

What Is the Relationship Between *Fluency and Automaticity through  
Systematic Teaching with Technology (FASTT Math)* and Improved Student  
Computational Skills?

Patty Lehner  
Virginia Beach City Public Schools

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## **Introduction**

Developing rapid recall of arithmetic facts, automaticity, remains a concern to elementary education teachers in the twenty-first century. By the time students reach fourth grade, it is expected that they have a fluent recall of the basic facts in addition, subtraction, multiplication, and division, giving them the foundation to proceed to higher-level mathematical computation and problem solving. The problem is each year students come to fifth grade without automaticity of multiplication fact recall and consequently have no foundation upon which to build higher-level computational skills. Students think they know their facts. In actuality, they only know how to use various strategies to arrive at the answer without automaticity, or they do not know the multiplication facts at all. To the experienced teacher, this signals potential problems in subsequent math success.

The significance of this lack of knowledge and mathematical foundation is the resultant struggling student who often loses confidence in his or her math ability and performs poorly with higher-level math concepts in algebra, geometry, and calculus. Mastering the basic skills is necessary in order to advance in math, and it ultimately correlates with later success in the workplace as concluded in the landmark study of Richard Murnane and Frank Levy (as cited in Loveless, 2006). Instructional best practices must include a means to address the needs of these learners in elementary school. The system known as *Fluency and Automaticity through Systematic Teaching with Technology* (FASTT Math) is one form of computer software instruction from Tom Snyder Productions which holds promise in helping students automatically recall and understand math facts. The program correlates to the National Council of Teachers of Mathematics Principles for Grades Pre-K-2, 3-5, and 9-12, and provides students at all levels of understanding with an individualized format for acquiring a solid foundation in

automatic recall and understanding of basic mathematical facts in elementary school (FASTT Math from Tom Snyder Productions, 2005) Foundational learning of basic arithmetic operations has been shown to be powerful preparation for high school or earlier algebra. In order to compete with world class elementary math curriculum in Singapore, Korea, Japan, Hong Kong, Belgium, and the Czech Republic, according to researchers, the United States must prepare its students early in order for them to achieve success and self-confidence in a twenty-first century global economy (Hook, Bishop, Wayne, & Hook, 2006). *Fluency and Automaticity through Systematic Teaching with Technology* (FASTT Math) is a means to that end.

### **Literature Review**

In March 2008, U.S. Secretary of Education Margaret Spellings reported the findings of the National Mathematics Advisory Panel, created in 2006, by President George W. Bush (Spelling, 2008).. After more than two years of reviewing scientific evidence to advance the teaching and learning of mathematics, it was the conclusion of the panel that number and math concepts must be taught early and that students must have confidence in improving their math skills in order for them to fully comprehend algebra concepts upon graduating from high school. Rapid recall (automaticity) of arithmetic facts in the early grades is a significant component of future math comprehension.

In the study of Wong and Evans (2007), it was noted that without procedural fluency and the ability to recall facts from memory, the student's focus during problem solving will be on basic skills rather than the task at hand, thus drawing attention away from the learning objectives of the task (as cited in Mercer & Miller, 1992). If the student cannot perform these basic calculations without the need to use calculators or

other aids, higher-order processing in problem solving will be impeded (Westwood, 2003).

Many researchers have noted the importance of frequent timed practice and the use of strategy instruction for all students through the end of elementary school.

“Cognitive psychologists have discovered that humans have fixed limits on the attention and memory that can be used to solve problems. One way around these limits is to have certain components of a task become so routine and over-learned that they become automatic.” (Whitehurst, 2003)

In the Research Foundation & Evidence of Effectiveness for FASTT Math, researchers found that lack of math fact retrieval can impede participation in math class discussions (Woodward & Baxter, 1997), successful mathematics problem solving (Pellegrino & Goldman, 1987), and even the development of everyday life skills (Loveless, 2003). Rapid math fact retrieval has been shown to be a strong predictor of performance on mathematics achievement tests (Royer, Tronsky, Chan, Jackson, & Marchant, 1999).

The cited research features the importance of math fact fluency. Tom Loveless, Brookings Institute, reviewed responses to select items on the National Assessment of Educational Progress (NAEP) and concluded that performance on basic arithmetic facts declined in the 1990s (Loveless, 2003). Teachers should help these low-performing students with instruction geared for their success in recall of basic math facts which will allow advancement in math concepts in the areas of algebra, geometry, and calculus. Success in higher-level math course work appears to be a good indicator of college- and career-related success.

### **Action Research Question**

Teaching fourth grade math for many years, I have observed an increasing number of students each year losing confidence and then interest in math because they do not have the foundation, automaticity in math facts, necessary to advance or even keep pace with grade-level math expectations. This led me to the question: **What is the relationship between *Fluency and Automaticity through Systematic Teaching with Technology* (FASTT Math) and improved student computational skills?**

I would like to use *Fluency and Automaticity through Systematic Teaching with Technology* (FASTT Math), a new software program from Tom Snyder Productions, to test its effectiveness in increasing fluency with basic multiplication facts on my students' computational skills. It is the desired intervention for students because its components include an opportunity for teachers to determine what students understand and misunderstand. *Fluency and Automaticity through Systematic Teaching with Technology* (FASTT Math) will help me to make decisions about curriculum and instructional practices that I should implement in the classroom to guide differentiated instruction to ensure student success. The software program is individualized and can be easily incorporated into the classroom instruction. Additionally, the reporting system is measurable and provides feedback for the student, parents, and teacher.

### **Methodology**

*Fluency and Automaticity through Systematic Teaching with Technology* (FASTT Math) was implemented in a daily, ten-minute classroom setting for 44 days. The computer-based *Fluency and Automaticity through Systematic Teaching with Technology* (FASTT Math) program designed as differentiated intervention, helped students develop the ability to retrieve answers to basic multiplication math facts from memory with

accuracy and fluency. Additionally, it helped students without a strong foundation in basic math concepts to achieve developing math-fact fluency with additional instruction in number sense and operations for multiplication facts 0-12. Students were enthusiastic and motivated to increase their speed. They could readily observe their progress with each customized activity. While formal goal-setting was not recorded in the day's practice, students were observed to be excited to achieve faster recall and higher accuracy. They asked to participate in the lessons.

It was assumed but not determined in 44 days that if FASTT Math was implemented for fifth-grade students who needed assistance with developing multiplication fact fluency, then computational skills would improve and self-confidence in math would be restored. The expectation remains that if math achievement scores on district assessments rise, then more students would be recommended for advanced math at the end of the fifth-grade school year, and there would be an increase in SOL math pass advanced rates.

Fifth-grade students for the year 2008-2009 were pre-assessed on multiplication facts (0-12) in September 2008 for a set amount of time (program's default setting) to determine their current level of proficiency. Students should be expected to answer approximately 40 basic mathematics questions correctly in one minute (Hasselbring et al., 1988; Howell & Nolet, 2000).

Data collection consisted of identification of fluent and non-fluent facts for the student initially placed by using the computer-generated fact grid (Placement Assessment). Progress monitoring and performance reports (Progress Report) were included in the *Fluency and Automaticity through Systematic Teaching with Technology* (FASTT Math) software and provided periodic feedback. Intervention Grouping Report

grouped students under FASTT Math performance standards: Fluent, Near Fluent, Developing, and Underperforming. Most importantly, students were provided pre- and post-self-assessments (Appendix A) that were collected and reviewed for growth at the end of the trial period.

*Fluency and Automaticity through Systematic Teaching with Technology* (FASTT Math) periodic assessments included the Fast Fact Challenge (Mastery) that determined which Focus Facts students could retrieve in .8 of a second or less and the Fast Fact Challenge (New Level) that determined whether the student was able to respond fluently to a fact in the next level, even if he/she was unable to do so during the placement quiz. Generated actionable reports for monitoring students' progress included:

- Intervention Grouping Report showing intervention levels (fluent, near fluent, developing, and underperforming).
- Progress Report for the class showing current performance and usage for each student.
- A student's Fact Grid, which could be shared with parents to see the fluency status with all facts in an operation.
- A pre- and post-5<sup>th</sup> Grade Math Self-Assessment, Confidence in Multiplication was administered.

A parent letter (Appendix B), composed by the teacher, explaining the goal of the program, steps students would be completing as they learn, and ways to reinforce their learning at home was used for parent involvement and communication. To measure the effectiveness of the program, the same fact test was administered via the program and is not a part of the appendix. The district math assessment will be administered second

semester, and multiplication computational results for students receiving intervention with FASTT Math will be reviewed at that time.

### Data Analysis

Question #1: What is the relationship between FASTT Math and improved student computational skills?

**Table 1. 5<sup>th</sup> Grade Math Self-Assessment Confidence in Multiplication**

Question	1	1	2	2	3	3	4	4	5	5
	Oct.	Dec.	Oct.	Dec.	Oct.	Dec.	Oct.	Dec.	Oct.	Dec.
How would you rate your confidence in answering multiplication facts correctly?	1 4%	0 0%	0 0%	0 0%	1 4%	0 0%	12 48%	6 24%	11 44%	19 76%
How would you rate your confidence in your ability to recall multiplication facts quickly?	0 0%	0 0%	2 8%	0 0%	7 28%	4 16%	11 44%	11 44%	5 20%	10 40%
How would you rate your confidence in your accuracy in double-digit multiplication?	0 0%	0 0%	2 8%	3 12%	6 24%	2 8%	8 32%	10 40%	8 32%	10 40%
How would you rate your confidence in your ability to recall multiplication facts (0-9) mentally?	0 0%	0 0%	1 4%	0 0%	3 12%	1 4%	7 28%	2 8%	14 56%	22 88%

The majority of students rated each item high on a 1-5 scale (1 being low confidence and 5 being high confidence) .

### **Qualitative Analysis (Table 1)**

On the 5<sup>th</sup> Grade Math Self-Assessment Confidence in Multiplication, there was an increase in confidence level in all four categories from October to December.. Forty-four percent of the students rated their confidence as high (5) in answering multiplication facts correctly on the pre-self-assessment. This false sense of confidence was apparent when all of the 25 students underperformed on the initial facts assessment. Initially, twenty percent of all students rated their confidence as high (5) in their ability to recall multiplication facts quickly. Thirty-two percent of all students rated their confidence as high (5) in their accuracy in double-digit multiplication, and 56% of all students rated their confidence as high (5) in their ability to recall multiplication facts (0-9) mentally. Over time and with exposure to FASTT Math, confidence levels improved and were more realistic, along with accuracy in recalling multiplication facts.

**Table 2. Intervention Grouping Report**

(Underperforming students-Fewer than 50% Fast Facts Multiplication)

*x=Underperforming; d=Developing; nf=Near Fluent; f=Fluent*

<b>Student</b>	<b>9/23/08</b>	<b>10/08/08</b>	<b>11/16/08</b>	<b>11/26/08</b>
<b>1</b>	<b>x</b>	<b>x</b>	<b>d</b>	<b>d</b>
<b>2</b>	<b>x</b>	<b>d</b>	<b>d</b>	<b>d</b>
<b>3</b>	<b>x</b>	<b>d</b>	<b>nf</b>	<b>nf</b>
<b>4</b>	<b>x</b>	<b>x</b>	<b>x</b>	<b>d</b>
<b>5</b>	<b>x</b>	<b>x</b>	<b>x</b>	<b>d</b>
<b>6</b>	<b>x</b>	<b>x</b>	<b>d</b>	<b>d</b>
<b>7</b>	<b>x</b>	<b>d</b>	<b>d</b>	<b>d</b>
<b>8</b>	<b>x</b>	<b>x</b>	<b>x</b>	<b>d</b>
<b>9</b>	<b>x</b>	<b>x</b>	<b>d</b>	<b>d</b>

<b>Student</b>	<b>9/23/08</b>	<b>10/08/08</b>	<b>11/16/08</b>	<b>11/26/08</b>
<b>10</b>	<b>x</b>	<b>d</b>	<b>d</b>	<b>nf</b>
<b>11</b>	<b>x</b>	<b>x</b>	<b>x</b>	<b>x</b>
<b>12</b>	<b>x</b>	<b>x</b>	<b>d</b>	<b>d</b>
<b>13</b>	<b>x</b>	<b>d</b>	<b>d</b>	<b>d</b>
<b>14</b>	<b>x</b>	<b>d</b>	<b>d</b>	<b>d</b>
<b>15</b>	<b>x</b>	<b>x</b>	<b>d</b>	<b>d</b>
<b>16</b>	<b>x</b>	<b>x</b>	<b>x</b>	<b>x</b>
<b>17</b>	<b>x</b>	<b>d</b>	<b>d</b>	<b>d</b>
<b>18</b>	<b>x</b>	<b>d</b>	<b>d</b>	<b>d</b>
<b>19</b>	<b>x</b>	<b>x</b>	<b>x</b>	<b>d</b>
<b>20</b>	<b>x</b>	<b>x</b>	<b>x</b>	<b>d</b>
<b>21</b>	<b>x</b>	<b>d</b>	<b>d</b>	<b>d</b>
<b>22</b>	<b>x</b>	<b>x</b>	<b>x</b>	<b>x</b>
<b>23</b>	<b>x</b>	<b>x</b>	<b>x</b>	<b>x</b>
<b>24</b>	<b>x</b>	<b>x</b>	<b>d</b>	<b>d</b>
<b>25</b>	<b>x</b>	<b>x</b>	<b>No record</b>	<b>x</b>

### Quantitative Analysis (Table 2)

On the first day of trial, September 23, 2008, 100% of all students performed lower than expected (fewer than 50% Fast Facts 0-12). Approximately two weeks later on October 8, 2008, 64 % of all students performed lower than expected (fewer than 50% Fast Facts 0-12). By November 16, 2008, 36 % of all students performed lower than expected (fewer than 50% Fast Facts 0-12). Remarkably, ten days later on November 26, 2008, only 20 % of all students performed lower than expected.

Consequently, by November 26, 2008, 8 % of all students had progressed from underperforming to near fluent grouping, 72% of all students had progressed from underperforming to developing, and 20 % had not progressed from the underperforming grouping.

## **Results**

Based upon the data, it was observed that students rated themselves highly in confidence levels regarding math fact automaticity; however, their initial performance with FASTT Math indicated that all students were underperformers in basic multiplication fact automaticity.

When asked what it would take to make confidence levels high (5), students listed practice and use of flash cards. It was observed there were no known methods to learning the facts other than these in most responses.

Some students (52% of the 25 original underperformers) did not meet average lessons per week. Four out of the five underperforming students on November 26 did not have sufficient lessons for the week of October 27-November 26.

After 44 days, underperforming students had progressed from the initial 100% to only 20% underperforming. It appears that FASTT Math did improve multiplication fact automaticity for many students.

## **Summary and Conclusions**

Based on the results of the student pre-self-assessment, it appears that students had a false sense of confidence in multiplication fact automaticity. I feel comfortable in asserting that our fifth-grade students demonstrated progress in FASTT Math multiplication automaticity. I cannot conclude that students will progress to fluent status at this point. However, if the students continue to be engaged in the FASTT Math on the requisite time per week, I feel that they will improve in math fact recall.

I was surprised to see that no students had achieved fluent status (97% or greater Fast Facts 0-12) as of November 26, 2008. The good news is that 80% of all students are showing progress/improvement.

It is difficult to effectively answer at this time the research question, What is the relationship between *Fluency and Automaticity through Systematic Teaching with Technology* (FASTT MATH) and improved student computational skills? More time is required to allow students to continue their practice, and students will need to take the math assessment for the school district at semester's end to identify a true progression in computational skills.

My conclusion from this research project is that FASTT Math is a novel alternative to learning multiplication facts, and students are motivated to engage in the activities.

### **Future Actions and Directions**

This action research will change my future math plans and procedures. I would highly recommend that other teachers target a small group of students at one time to work their way to fluency using the *Fluency and Automaticity through Systematic Teaching with Technology* (FASTT Math) computer program. In my opinion, teachers can more effectively manage classroom instruction and allow adequate time on a weekly basis for students to practice and receive feedback (fact grid) from their performance. Setting aside more time to implement the lessons could have an impact on the rate of success. Motivation will be moved up a notch and students will not forget their goal! I continue to believe in FASTT Math for all math students.

My analysis of the data led me to believe that FASTT Math holds great promise in furthering the memorization of multiplication facts for students regardless of the age. Students were encouraged by their progress and wanted to continue seeing positive results.

### Reflections

In reflection, by implementing the entire action research process,, it has caused me to examine what I do every day in a scientific manner. Because of this new vision, it has allowed me to relate the scientific process and research with my lessons. Students love to hear that teachers are doers, just like they are! The “action” in this process allowed me to question progress and results in a way that I had not practiced prior to the research.

There were differences in what I set out to do and what actually happened. Due dates and data collection did not happen in the prescribed manner. If I had to do it all over again, I would mark the calendar. Also, I would not take on a research project that I could not manage in its entirety by myself. I think my teammate and I worked very well together and did as well as could be expected for two novices. Surely, we would be better the next time!

Setting aside time for the activity is sometimes difficult in the day’s schedule. It takes prioritizing and small groups. There is viable computer access. Organization of the day is the dilemma. I would be interested in seeing the results of a more defined schedule, possibly a smaller group to study. The math teacher and I worked closely together with this project; however, being the math teacher and reporting findings would have been more productive in my opinion.

As a language arts teacher integrating science, I can tell you that there have been many opportunities to mention the action research involved in this paper. It seemed to give validity to what I was asking for in the classroom if I told the students that I had had to do it in my class. The relevancy of why you need to know your math facts is evident

to many fifth graders. Our students seemed to appreciate a new avenue to learning what they really did not know well.

Educators would benefit from the action research process because it brings what we are teaching to the classroom door. It involves our students, and they are excited to be a part! Action research is a win-win process! Teaching best practices are emphasized and include but are not limited to differentiation, goal setting, and student self-motivation.

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## Appendix B

September 2008

Dear Parent,

During the months of September through December 2008, Mrs. Wanamaker and I will be conducting research using the computer program, FASTT Math, which is an approved component of the math curriculum in Virginia Beach City Public Schools. The purpose of the action research is to find out whether the instructional method is effective in improving students' computational skills in multiplication. While we are not doing anything differently in our classes or with our students because of the action research project, we are seeking to prove that FASTT Math has improved our students' math performance.

Our research is being supervised by the Virginia Beach City Public Schools and the University of Virginia. Our principal is also supporting this project.

We are requesting your permission to use your child's self-assessments and work in our study. Confidentiality will be maintained, and no information identifying your child or the school will be included in the final report.

If you do not want your child's data used for our research, please sign, date, and return the attached permission form tomorrow. There is no need to return the letter if you have no objections. Please feel free to contact either Mrs. Wannamaker or myself if you have any questions.

We thank you for your support in this exciting endeavor as we learn as a class about research from personal experience!

Sincerely,

Ms. Lehner and Mrs. Wanamaker  
[www.Patricia.Lehner@vbschools.com](mailto:www.Patricia.Lehner@vbschools.com)  
[www.Teri.Wanamaker@vbschools.com](mailto:www.Teri.Wanamaker@vbschools.com)

I do not want my child's data used for research.

\_\_\_\_\_  
 Parent name (Please print)

Date \_\_\_\_\_

\_\_\_\_\_  
 Parent signature