention would be a student studying for a medical exam. The student studies daily for over a year, takes the test and passes. That student then goes on to become a doctor and is able to recall most, if not all of the information studied for the exam.

This study specifically addresses the problem of retention within addition math facts. Addition math facts lay the foundational principals needed in order to continually build in mathematical concepts. Without the understanding of this foundational concept of addition, students may fall behind in school and may become less confident in their ability to understand mathematical concepts.

Research has shown that students learn better through active learning, more specifically, movement. Current research has also indicated that rhythmic movement helps the working memory build a stronger recall memory or retention. This leads one to question whether rhythmic movement builds better retention in students recall memory, or more explicitly in the area of mathematics in the first grade classroom. Therefore, my research question is: Is there a significant difference between rhythmic movement, general movement, and non-movement in the memorization and retention of addition facts measured by the ABEKA curriculum.

Literature Review

There are three main areas of study that bring greater understanding to the purpose of this research: music, movement and retention. All three areas must be understood as coexisting within the context of this research while still remaining independent in their own definition or meaning. These three concepts flow into one another in a sequential order that helps define and reestablish its common meaning among this research.

Music

Music has been integrated into the realm of academic achievement over the last century. We see that music affects the way students see other races, other nations and other religions. Many studies have shown that music can directly impact the way that we memorize and retain information within the classroom. When students are given the capabilities to bring musical rhythm or beats into the classroom "Reinforcing these capabilities by teaching patterns through music at an early age may benefit children's cognitive abilities"(Geist, 2012, p. 1). Teachers have found that, "children overwhelmingly prefer to learn tedious academic material through music or song"(Hayes, 2009, p. 34). Students are given the opportunity, through music, to memorize and participate in activities that were once tiresome and systematic. Hayes (2009) concluded that, "If the content is taught through the medium of a tune or melody they already know, and it is taught with explicit strategies for recall, students are able to utilize them when apt during tests, quizzes or simply when asked a question by a teacher" (p. 34).

Extensive research within the areas of mathematics and science has indicated positive effects when musical rhythms are incorporated. Shillings (2002) reports, "The rhythm of the chant and the repeated sound patterns provided an opportunity for both interaction and expression" (p. 179). Rhythms within music closely connect and relate the mathematical assumptions that students bring to early education classrooms and " The rhythmic components of music with its accompanying speech afford rich opportunities for exploring mathematical concepts through experiences with beat, meter, duration of sounds, rhythmic patterns, and tempo" (Shillings, 2009, p. 179). Providing music in everyday natural activities, including mathematics, not only reaches to the logical/mathematical intelligences but also to the musical/rhythmic intelligences. Shillings (2009) states that bringing in music and rhythmic elements to the classroom is rewarding and educationally sound to more than just one level of student, but rather to the classroom as a whole.

Movement

Music and movement often go hand in hand. The sequential step from music to movement is seamless because "Kinetic movement is *at the very core* of our theoretical alternatives" (Bautista, Roth, and Thom, 2011, p. 367). Therefore, students and parents, have an innate desire to change and grow through movement. Bautista's (2011) research was based off of the theory that "The human body is understood as the semiotic signifier of mathematics par excellence, as it is the material ground of any mathematical idea we can express and convey to others" (p. 368). This article goes on to explain and conclude that the information we already have as human beings on geometrical insight and movement cannot be coincidental but rather learned behaviors through our internal/mental cognition.

The greater goal in incorporating movement into our every day mathematical lessons is one of great importance. Shoval (2011) states that, "It can be said that the more the learners used learning activities with movement, the higher their academic achievements" (p. 462). Teachers want their students engaged in ways that solidify the content in which they are learning. Wood (2008) created a study that looked at movement specifically within mathematics and how it affected not only their curiosity within the mathematical concepts, but also the process in which they understood and learned mathematics. The results showed that bringing movement into math lessons gave understandable purpose and meaning to each student. Rather than force-feeding a lecture, students were able to connect mathematics to their everyday lives through movement and non-verbal communication and "Since the students were highly engaged in the activities, the potential to learn was greatly heightened" (Wood, 2008, p. 21).

A purposeful engagement of movement not only heightened the understanding but the retention of the student's knowledge and understanding of a subject area. While general movement occurs within each classroom, "Mathematics through movement offers an interesting and engaging strategy to achieve the vast outcomes that make up Being Numerate" (Wood, 2008, p. 22). There is an importance in understanding that through our lives the basic concepts and principals of language, mathematics or science need to be understood and acknowledged within each classroom. Identifying the connection of a deeper-rooted understanding can only come from the understanding of movement.

Retention

Goos, Damme, Onghena and Petry (2011) propose that repetition of foundational concepts will help students retain content introduced farther in their educational journey. These claims consist of foundational methods and concepts that are compiled into many grades across educational institutions. The general argument that arises involves the repetition of an entire grade level. Studies have been conducted and concluded that it is not helpful to repeat a grade level for the retention of foundational information, but rather the repetition with progressive information brought along side the materials given to the student. Teachers develop specific biases that create "severe negative perception with regards to repeaters" (Goos, 2011, p. 5). Silberglitt, Jimerson, Burns, Appleton (2006) ran similar tests specifically regarding the lower elementary grades and came to the same conclusion as that of Goos (2011), that repetition of an entire grade does not significantly improve a child's retention. While repetition can improve the retention of a student's knowledge, these findings indicate that repetition paired with progressive knowledge create impressive retention.

The idea of retention and mathematics is one that has been studied extensively (Lemaire, 1994; Range, 2012). One idea presented within the study showed that "Mental math is not limited by competence to complete the problem, but by working memory to store the problem until needed for further use" (Lemaire, Barrett, Payol, and Abdi, 1994, p. 7). Therefore, this type of retention allows for the working memory to recall information on visual tasks such as worksheets, flashcards, quizzes and tests. Lemaire (1994) gives greater understanding to the connection of working memory to oral mental math. This process allows the student to retain information from their working memory and then present it orally to the present audience.

Retention and working memory can be interchangeable when researching topics of mathematics and language arts. The idea that a student's working memory retains what is being taught inside a classroom, is an idea that has recently formed within educational research (Vuontela, 2013; Swanson & Orosco, 2011; Swanson, 2011). There have been many problems in identifying why mathematics is one of the most difficult subjects to gain retention in, but "one of the core problems children face in solving mathematical word problems relates to the growth of some of the operations ascribed to working memory" (Swanson, 2011, p. 834). Mabbott (2008) indicates that as students progress into higher levels of education this working memory decreases and the level of retention drops significantly. When the working memory is not constantly being used there may be little to no retention being obtained within an individual student.

Trends in Research

There were four main trends found within the research of the fifteen articles reviewed. The first two trends found within the articles were in regards to the methodology of the individual research and the last two trends were in regards to the conclusions.

Trends in Methodology. Several of the studies have a methodology of a student testing based model. This is where the researcher teaches students certain content or specific information and assesses them on what students understand or remember. The research done by Shillings (2002), Bautista (2011) and Wood (2008) all share the same basic model of methodology. While there are differences in content, geographical area, and student count, their basic methodologies trend in process.

The other methodology trend involves surveying or interviewing teachers. This method allows a researcher to see the progress of education through the eyes of the one teaching the content area. The research done by Hayes (2009) lifts up the opinion of the teacher and uses their input as a means for data and analysis. While this method can get the less popular viewpoint of a conclusion, the teacher's perspective is important to understand in order to find gaps within the research and possibly the outcome of a larger area of content retention or understanding.

Trends in Conclusions. There were two obvious trends within all fifteen articles regarding conclusions. The first trend was developed with all of the articles that studied aspects of movement. Baustista (2011) concluded that movement alone could not enhance the retention of a student's understanding on any given subject matter. The concept of movement and retention can succeed only when it is paired up with another common factor like lecturing or musicality. The concept that movement on its own does not succeed in furthering educational content matter was found throughout the four articles pertaining to movement. These four articles could not prove their hypothesis because they were solely researching the effects of movement within the classroom. While some studies like Wood's (2008) were able to find an increase in interest of the subject matter, the actual understanding and retention of content was not significantly affected.

The second major trend within the conclusions of these articles was the lack of participants. All but one of the articles reviewed state in their conclusion that the students and teachers that they tested or interviewed, were either small in number or too large in number to find actual significance in their data. This trend could possibly conclude that the research done previous to this article review, pertaining to movement and musicality within the classroom has only been tested on a very specific group of participants. Whether this is a gap in the methodology or a gap noted in the conclusion, this is something to take notice of when researching all subject areas involving movement and music combinations.

Methodology

My methodology design is based off of the research done by Fife in 2003. I performed a quantitative experimental design study, focused on three groups: non-movement, general movement and rhythmic movement. This experimental approach allowed me to look at three different groups and compare the data between genders, individual students, between the three groups and by the class as a whole. The two major changes between this study and the one conducted by Fife in 2003 are that my study focuses on three different types of experimental groups while Fife's focuses on two experimental groups.

Groupings

There were twenty-six students that participated in this study. Consent forms were sent out three weeks before the study was conducted and all twenty-six students returned their forms with signatures giving permission to use the student's data in the research. There were thirteen girls and thirteen boys. The students ranged in ages from six years old to eight years old. A computer-generated program randomly selected the three groups in which the students were divided into. Group number one, the non-movement group, contained nine students with five boys and four girls. Group number two, the general movement group, contained nine students with five boys and four girls. The third group, the rhythmic movement group, contained eight students with three boys and six girls.

Data Collection

Once the students were put into three groups I verbally explained to the entire class of twenty-six students that on Monday, Wednesday and Friday of each week, for two consecutive school weeks, each group would be pulled from the classroom to practice their addition math facts through the sum of twelve. I posted a list of the groups on the white board for the students to look at on their own time. The groups were labeled number one, number two and number three so that students would see the groups as equal learning opportunities.

On day one of data collection, and the last day of the study, day fourteen, the students were given the ABEKA time test. The entire class was instructed to keep their paper face down until the teacher gave them permission to turn over their papers. The students were instructed to write their names on the back of the paper and to flip the sheet over once they heard the word "now". Students were also instructed to turn their paper upside down again once they heard the teacher say the word "stop". The test consisted of thirty addition math facts adding up to the sum of twelve. The entire class was given two minutes to complete all thirty addition math facts allowing approximately four seconds to recall each answer on the test.

Data Analysis Methods

The tests were collected immediately after the students finished. The tests were then graded between 3:30pm and 4:30pm on day one of the study as well as on day fourteen. The ABEKA time tests were hand graded and the scores of the twenty six tests were recorded within an excel spreadsheet on a computer in the classroom. The results and data for my study were generated by computer software that identifies if the data collected had enough significant difference to prove or disprove the validity of the data collected between groups one, two and three.

Group Instructional Methods

Groups one through three came into an empty classroom across the hall Monday, Wednesday and Friday for week one and two of data collection, and were shown addition math fact flashcards. All of the flashcards were vertical addition problems, as seen on the ABEKA time test. The flashcards presented to the students ranged in the sum of one to twelve. All twenty-six students were shown the same set of flashcards in the same order to keep the variables consistent with the data collection within the ABEKA time test. The math practice session lasted approximately fifteen to seventeen minutes.

The non-movement group, labeled group number one, was given the additional math facts in a verbal setting. Students were instructed to stand throughout the room with their legs and feet together and their palms touching the sides of their legs. Students were told that they were to stay frozen the entire time they worked on their flashcards. I showed the flashcard to the students and said, "Repeat what I say. Two, plus six, equals eight. Repeat". The students then repeated back, "two, plus six, equals eight". This process continued until the stack of addition facts flashcards were completed.

The general movement group consisted of the nine children in group number two. These students were given the addition flashcards verbally and performed a general movement that coincided with their verbal cues. The students were shown the flashcard and I asked the students to repeat the following example, "Two (right hand is thrust outward to the right, extending the arm so the elbow and hand are straight) plus six (left hand is thrust outward to the left, extending the arm so the elbow and hand are straight) equals eight (both hands would come together in a clapping motion and then dropped to the side of the body)". This allowed movement of the entire upper body while verbally communicating the problem on the addition flashcards.

The rhythmic movement group consisted of the eight students in group number three. These students were given the addition flashcards verbally and performed a rhythmic movement that coincides with their verbal cues. For example, I would tell the students, "Two (insert rhythmic movement indicated in Appendix D) plus six (insert rhythmic movement indicated in Appendix D) equals eight (insert rhythmic movement indicated in Appendix D)". This allowed for the rhythmic movements to not only coincide with the addition facts but reestablishes what addition facts the students have covered in that session.

Potential Threats to Validity

There were three major threats to the validity within this research. The first threat is the number of students within this particular class of first graders. Twenty-six students is a smaller set of students and does not reflect the average classroom size. The second threat to validity within this research is that it is taken from within a suburban, private school. This could potentially skew the results of student's data in that it would favor one specific demographic of students. The last threat to validity is the size of the groups within my study. There are only eight to nine students within each group. This could potentially pose a problem in that there may not be enough students to find a significant difference within the data that is collected.

Results

I stated that there would be a significant difference between rhythmic movement, general movement, and non-movement in the memorization and retention of addition facts. The data collected from my research showed several different outcomes. First, there was no significant difference between the result of group one and group three's test scores. In table #1- Group 1: Non Movement, we see that the mean from test score one to test score two increases, but our significant figure is nowhere near the .03 that we need for the data to be conclusive. In table #3- Group 3:Rhythmic movement, we see the test score mean increase from test one to test two, but yet again the increase in not close enough to be a significant figure.

The second outcome from the data collected was an aspect that was not originally expected. I ran the data to see the difference in test scores regarding gender. In table #4-Gender: Male we see that the mean test scores of the male students significantly increase from test one to test two. We can see that the significant figure is at a .016 giving us an indication that since only 5 of the 13 boys were in the non-movement group, some form of movement helped the male students to retain the information taught within the two-week study. The data reflected from table #5-Gender: Female, indicates that the females within the study also increased in their mean test scores, but with a significant difference of .095, it is not high enough to prove that all females learn significantly better when movement is brought into the learning process.

The last thing I learned from the data collected is shown in Table #6: Class Frequency and Figure #1: Overall Test 1 Comparison Figure and Figure #2: Overall Test 2 Comparison Figure. These figures and tables indicate how frequently the students answered a specific number of questions correctly within the class. We can see that the students as an entire class significantly increased their overall scores from test one to test two. This coupled with the fact that the significant increase was between Group 1 and Group 2, not Group 1 and Group 3 would indicate that Rhythmic movement does not specifically help a student retain information but rather movement in general increases the retention and recall for students in the area of mathematics.

Discussion

I found this research and data collection to be not only beneficial but also overwhelmingly helpful in planning for future math lessons in my classroom. While I was trying to find the significance between rhythmic movement and mathematics, I discovered that general movement increases the retention, possibly more, than Rhythmic movement. The results collected from my data allowed me to find different conclusions than I had anticipated. For example, I did not even think about comparing the data of genders. If I were able to study this subject deeper, I would like to collect more trends between boys and girls. Before my data collection, I believed that it was more of a stereotype comment to say that boys are movers and need physical activity to be able to concentrate on certain tasks. After the results I found in this research, I am more inclined to not only add movement to my mathematical lessons, but also to the main subjects taught within the classroom.

The other result I loved seeing in my data collected was that my class as a whole significantly increased their test scores. While the boys mean test scores jumped higher, the overall understanding of additional math facts within my classroom increased and the students were able to retain and recall the information that was taught within the two-week study.

Based off of the data collected, some implications that could be taken from my research would be to suggest that other teachers implement kinesthetic strategies into their everyday mathematical lessons. It not only keeps the students engaged but also increases the understanding, retention and recall memory of a student in their foundational years of education. The data also implies that young boys are more inclined to succeed when given the opportunity to move around while learning new concepts.

Lastly, the data supports that no movement within a lesson allows for the least amount of retention or understanding of a subject being taught. While the rhythmic movement data did not increase as much as the general movement mean test scores, the non-movement group increased significantly less than group two and three which involved necessary movement within their learning times. This data has encouraged me to think of ways to move the students out of their desks and into spaces where they can both move and learn in a constructive manner.

While the outcome of my study was not what I had originally expected, I have been excited about what I have learned and understand through the data I concluded with. While there was no significant connection between rhythmic movement and retention, there was a significant connection between movement as a whole. Therefore, I conclude the outcome of my study to be successful and the overarching research question to be answered.

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Tables

Pre and Post Test Comparison by Groups

Table # 1-Group 1: Non-Movement

		Mean	Sig. (2-tailed)
Pair 1	Test 1	24.33	
	Test 2	25.89	**.284**

Table #2- Groups 2: General Movement

		Mean	Sig. (2-tailed)
Pair 1	Test 1	24.33	
	Test 2	29.11	**.039**

Table # 3- Group #3: Rhythmic Movement

		Mean	Sig. (2-tailed)
Pair 1	Test 1	25.25	
	Test 2	29.00	**.095**

Pre and Post Test Comparison by Gender

Table # 4- Gender: Male

		Mean	Sig. (2-tailed)
Pair 1	Test 1	23.77	
	Test 2	28.31	**.016**

Table # 5- Gender: Female

		Mean	Sig. (2-tailed)
Pair 1	Test 1	25.46	
	Test 2	27.62	**.095**

Overall Pre Test and Post Test Comparison

Table #6- Class Frequency

		Mean	**Sig. (2-tailed)**
Pair 1	Test 1	24.62	
	Test 2	27.96	**.003**

Figures

Figure #1- Overall Test 1 Comparison Figure

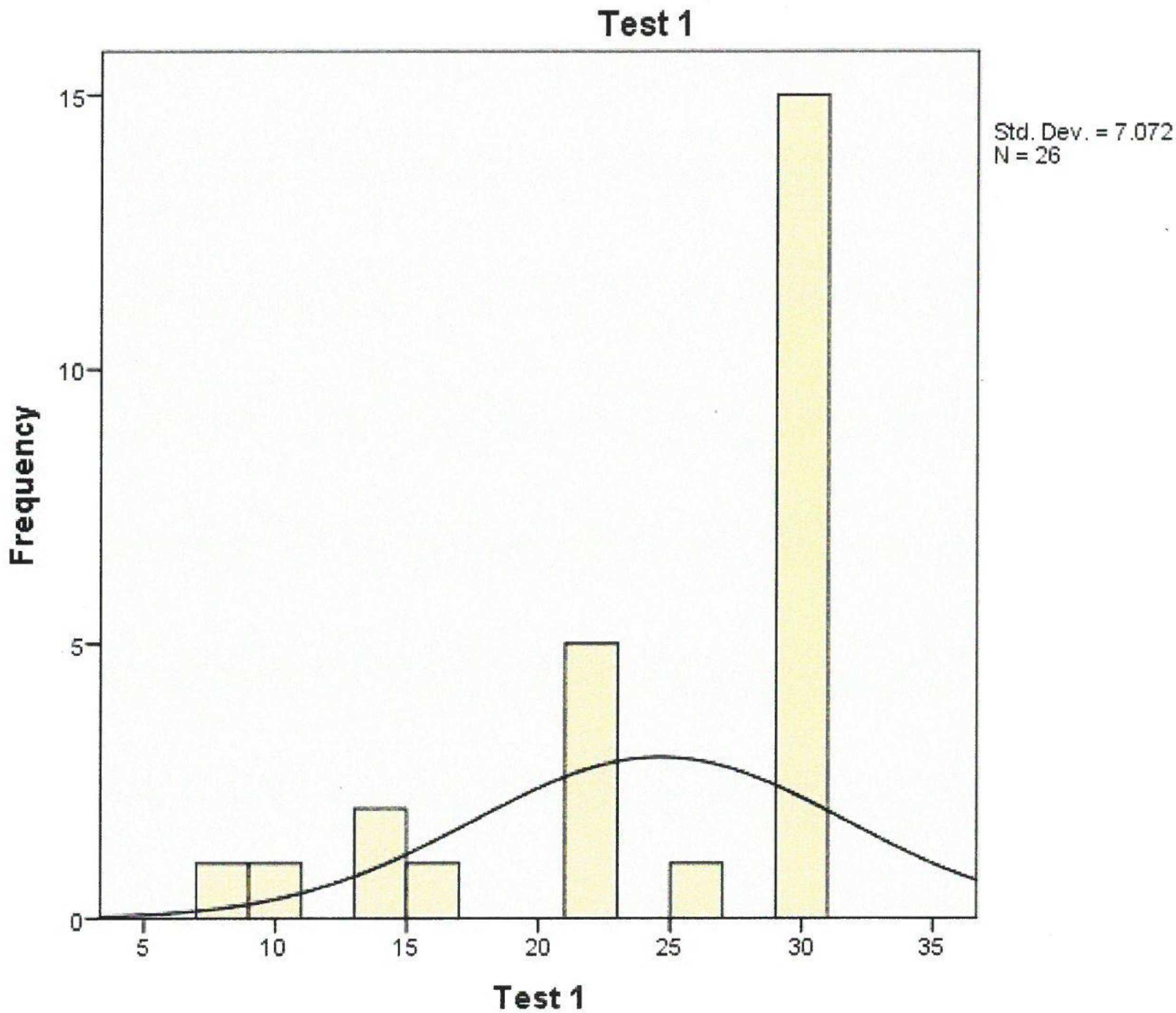
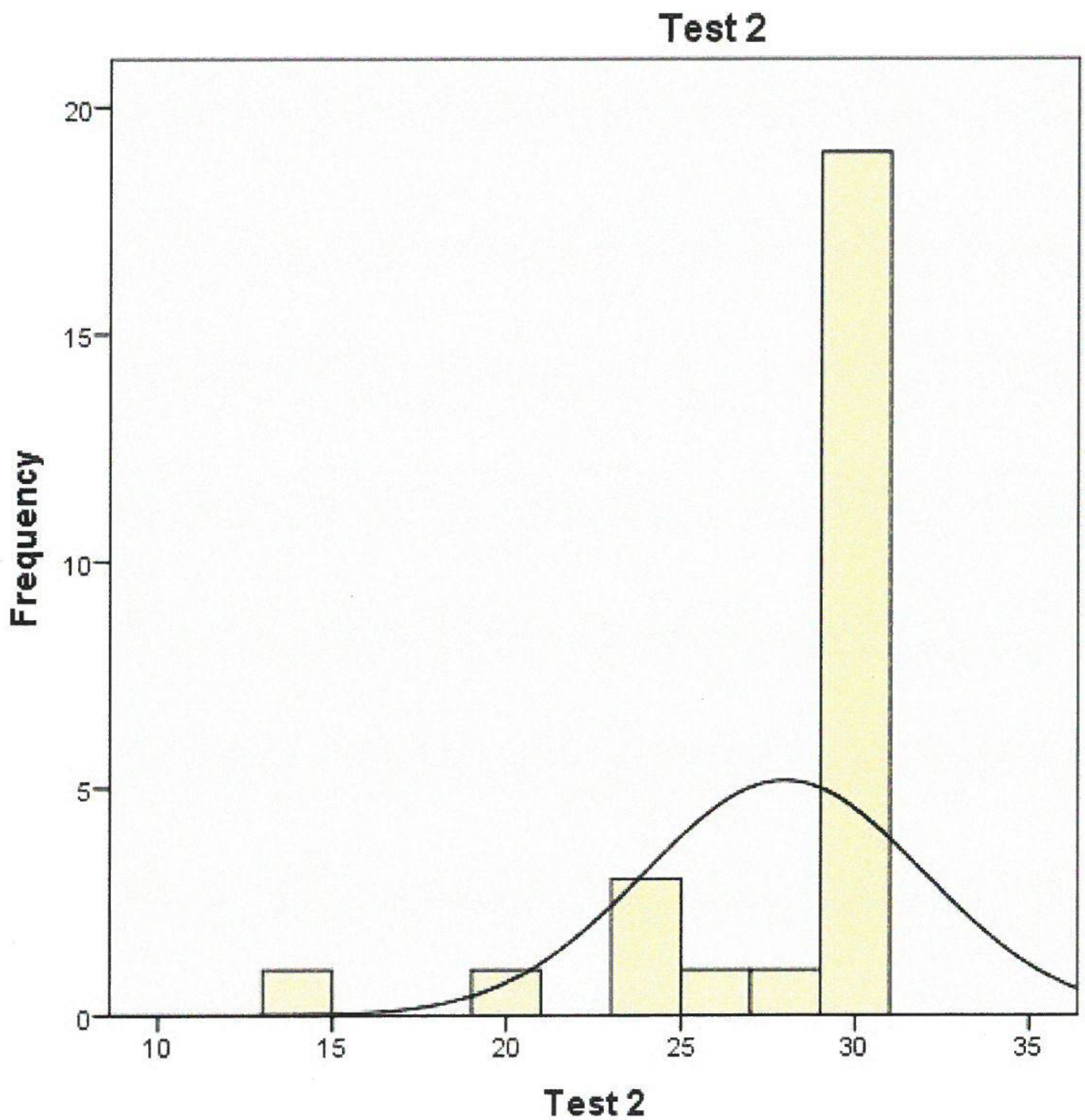


Figure #2- Overall Test 2 Comparison Figure



Appendix A

Original Class Scores

Team #	Student #	Day 1 Test	Day 14 Test
Team 1	Student 10	22	23
	Student 11	10	20
	Student 16	30	30
	Student 17	30	30
	Student 19	30	26
	Student 21	8	14
	Student 23	30	30
	Student 24	29	30
	Student 4	30	30
Team 2	Student 1	29	30
	Student 12	30	30
	Student 14	30	30
	Student 18	14	24
	Student 2	21	30
	Student 22	14	30
	Student 25	29	30
	Student 7	22	28
	Student 9	30	30
Team 3	Student 13	30	30
	Student 15	22	23
	Student 20	30	30
	Student 26	15	30
	Student 3	29	30
	Student 5	30	30
	Student 6	21	30
	Student 8	25	29

Appendix B

ABEKA Time Test

Score: ________

Date: ________

Name: ________________

1) 9 + 1	2) 2 + 4	3) 9 + 3	4) 9 + 3	5) 7 + 2	6) 2 + 10
7) 0 + 6	8) 3 + 9	9) 8 + 4	10) 2 + 3	11) 6 + 1	12) 4 + 0
13) 2 + 8	14) 7 + 4	15) 5 + 0	16) 4 + 4	17) 6 + 0	18) 3 + 6
19) 10 + 2	20) 3 + 4	21) 0 + 10	22) 2 + 10	23) 3 + 7	24) 0 + 2
25) 4 + 0	26) 4 + 1	27) 1 + 3	28) 3 + 2	29) 2 + 4	30) 1 + 1

Appendix C
Consent Form for Study

Rhythmic Movement in Addition Math Facts
Consent Form
EDMA 5691
Shelby Leising

You are invited to participate in a research study conducted by an education student in the MIT program at Northwest University. The study is being conducted as a class requirement for EDMA 5691, Research Methods and Applications. The purpose of this study is to find a significant connection between rhythmic movements in the retention of addition facts.

If you agree to participate in the study your student will participate in a two-week study that involves a test and six group study sessions. Each group will be given fifteen minutes, every Monday, Wednesday and Friday, to study addition facts flashcards. This allows an equal amount of time for each study group to learn the same set of addition problem flashcards.

There will be minimal risks exposed to the participants in this study. The minimal psychological risks could occur during the verbal question and answers techniques. Students will be asked to answer randomly selected addition problems in front of their peers. Those students that are not confident in their abilities or answer incorrectly may feel ostracized or inadequate if the person giving the study corrects them. You may choose not to participate in this research study. The benefit of taking part in this study is helping researchers to better understand the area of students learning mathematics.

Participation in this study is voluntary. You may choose not to participate in this study at any time and for any reason. There will not be any negative consequences for you if you refuse to participate. Those students that choose not to participate will form their own group labeled "E" for exempt. These students will still learn the same material but their data will not be included in the study. This way, all of the students get a chance to learn the material but are penalized for not being a part of the educational study. You may keep a copy of this consent form for your records. By turning in this consent form, you are giving permission to use your student's responses in this research study.

The results from this study will be presented in my Masters Thesis at the end of my MIT program at Northwest University. All data forms will be destroyed August 1, 2014.

If you have any questions about this study, contact Miss Leising at Shelby.leising@cedarpark.org If further questions, please contact my/our faculty advisor Dr. Delemarter at jeremy.delamarter@northwestu.edu. You may also contact the Chair of the Northwest University IRB, Dr. Kevin Leach, at kevin.leach@northwestu.edu or 425-889-5248.

Thank you for your consideration of this request.

Shelby Leising
Shelby.leising13@northwestu.edu
Dr. Delemarter
jeremy.delamarter@northwestu.edu.

Parent Signature: Date:

Appendix D

Rhythmic Pattern