Impact of Technology Games and Activities, Through CBI, on Multiplication Fluency

by

Kelly Ronson

May 2014

Goucher College

Graduate Programs in Education

Table of Contents

Table

Abstract

The purpose of this study was to determine the effectiveness of a lunchtime intervention involving computer based multiplication practice for fifth grade students struggling with multiplication facts. This study, occurring over 4 weeks, used a pre-test/post-test design in which post-test scores were compared between groups. All students received regular education instruction in mathematics. Students in the treatment group (n = 6) participated in a Lunch Bunch Program 3 times a week. Students in the control group (n = 6) did not participate in the Lunch Bunch Program. The mean fast facts multiplication score, based off of the number of multiplication fact problems from 0-10 correctly completed in five minutes, was significantly higher for the Lunch Bunch group (Mean = 93.00, SD = 6.90) than for the control group (Mean = 68.33, SD = 16.77 [$t(10) = 3.33$, $p < .05$]. Limitations and implications for practice and future research are discussed.

CHAPTER I

INTRODUCTION

Overview

At the beginning of every school year, refreshed fifth grade teachers all over the country pass out a popular assessment to the energized faces of their new students. However, many of these young faces often distort to inhuman appearances once the students realize they are being assessed on their multiplication facts. They look up from their papers, eyes narrowed with pencils tightly gripped in their clenched fists, with expressions that seems to imply what they are being asked to do is borderline barbaric. At the about this time, teachers look up to the heavens seeking the answer to same question they ask themselves every year, why are these basic multiplication facts so problematic for students?

Even though multiplication facts are often expected to be mastered by the end of third grade and most certainly by fourth, countless students enter fifth grade without this skill. Educators know that multiplication fluency is critical in fifth grade. This is the year students will encounter long division, identifying factors and multiples, as well as basic algebra. Multiplication is the foundation for all of these operations. It is important for children to have mastery of multiplication skills so that they can manage the cognitive demands associated with complex math problems (Woodward, 2006). Without a strong foundation, students will crumble under the pressure of more complex problems. Some students try to compensate by using their fingers, looking at multiplication charts, or counting up. Unfortunately, while these strategies may have worked for them in past, the increased pace of fifth grade, coupled with the new intense rigor of Common Core won't allow enough time needed for these previous strategies.

Students must be able to recall their facts quickly in order to keep up with the work load they will encounter.

After countless years of watching fifth graders struggle with their facts, and in turn many other fifth grade concepts that stem from those facts, this researcher decided to devote more time to the problem in order to improve students' multiplication fluency. Hopefully, these strategies would also empower students to solve more complex problems (Woodward, 2006).

This researcher's interest in improving students' fluency comes from the fact that it would not only help students, but that it could also have a positive impact over every aspect of instruction. Students who have their facts memorized require not only less planning time for teachers, but instruction can be focused on more exposure to and practice with more complex problems. The time that is freed up by memorizing facts allows teachers and students to dive deeper into the curriculum. More importantly, if these essential facts aren't memorized, students will remain behind their peers throughout their whole academic careers.

Statement of the Problem

The purpose of this study is to determine whether exposure to technology games and activities during additional instruction time will lead to an increase in multiplication fluency for students who struggle with this skill.

Hypothesis

The null hypothesis is that among fifth grade students who struggle with multiplication fluency, students who participate in technology games and activities during additional instruction time through a "Lunch Bunch" program will not have significantly different multiplication fluency scores than students who do not participate in the "Lunch Bunch" program.

Operational Definitions

Struggle with multiplication fluency: Students who score 75% or less on a timed pencil and paper multiplication test. The test consists of 100 basic multiplication facts, zero through ten, and students have five minutes to complete the assessment.

Lunch Bunch: For the purpose of this study, "Lunch Bunch" refers to additional instruction time, focusing on multiplication facts that students will receive three times a week for four weeks during their lunch period.

Technology games and activities: Individual played computer based multiplication games that will include immediate feedback to students in a game based format.

CBI: Computer based instruction in the form of games and activities that the "Lunch Bunch" students would be using to gain more practice time with their multiplication facts.

Multiplication Fluency Scores: Number correct out of 100 basic multiplication facts, zero through ten, on a pencil and paper assessment in five minutes.

CHAPTER II

REVIEW OF LITERATURE

Multiplication fluency is a student's ability to recall facts without hesitation. The retrieval of facts should not only be quick, but also accurate as well. Automaticity with facts is fundamental to a student's success with higher level math skills and memorizing multiplication facts helps set the foundation for a strong mathematical journey throughout a student's academic career. Students who struggle with their basic multiplication facts are extremely vulnerable to future mathematic difficulties and can succumb to aggravation and failures (Baroody, Bajwa, Eiland, 2009). Because multiplication fluency plays such a key role in child's academic future, it is imperative to explore the importance of mastering multiplication facts, types of problems students face with memorizing multiplication facts, interventions for helping with mastery of multiplication facts, and professional development for educators.

Importance of Mastering Multiplication Facts

Much like learning how to walk sets the foundation for learning how to run, mastering multiplication facts sets the foundation for more complex problem solving like division, fractions, and algebra. For children who don't have a stronghold on their multiplication facts, division becomes almost unachievable. In one long division problem, students must divide, multiply, add, and subtract several times. Without knowing their multiplication facts, division will seems like an impossible task. Long division has claimed many bright students into the category of 'math haters'. If a student struggles with basic multiplication facts, they cannot focus on the complexities of long division or fractions.

Memorizing facts isn't all there is to multiplication. When a child starts out, he/she needs to first understand what multiplication is and how it works. Real world ideas and situations create the most powerful learning experience for children (Zemelman, Daniels, & Hyde, 2005). Exposing students to group sets and repeated counting are good first steps. Once this is explored, students can then start learning their facts with an end goal of recalling answers instantaneously.

Students who do not master these facts are at a higher risk of struggling with high cognitive loads as they work on complex math problems (Woodward, 2006). These students are also quick to fall behind which in turn can negatively impact their confidence. Low confidence fosters a feeling of being no good at math. If a student begins to show signs of low confidence in math, educators must be quick to give them assurance and support so that the student can gain the confidence that will be necessary to try new and challenging tasks.

Not only is multiplication important for students to ensure their academic success, but we also use these facts in everyday life. When we need to double a recipe, order the right amount of food for a party, or determine travel times, multiplication is a part of the world around us. Knowing their facts also helps to ensure students are not taken advantage of in the retail world.

When students struggle with their facts and are not provided with support early on to master their facts, they can often refuse to attempt the work through passive aggressive behaviors. If this behavior continues, it can even lead to math anxiety which can have long-term harmful consequences (Caron, 2007).

Problems Students Face with Memorizing Multiplication Facts

Negative emotions such as anxiety can restrict learning outcomes and even make it impossible for information to be memorized. Math anxiety can be defined as "a feeling of

tension, apprehension, or fear that interferes with math performance" (Ashcraft, 2002, p. 181). When a student suffers from math anxiety it can cause him/her to disengage from the subject making it difficult for them to practice and master multiplication facts. Math anxiety can lead directly to a disturbance in the cognitive process which in turn hampers a student's ability to memorize their multiplication facts (Witt, 2012). If a student experiences anxiety at an early age, such as elementary school, it is very difficult for them to progress. Consequently, that same student may always associate math and math facts with negative feelings and worries. This feeling can then carry into years of poor math performance and an avoidance of the subject all together. This reality is evident in colleges as instructors report high levels of aversion to math classes and employment opportunities that rely on mathematical skills (Geist, 2010).

Students with learning disabilities also frequently face obstacles when trying to memorize multiplication facts. Often times, students with learning disabilities have problems with their cognitive process. Complications with one's cognitive process can hinder the ability to master multiplication facts with accuracy and speed (Watson & Gable, 2013). Some students may suffer from visual-spatial problems, having trouble processing what their eyes see. Yet other students may have trouble with language processing, struggling to make sense of what they hear. There are many other types of learning disabilities as well. Learning disabilities can be very challenging for educators to address. Each learning disability can vary from person to person. Adding to the challenge is the inconsistency of student's disability at different stages in their lives. No matter what the challenge, educators are responsible for helping students overcome them.

Rote memorization is the leading method most educators use to teach students multiplication facts. Rote learning is when students are exposed to information and expected to

memorize that information trough repetition. However, there are some learners who simply do not find success with rote memorization. Brain research stresses the significance of students needing to make meaningful connections between their facts and real word practices and not just simply memorizing them through rote rehearsal (Caron, 2007). When students are given the opportunity to combine manipulating, implementing, and rehearsing their facts, they are often more capable of finding success with automaticity rather than with rote rehearsal alone.

No matter what the reasons are for a student's difficulty memorizing their multiplication facts, an educator's ability to look for early warning signs, and provide intervention as soon as possible, is the best practice for helping students overcome their obstacles.

Multiplication Interventions

Children all across the country enter math classrooms with vastly different math challenges. It is critical that educators provide these students with early interventions in order to ensure students' success. Early interventions should target specific difficulties students have so that these struggles can be addressed before they become too difficult to overcome. The best time to help students with multiplication fluency is as soon as it is introduced, often third grade.

One intervention educators can implement with students to help with multiplication facts is peer tutoring. Results of research suggest that not only can peer tutoring help students memorize multiplication facts, but it also can have positive effects on engagement as well as other social behaviors for both students with and without disabilities (Hawkins, Musti-Rao, Hughes, Berry, & McGuire, 2009). While there are countless ways to establish peer tutoring programs in a classrooms, in order for it to flourish educators must be willing to devote time to training students who will be participating in the program. Educators must model the procedures they want peer tutors, as well as tutees, to follow and must not implement the program until

students have ample time to practice and find their confidence. Educators should provide feedback and suggestions to help peer tutors maximize their ability to help others with their multiplication facts.

Another intervention educators can apply to help students with multiplication fluency is small group tutoring. Again, the ways an educator can execute a small group tutoring program are endless. However, it is vital that an educator must look closely at the specific needs of their population. Small group tutoring is a highly effective differentiating strategy that allows educators to zero in on individual students' needs. Studies have shown that when students are exposed to small group tutoring, they are encouraged and prompted to think aloud during mathematics and with the individualized feedback from their teachers, they show improved learning (Jitendra et al., 2013).

Yet another intervention could be rote memorization without rote methods. Because rote memorization does not work for many students, some educators have been able to teach students to pull multiplication facts from memory like rote but have been able to get them to memorize these facts without the rote method. For example, just as students learn the names of family and friends by being exposed to them countless times until they internalize the names and can execute them, some educators simply have students practice their facts many times. Memorizing multiplication facts does not need to be any harder than learning the words to favorite songs or the names of loved ones (Caron, 2007). This method can be done by providing the answers for multiplication facts at the top of a paper. Exposure to the answers will allow students to avoid guessing and instead encourage ownership of the facts. Eventually, when given many opportunities to see the facts as well as their answers, students will no longer need to look at the top of the page to retrieve the answers. They will have memorized them.

An additional intervention to utilize could be incorporating technology. Not only does technology allow students access to the skills they are working on in class anytime anywhere, it also allows them to work at their own individual pace. Technology gives students the opportunity to see mathematics through a world view and not just their classroom. While technology is not a substitute for an inspiring teacher, it certainly can play a beneficial part in a child's education. Even the best, most creative teachers, often turn to generic worksheets to collect data on how their students are performing.

Educators can also use Computer Based Instruction (CBI) to create prudent individualized practices and assessments which can be a practical substitute to those common generic worksheets (Gersten, Joradan, & Flojo, 2005). By incorporating CBI, educators not only give their students the opportunity for more individualized learning, they are also preparing their students with the technical skills that will be necessary for higher education and the workplace. In addition, studies have shown that moderate amounts of CBI can improve students' multiplication fluency considerably (Schoppek & Tulis, 2010). For multiplication fluency a computer program like *Math First* is offered for free in this researcher's school district. This wonderful resource is just one of countless others that teachers, students, and families can access free of charge.

Professional Development for Educators

Students deserve the best possible instruction in a manner that best meets their individual needs. Well prepared educators are the most powerful resource for successful student achievement. It is critical that appropriate time be spent training and supporting all staff in the field of education. Professional development can provide educators with up-to-date research on

learning styles, cutting edge technology, and curriculum resources. Above all else, professional development must be on-going, collaborative, and connected to student learning.

When professional development is being created, it is essential that developers survey educators to give them a voice as to their concerns and areas of weakness (Bently, Morway, & Short, 2013). Teacher questionnaires can be a useful way to gather input from educators about what they see as pressing needs. Professional development surveys, after the professional development has been delivered, are also crucial when trainers reflect on their trainings and begin to make adjustments for the next professional development (McGee, Wang, & Polly, 2013).

Professional development on co-teaching provides educators with the ability to better use one another as resources. Co-teaching is a great way for educators to share intervention strategies that they have found successful. Studies of co-teaching show higher levels of communication between teachers and students as well as enhanced retention and academic performance (Devlin-Scherer & Sardone, 2013). Co-teaching can increase options for flexible student grouping, provide classrooms with another professional problem solver to help address various needs of students, as well as reduce the student/teacher ratio thus allowing students to receive more on-on-one support from teachers.

Summary

Educators now face relentless pressure to ensure all students meet the new rigorous requirements of Common Core. Never before in the history of public education have teachers and administrators been more accountable (Winebrenner, 2006). Educators must find ways to help ensure the success of all students.

Multiplication fluency is critical to a student's overall success in mathematics throughout their academic careers as well as throughout their lives. Educators should be alert to possible struggles students face with mastering their facts such as anxiety, learning disabilities, and challenges with rote memorization. By providing struggling students with early interventions, educators can help improve not only a student's fluency, but also their confidence. Educators must be given professional development about the challenges that some students face when trying to master their facts and they must also be trained on early intervention strategies to help students overcome these challenges.

CHAPTER III

METHODS

The purpose of this study was to examine the effects of extra CBI on multiplication fluency.

Design

A pretest-posttest quasi-experimental design was used in this study. The independent variable in the study was participation in the "Lunch Bunch" program which provided additional CBI focusing on multiplication fluency. The dependent variable was the students' score on the posttest which was a pencil and paper timed multiplication test. A pre-test was administered to all subjects to determine their multiplication fluency before the "Lunch Bunch" program was offered in order to insure that there were no significant differences in fluency between the two groups prior to the intervention.

Participants

The participants in the study were fifth grade students attending a school in a middle class Maryland suburban community. They were a convenient sample drawn from this researcher's on-grade level math class which consists of 19 students. The 12 participants were selected for participation based on a pre-test multiplication fluency assessment. All 12 participants scored 75% or less on the assessment and were considered to be struggling with their multiplication facts.

Of the 12 students who scored 75% or less, 6 were randomly selected to attend a "Lunch Bunch" program and the other 6, who did not attend the program, were used as the control group.

The 6 students who participated in the "Lunch Bunch" program consisted of 3 females, and 3 males. Of those students, 1 student had a 504; ADHD and 1 was an English Language

Learner. Four members of this group were Caucasian, 1 was Hispanic, and 1 was African American.

The control group, who did not participate in the "Lunch Bunch" program, consisted of 1 female and 5 males. Of those students, 1 had an IEP and 1 was an English Language Learner. Three members of this group were Caucasian and 3 were African American. These children were able to participate in the "Lunch Bunch" intervention after the study was completed.

Instrument

At the beginning of this study, students were given a pretest on their basic multiplication facts zero through ten. The test was created by the researcher. This same instrument was administered at the end of the study. The assessment consisted of 100 basic multiplication fact problems zero through ten presented in a paper format. Students were given five minutes to complete as many problems as they could. The teacher then graded each student's paper. Students who scored 75% or less on this pretest were used in the study.

The only person to assess the students using this assessment was the researcher so there was no measure of inter-rater reliability. Since items were scored objectively based on multiplication tables, inter-rater reliability would not be an issue unless the researcher made an error in grading. This researcher double-checked her scoring. There was no reliability or validity data available for this instrument.

Procedure

Participants were identified as students who struggle with their multiplication facts by scoring 75% or less on a five minute pencil and paper pre-test assessing their knowledge of basic multiplication facts zero through ten. Students were timed with the use of stop watch displayed

on the classroom white board. Students were also given verbal time reminders when the clock reached two minutes and again at one minute.

Out of a class of 19 students, 12 students scored 75% or less. Of those 12, students were randomly placed into two groups of 6. Group One took part in the CBI "Lunch Bunch" program while the other 6 were used as a control group. Prior to the intervention, there was no significant difference between the mean fast facts multiplication score of the intervention group (Mean = 59.00, SD = 15.11) and the control group (Mean = 50.17, SD = 18.300 [$t(10) = .91$, $p \geq .05$].

Students who participated in the CBI "Lunch Bunch" program were required to turn in a permission slip from parents as well as sign a contract themselves stating that they would attend and give their best effort.

The "Lunch Bunch" program consisted of 12 sessions and was hosted by this researcher. The participants met three times a week for four weeks in order to gain extra practice with their multiplication facts zero through ten using CBI.

Each session that students attended of the CBI "Lunch Bunch" program was thirty minutes long, held in the researcher's classroom, and students ate their lunches as they used CBI. During each session, participants engaged in a new game or activity that reviewed basic multiplication facts zero through ten. Before the sessions started, students were given a list of three or four websites they could use that day. Students could pick whichever site was most interesting to them, but they were told to stick with one game or activity per day and not to bounce between games or activities. Some of the activities were timed while others were not. Every game and or activity gave students immediate feedback about their performance. The last five minutes of each session, students could choose to race against each other on a timed game or use the time to finish up a game or activity they were working on that day. The control group,

which did not participate in the CBI "Lunch Bunch" program, did not receive any additional practice with their basic multiplication facts. Other than the "Lunch Bunch" intervention, the two groups were equal in the amount of multiplication fluency practice they obtained during classroom instruction or homework assignments.

At the conclusion of 12 sessions, participants in both groups were given the same post-assessment. This post-assessment was identical to the pretest given before the program started: 100 basic multiplication fact problems, zero through ten, with five minutes to answer as many as they could. The post-test scores were compared by an independent sample t-test.

CHAPTER IV

RESULTS

The purpose of this study was to determine whether there was a statistically significant difference in multiplication fluency among a group of struggling fifth graders who participated in a Lunch Bunch Program involving CBI multiplication practice as compared to a control group of students who did not participate.

Before the Lunch Bunch Program began, all students were given a timed pre-test assessment on multiplication facts. Prior to the intervention, there were so significant differences between the mean fast facts multiplication score of the intervention group (Mean = 59.00, SD = 15.11) and the control group (Mean = 50.17, SD = 18.300 [$t(10) = .91$, $p \geq .05$].

At the conclusion of the Lunch Bunch Program, all students were again given the same timed post-test assessment. The post-test multiplication fluency scores of the students in the Lunch Bunch were compared to those of the control students by an independent sample t-test. The results of the post-tests and analysis are shown in Table 1.

Table 1: Means, Standard Deviations, and T-test Results for the Post Intervention Multiplication Fluency Test

Group	N	Mean	Std. Deviation	T-test
Lunch bunch	6	93.00	6.90	3.33*
Controls	6	68.33	16.77	

*significant at $p < .05$

The mean fast facts multiplication score was significantly higher for the Lunch Bunch Program participants (Mean = 93.00, SD = 6.90) than for the control group (Mean = 68.33, SD= 16.77 [$t(10) = 3.33$, $p \leq .05$]. Consequently, the null hypothesis that among fifth grade students who struggle with multiplication fluency, students who participate in technology games and activities during additional instruction time through a "Lunch Bunch" program will not have significantly different multiplication fluency scores than students who do not participate in the "Lunch Bunch" program was rejected.

CHAPTER V

DISCUSSION

The null hypothesis states that among fifth grade students who struggle with multiplication fluency, students who participate in technology games and activities during additional instruction time through a "Lunch Bunch" program will not have significantly different multiplication fluency scores than students who do not participate in the "Lunch Bunch" program was rejected. The score was significantly higher for the Lunch Bunch Program participants who participated in CBI than for the control group.

Validity

While the results of the study are notable, there were several factors that affected this study. One of the greatest risks to the validity was that the testing sample was very small and was chosen for convenience. Although statistically significant results were obtained despite the low statistical power, it is important to consider that the results are based on a small number of students and any students with outlier performance could significantly impact the results. Since the study was conducted within one school, with one fifth grade class, with regular education students, the ability to generalize the results to a variety of populations is limited.

Another threat to the validity was the timing of the intervention. The study was completed over a four week period with students meeting 3 times a week for a total of 12 sessions, however it was broken up considerably due to inclement weather that forced schools to close. The school closings interfered with the consistency of the intervention which could potentially have impacted learning. The results could also have been impacted by the short duration of time the study was completed. Four weeks is a short period of time. The gap

between the Lunch Bunch and control group potentially could have been wider if the intervention had lasted for a greater period.

The validity could also have been compromised by events the researcher had no control over. Some students may have been receiving additional practice at home.

Another concern is that the post-test was given immediately after the last session was completed. It is possible that giving the post-test after more time had passed could have an effect on a student's ability to recall quickly their multiplication facts. It is not possible to generalize whether the Lunch Bunch intervention provides long term gains in multiplication fluency.

Additionally, the researcher cannot say for sure that it was specifically the CBI that made the difference. Because the control group was not spending as much time on school math as the Lunch Bunch students, it cannot be determined that the important factor was the CBI since it is possible the same results could have been obtained with a different math intervention.

Relationship to Existing Literature

Woodward (2006) emphasized that students who do not master multiplication facts are at a higher risk of struggling with high cognitive loads as they work on complex math problems. Baroody (2009) agreed with Woodward and detailed how automaticity with facts is fundamental to a student's success with higher level math skills. They went on to state that memorizing multiplication facts helps set the foundation for a strong mathematical journey throughout a student's academic career. When a student does not master their multiplication facts, it often leads to lifelong anxiety towards math which in turn can have long-term harmful consequences (Caron, 2007).

By incorporating CBI, the researcher exposed students to multiplication in a way that mirrored the way they learned their favorite songs or the names of their loved ones- through repeated exposure (Caron, 2007).

Similar to Schoppek and Tulis (2010) study, this researcher's results found CBI to be an effective strategy for improving multiplication skills even though Schoppek and Tulis worked with third grade students for their study population. This suggests that CBI can be effective for students of various grade levels.

Implications of Results

The results of this study suggest that math fluency scores improve if students participate in CBI or a similar intervention. Educators may want to consider implementing CBI into their own multiplication review for students or increasing the amount of CBI used by their students if it is already a part of learning activities. As a result of this study, this researcher plans to continue to use CBI as an intervention for students who struggle with their multiplication fluency. For schools who want to incorporate CBI into their instructional time, they need to have adequate computer access and appropriate funding to maintain their computers as well as purchase effective computer programs. If a school is interested in CBI but does not have the ability to provide it to students during lunch time they could devote time using regular instructional time. Parent volunteers could also be used to run the program during lunch or afterschool.

Educators may also consider how they can relay the importance of extra multiplication practice and CBI to the parents of their students. Many districts offer a list of valuable and age appropriate websites to parents on Back-to-School Nights. Some schools are part of the Math First program which is also free to parents and allows for extra practice at home. This

information could be extremely beneficial because when students increase their fluency with their facts, they also can increase their math confidence.

The study has implications based not only off the student performances on the math fluency testing but also based on this researcher's observations. The lunch time CBI that was implemented during this study engaged and motivated students to increase their multiplication fluency. The participants enjoyed using technology independently as well as with friends during friendly competition through playing CBI games. When the participants received their improved post-test scores, they felt a sense of accomplishment. This suggests that educators' attempts to increase CBI multiplication practice will be perceived positively by students.

Implication for Future Research

This researcher's study involved a small sample group over a short period of time. In the future, studies could benefit from using a larger and more diverse sample size, including students from different schools, grades, and those in special education. Future research could also allow more time for the intervention and also assess whether any gains from the intervention persist over time.

It would also be beneficial to conduct research that hosted another form of intervention for one group such as flash cards, CBI for a second group, and finally a group that would not receive any intervention. By using various methods, a researcher could better be able to determine if simply allowing students more time to practice multiplication helps their fluency or if CBI, specifically, makes a difference. Future research could also study the effectiveness of CBI for increasing other areas of math fluency such as addition, subtraction, and division.

Conclusion

Previous research has demonstrated the positive effect that increased practice with multiplication fluency can have on students mastering their facts. In the current study, not only did the fifth grade Lunch Bunch students enjoy the CBI activity, but their multiplication fluency scores were significantly higher than that of a control group after only 12 sessions.

These findings indicate that CBI offered during non-traditional instructional time is an effective and enjoyable way to improve students' performances with their multiplication fluency. The researcher recommends that educators provide students with more opportunities for practice with mastering their multiplication facts. CBI proved successful for this researcher and is recommended as one way to improve students' performance with their multiplication fluency.

Because mastering multiplication facts is an important academic foundational skill, it is important to support students in this area so they do not fall behind or develop math aversion. The goal for all students should be to meet higher level math tasks with greater confidence and skill as they progress throughout their academic careers and lives.

References

Ashcraft, M. H. (2002). Math anxiety: Personal, educational, and cognitive consequences. *Current Directions in Psychological Science (Wiley-Blackwell), 11*(5), 181-185. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=7317059

Baroody, A. J., Bajwa, N. P., & Eiland, M. (2009). Why can't Johnny remember the basic facts? *Developmental Disabilities Research Reviews, 15*(1), 69-79. doi:10.1002/ddrr.45

Caron, T. A. (2007). Learning multiplication: The easy way. *Clearing House, 80*(6), 278-282. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=2628

Bentley, E., Morway, A., & Short, T. (2013). The wish list: Articulating and responding to new teachers' concerns. *English Journal, 102*(3), 33-39. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=85114877

Caron, T. A. (2007). Learning multiplication: The easy way. *Clearing House, 80*(6), 278-282. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=26288456

Devlin-Scherer, R., & Sardone, N. B. (2013). Collaboration as a form of professional development: Improving learning for faculty and students. *College Teaching, 61*(1), 30-37. doi:10.1080/87567555.2012.714815

Geist, E. (2010). The anti-anxiety curriculum: Combating math anxiety in the classroom. *Journal of Instructional Psychology, 37*(1), 24-31. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=50303275

Gersten, R., Jordan, N. C., & Flojo, J. R. (2005). Early identification and interventions for students with mathematics difficulties. *Journal of Learning Disabilities, 38*(4), 293-304. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=17522161

Hawkins, R., Musti-Rao, S., Hughes, C., Berry, L., & McGuire, S. (2009). Applying a randomized interdependent group contingency component to classwide peer tutoring for multiplication fact fluency. *Journal of Behavioral Education, 18*(4), 300-318. doi:10.1007/s10864-009-9093-6

Jitendra, A. K., Rodriguez, M., Kanive, R., Huang, J., Church, C., Corroy, K. A., & Zaslofsky, A. (2013). Impact of small-group tutoring interventions on the mathematical problem solving and achievement of third-grade students with mathematics difficulties. *Learning Disability Quarterly, 36*(1), 21-35. doi:10.1177/0731948712457561

McGee, J. R., Wang, C., & Polly, D. (2013). Guiding teachers in the use of a standards-based mathematics curriculum: Teacher perceptions and subsequent instructional practices after an intensive professional development program. *School Science & Mathematics, 113*(1), 16-28. doi:10.1111/j.1949-8594.2012.00172.x

Schoppek, W., & Tulis, M. (2010). Enhancing Arithmetic and Word-Problem Solving Skills Efficiently by Individualized Computer-Assisted Practice. *The Journal of Educational Research, 103*(4), 239-252.

Watson, S. M. R., & Gable, R. A. (2013). Unraveling the complex nature of mathematics learning disability: Implications for research and practice. *Learning Disability Quarterly, 36*(3), 178-187. doi:10.1177/0731948712461489

Winebrenner, S. (2009). Teaching kids with learning difficulties in the regular classroom: ways to challenge and motivate struggling students to achieve proficiency with required standards. Minneapolis, MN: Free Spirit Publishing.

Witt, M. (2012). The impact of mathematics anxiety on primary school children's working memory. *Europe's Journal of Psychology, 8*(2), 263-274. doi:10.5964/ejop.v8i2.458

Woodward, J. (2006). Developing automaticity in multiplication facts: Integrating strategy instruction with timed practice drills. *Learning Disability Quarterly, 29*(4), 269-289. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=23155444

Zemelman, S., Daniels, H., & Hyde, A. (2005). Best practice: Today's standards for teaching and learning in America's schools. Portsmouth, NH: Heinemann.