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Computer-Assisted Instruction in the Mathematics Intervention Classroom

Stephen R. Christensen
St. Cloud State University, schriste44@hotmail.com

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Computer-Assisted Instruction in the Mathematics Intervention Classroom

by

Stephen R. Christensen

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Starred Paper Committee:
Hsueh-I Lo, Chairperson
Ramon Serrano
Sue Haller

Table of Contents

List of Tables

Chapter 1: Introduction

Purpose of the Study

What difference can a teacher make in a math intervention classroom? I am currently working with Apple® iPads and a web-based intervention course run by ALEKS (Assessment and LEarning in Knowledge Spaces). In the current year, and in years to come, a 1-to-1 (1:1) Google Chromebooks program will be introduced and used in all grade levels 5-8 at North Branch Area Middle School (NBAMS). Various other methods of problem-solving are also integrated into the curriculum. The purpose of this study was to see if there are intervention strategies with technology that help students progress more than traditional strategies.

The students in the math intervention course are also enrolled in the general education math class. On a typical day, they will partake in 90 minutes of math, compared to other students with just 45 minutes. Intervention students have a 7-period day, and the schedule does not always allow all of them to take both classes back to back. The entrance into an intervention class is limited due to the size constraints. Class size cannot be more than 12 students as part of the grant monies used. Students' progress is monitored biweekly and monthly using Academic Improvement Measurement System based on the web (AIMSweb) and the Math Concepts and Applications (MCAP) probes.

As these students complete their MCAP probes, they have the possibility of exiting the intervention classroom, as it corresponds to the Response to Intervention (RTI) model. The RTI model uses a 3-tier system to categorize students. The regular classroom is Tier 1 instruction, the intervention classroom is Tier 2, and an additional smaller group setting is Tier 3. The students in the classroom will be educated in three different areas. The first is to narrow down their deficiencies like math facts, automaticity, and work to improve their skills and problem

solving within that area. Second, students will have an opportunity to continue to learn about skills they have worked on. And last, the students will be exposed to skills they would see in their grade level Tier 1 instruction. Due to the nature of the mixed seventh- and eighth-grade classrooms, the use of ALEKS helps to narrow skills in which they need to work on and what to increase. The ALEKS program locates skill and concept gaps for each individual student. The program works with each student on a path that includes pacing and using prerequisite skill knowledge to achieve different types or strands of mathematical knowledge.

As I look to increase the skills of the students, I tend to look at the growth of each student's scores on their MCAP probes, Northwest Evaluation Association's (NWEA) Measures of Academic Progress (MAP) test, and the Minnesota Comprehensive Assessment (MCAIII). Along with progress monitoring probes given three times a year in the fall, winter, and spring; the MAP, MCAP, and MCAIII measurements are all used to place students into the math intervention course.

The teachers in these courses are funded through Alternative Delivery of Specialized Instructional Services (ADSIS). It is expected through the Minnesota Department of Education (MDE) that this support system help to alleviate the number of referrals to special education. ADSIS is meant to be an additional support to help students in the lower percentiles of tests who need more academic or behavioral assistance.

There is one full-time math ADSIS intervention employee at NBAMS. Financial support from the state of Minnesota, MDE, and the ADSIS program is a yearly application process. In the first 2 years of this process, one teacher maintained the full-time position. Currently, two teachers are working half-time each to maintain one full-time position.

Significance of the Study

       Students tend to have two issues: a lack of problem-solving strategies and deficiencies in their basic math facts and number sense. Due to the nature of the seventh- and eighth-grade curriculum set by the MDE with correspondence to the National Common Core standards, students with these issues fall behind in their algebra coursework due to their lack of understanding the concepts and automaticity of math facts. The students are still working on the computation part of the problem, while other students are completing and solving the problem. This deficiency creates a sense of defeatism, and some have simply given up trying. A CAI program that allows students to narrow their efforts on strands of mathematics skills can let them focus on their deficiencies and get almost instantaneous feedback. Therefore, the significance of the use of the ALEKS program can help students of the intervention math program to better understand the skills needed to grow according to their MCAIII scores.

       The existence of our current math intervention classes are a reminder that our students need assistance in finishing the task we are asking them to complete in the general education setting. I want to be able to meet the needs of the students in my class. Due to the nature of the combined grade levels and curricula, I need to have technology to assist. The use of devices will allow the time for feedback, both verbally and electronically, from math strategies used and the ALEKS program. While one group is engaged and gaining electronic feedback from ALEKS, another group is getting custom-fitted help from me.

Statement of the Problem

       How do we know what interventions and programs work to help students achieve a better understanding of number sense, math automaticity, and a higher level of problem-solving skills?

Does the intervention plan using the ALEKS program and other auxiliary programs help to improve student scores on State Standardized Tests like the MCAIII? With the growth of technology in the world, understanding math is growing and how to interpret the data we get can help pinpoint what needs to be known and developed. Without the growth, students will miss out on opportunities (Axtell, McCallum, Mee Bell, & Poncy, 2009). All students will be using the technologies in some form or another, and they need to have the basic skills necessary to manipulate their own thoughts on problem solving. The use of Chromebooks and iPads in the classroom allows for the ability to be a multi-functional classroom, where the use of technology and traditional paper and pencil formats can exist. Can we achieve more with the interventions using technology than our traditional methods?

Research Question

Does the use of computer-assisted instruction produce an increase in an individual student's growth over the course of a school year and beyond?

Focus of the Paper

The studies selected for this paper includes traditional and technological methods used in classrooms. The headings for these in the paper include: Math Strategies, Technology Use Strategies, and Cooperative Math and Technology Use. The reasoning behind this is to show a comparison between the different results given in all formats. The use of EBSCO was helpful in finding scholarly and peer-reviewed articles. Search terms used were as follows: computer aided instruction, math remediation, technology, and intervention. A total of 19 resources were found to be beneficial in the formation of the research.

Definition of Terms

Assessment and Learning in Knowledge Spaces (ALEKS): a testing and learning program used online.

Automaticity: refers to the phenomenon that a skill can be performed with minimal awareness of its use (Axtell et al., 2009).

Computer Assisted Instruction (CAI): the use of computers in helping students and teachers understand classroom material contextually and conceptually.

Computer Supported Collaborative Learning (CSCL): a technological method of instruction used with existing curriculum to help learning.

Curriculum Based Measurements (CBM): probes or tests covering the standards necessary to learning the curriculum.

Fluency: responding both accurately and quickly to selected stimulus (Axtell et al., 2009).

Measures of Academic Progress (MAP): a measurement used by the Northwest Evaluation Association testing agency to assess learning.

National Library of Virtual Manipulatives (NLVM): a website designated to the creation and use of manipulatives for the mathematics classroom.

Technology Supported Inquiry Learning (TSIL): a use of technology in learning a curriculum reinforced by an audience, which is technologically savvy.

Chapter 2: Review of the Literature

Improving Mathematics Skills

Solving math problems is a process that helps to give students ways to solve problems using different methods through what they already know and have possibly experienced (Xin & Jitendra, 2006).

Math Strategies

Teachers are asked to work with students in classrooms where there is a significant ability gap between the strongest and weakest learner. The following strategies are a way to incorporate strategies that are interesting and can fit in the classroom on different stages of learning (Kroeger & Kouche, 2006). The following strategies involve a more traditional approach in the classroom.

Cover-Copy-Compare & Detect, Practice, Repair. Axtell et al. (2009) stated that the Cover-Copy-Compare (CCC) strategy in the article *Developing Math Automaticity Using a Class-wide Fluency Building Procedure for Middle School Students: A preliminary study* focused on 12-15-year-old students, totaling 36 individuals. Thirteen of those students in the study were in a control group and 23 were in the intervention. Teachers worked with students in the intervention for 45 minutes each day for 18 total school days. Three basic pieces are required to be the most effective: immediate feedback, accurate responding, and appropriate responding. The use of the CCC method can be dictated by the size of the classroom, the nature of the question being asked, and the teacher feedback process. This method was first used as a means to increase spelling accuracy in elementary students, but has been adapted to measure

mathematics fluency as well. Students were asked to write down their work so that others could see their solving process.

Detect, Practice, Repair (DPR) is a procedure that uses short timing with multiple chances to answer and allows students to monitor their growth (Poncy, Skinner, & O'Mara, 2006). In the results from Axtell, et al. (2009), the DPR strategy was helpful to increase the automaticity of math facts in division.

CCC allows students to take a look at multiple ways some of the students in the class are working on these skills. Certain students may work to simply count-on or count-up in an addition problem, where others may spend time "seeing" different groups together and decompose the different numbers to help bridge a gap to other operations like multiplication. The immediate feedback, comparison, and results are integral in the CCC strategy. Without feedback, it is hard for the student to know whether or not the answer is correct. Sharing and comparing answers around the classroom are also important for the students to see different methods of solving the problem. The written work helps to provide a means to understanding what thinking is taking place in the student's minds.

Peer Assisted Learning Strategies. Peer Assisted Learning Strategies (PALS) is a strategy that helps to provide motivation, quick moving, multiple activities, and strong engagement. It also boasts an opportunity for students to be able to talk about the content and illustrate concepts and situations with numbers (Fuchs & Fuchs, 2001). Students in a PALS classroom are not necessarily low-achieving or at-risk students. The PALS approach shares structure with ClassWide Peer Tutoring (CWPT) and can be used with all students.   Using this method in the regular classroom can provide a measurement of prevention (Fuchs, & Fuchs,

2001). There is a great importance played in working with a two-way conversation of PALS and the old-style method of one-way teaching (Kroeger & Kouche, 2006).

PALS continues the momentum of sharing work between students, but also starts the conversation about the math problem and its subtleties. The most important part that needs to take place to be successful is communication. Having students simply "talk" about the problem without the guidance of what to ask about or how to ask is non-conducive to learning. Pairing students together or working in groups of three can make a difference as well. By working in groups of three or more students it allows one or more people to withdraw from the conversation. When working in pairs there is more of an impact to the conversation, or lack thereof, if one of the pair does not speak. This is where it is imperative for teachers to give students some information and guide them into what they could ask or look for in another student's work.

Technology Use Strategies

Computer-Assisted Instruction (CAI) is the use of the computer to help in delivering the subject matter (Seo & Bryant, 2012). The computers and programs that go along with the instruction can provide use of many different types of hands-on opportunities with the touch of a mouse. Some programs will have tools that are not as user friendly or require a short tutorial on how to use them correctly. As with most exposure to something new, the more practice with the tool will allow the students to become more familiar with its concept and application of the tool in their work.

PowerPoint. The use of PowerPoint is a strategy to help students practice their math skills as an exercise by following the learning could affect the achievement of students in math classes. As Tienken and Maher (2008) researched their study in the use of PowerPoint yielded

no positive significant growth in any of their categories in their Grade Eight Proficiency Assessment (GEPA). This finding, although somewhat defeating, had some limitations that factored into their results. While the use of PowerPoint should not stand alone, the students and teachers involved need to have a structure in which to share and review the concepts being learned. It is possible that the medium itself was not as conducive to the learning of skills and concepts. Also worth noting is to narrow and clarify the topic which is being presented.

   Math Explorer. One CAI intervention Math Explorer uses four cognitive strategy steps. Seo and Bryant (2012) listed the steps as: Reading, Finding, Drawing, and Computing. They also continued to list the metacognitive steps as doing the activity, asking about the situation, and checking to make sure the students understand (Seo & Bryant, 2012). This program, unlike Merlin's Math Mill, works to improve the problem-solving nature of math equations.

   Math Explorer will utilize the devices in the room as a program related problem-solving strategy. The use of programs and applications (apps) on devices is growing. Finding out which apps are the most beneficial to use, along with which context to use them, is important. Each student will have varying levels of competence. Using apps to bring the most appropriate information to them is vital to their learning. An efficient method of collecting data from a sample size of a population that represents the students that show a need for an intervention is key to sound research. Using strategies of both CAI provided by a 1:1 initiative could bode well for the demographics of students demonstrating a willingness to improve skills. Computer designs help make a picture of some mathematical applications that some cannot understand (Bai, Pan, Hirumi, & Kebritchi, 2012).

One-to-One Laptop. More recently, One-to-One (1:1) Laptop use in school districts has been growing. In the North Branch Area Public Schools (NBAPS) they will be starting to issue Chromebooks in the fall of 2014 to a select few grade levels. To begin the initiative, only sixth- and seventh-grades at the middle level will experience in the first stage. As the program grows, all grade levels will have this experience. Dunleavy and Heinecke (2008) studied the impact of the 1:1 program in an urban school from a seventh-grade sample population. Their goal was not to change the school's philosophy of teaching and learning, but simply boost the current curriculum. They were working to grow their successes using different means that are typically seen like state tests, national tests, school grades, and life-skill learning.

In 2004, the state of Texas issued funds to 21 middle schools, grades six through eight to become a technology immersion school. They also supported the immersion for grants for 4 school years. The climate of a building with technology was to help breed a more capable teaching environment in regard to the use of it in the classrooms with outside resources (Shapley, Sheehan, Maloney, & Caranikas-Walker, 2011). The technology immersion was measured at four levels, and five components assessed the strength of the immersion.

With this study only six of the 21 schools reached high levels of usage (Shapley et al., 2011). In their studies the control schools also had access to computers and digital devices, but from the more traditional approach. Students and teachers had to be individually motivated to access the computer labs, and check out mobile computers for their classrooms. Small group work and discussions happened more often in the high technology use classrooms (Shapley et al., 2011). This is said to have helped to engage the students more in their coursework, which helped to reduce the number of behavioral issues in the class.

The 1:1 laptop initiative needs to have substantial financial support, as well as buy-in from the administrators, teachers, students, and their families. Without a proper infrastructure to handle technological needs throughout the course of time, the initiative will lose ground on its validity to improve the learning environment. Consistent and continuous efforts still exist to exemplify the learning of curricula with technology, which is beneficial to the integrity of the 1:1 initiatives.

The use of CAI is a good method that can be used in our schools to help improve the skills of our students (Gross & Duhon, 2013). At its core, CAI is still simply a tool to help assist students in understanding the instruction. The support from schools and districts to include 1:1 initiatives is growing, but technology interventions by teachers compared to those of students have different results (Gross & Duhon, 2013). The delivery method of the 1:1 initiative and use of CAI needs to also include the use of feedback. This feedback can be given from the teacher in the classroom or a relevant program that allows for constructive feedback. Reid-Griffin and Carter (2004) stated that simply placing technology in front of students is not enough. Furthermore, the challenge is how to build technology into your everyday plans for an effective classroom.

Technology can be a valuable resource when working with problem-based learning (PBL). PBL is a different teaching method that allows students to understand the content and use it in problem-solving questions (Hmelo-Silver, 2004). Technology is not a requirement with this method, but it can also enhance through the inquiry process authenticity and relevance to the work of the student (Park & Ertmer, 2008). Park and Ertmer contended that its vital role is to

use technology as a tool in verifying information, making sure things are in order, and looking beyond the data that we have as we communicate its message to others.

Computer Supported Collaborative Learning. Computer Supported Collaborative Learning (CSCL) is a strategy for students to team up, technologically speaking, in an online environment. The students involved in a CSCL work together and come to a cooperative realization on the task being worked on (Zemel & Koschmann, 2013). The students that are a part of these Virtual Math Teams (VMT) work online in the format of writing their questions and possible solutions on an interactive and shared whiteboard. Each student is given a problem to solve together as a team. The VMT works together to discuss the problem over "chat," which allows the students to watch the arguments being made to solve the problems by other class members constructing an understanding of how to create a solution.

While the results of these methods do not always show significant growth, the characteristics learned could provide a new method as a cross-section for improving scores. The use of these strategies in an intervention course, or across all curricula could provide an opportunity for growth for all students especially those in the intervention courses.

Cooperative Math and Technology Use

ALEKS. The Assessment and LEarning Knowledge Spaces (ALEKS) program has students travel through an individualized program, based on their initial assessment, and marks their progress on a pie chart. Students build on their understanding of concepts by choosing topics that are unlocked as they show learning of prerequisite skills. They can build upon their own previous knowledge and can take aim at what they need to accomplish individually (Fuchs & Fuchs, 2001). The pie chart shows the concepts that they have completed and what else they

need to work on. The chart does not allow a student to complete a task that they have not shown knowledge on prerequisite skills. Goals can be created in both a time and topic goal and is monitored and recorded by the program. The instructor can also create assignments specific to each student in order to monitor their growth in that concept, or use it pre-teach a concept the student may see in their mainstream classroom.

Merlin's Math Mill. Merlin's Math Mill is a program that also works on the basis of prerequisite skills. This program hides those tasks until the student has shown to understand the prerequisites before introducing a higher level topic. This aspect has been studied in regard to Merlin's Math Mill, for which Schoppek and Tulis (2010) stated the requirement to diagnose students' current skill set, finding the appropriate means to get the information needed, and the ability to give feedback to comment on their responses. In a typical classroom, this is an arduous task for the teacher to complete. Likewise, Spradlin and Ackermen (2010) contended you need to pay attention to the research on how successful a CAI program might be. This is dependent on the technology and programs used, if it is used correctly, and if there is a requirement to use the programs.

WebQuest. This program will have students working on their own driven material while teachers can help to inspire students to participate noted Hakverdi-Can and Sonmez (2012). As this annotation is taken from an article supporting an environment that is inquiry-based and the information tends to lend itself to mathematics and science classrooms. The WebQuest allows for students to utilize simulations and work with real-life data that can be experimented with by the students. The use of the TSIL in both a math and science setting has been shown to give students an opportunity to work in a classroom where problems will seem realistic.

The inquiry-based learning of WebQuest is designed to make students ask questions about the tasks they are to complete. Likewise, help to give students practical, real-life applications and simulations to show why the learning is important. One of the toughest tasks a math teacher has is trying to link their knowledge of math and what needs to be attained, to things that students can take from the concept for continual growth. The WebQuest itself may not necessarily be the medium, but the inquiry-based nature of the questioning is the way students can achieve continual growth.

4MALITY. This web-based tutoring system was studied in a fourth-grade mathematics classroom. The anticipated result of students that were a part of this research was to increase their problem-solving strategies and skills on assessments. The problems students were asked to solve included multiple step and number operations. The tutoring program allowed students to ask the online tutors a series of hint-based questions which there were five different levels. The program mimicked the test-taking by providing a high level of familiarity to students who took the actual assessment.

In this study there were some auxiliary components to the research. When students completed the online program, they were directed to websites that offered skill improvements while simultaneously engaging students in a game-like format. They were also invited to participate in math board games without a technological component. In addition to the board games, students were given an option to try their skills at writing their own math problems by way of creative writing.

The integration of technology with other components was shown to be successful in three of the five classrooms. Students could work at their own pace to discover the problems of

4MALITY and continue their growth with the math-based online and offline games (Maloy, Edwards, & Anderson, 2010). The use of this program in conjunction with the traditional allowed for some transformations and approaches for teachers to use in their classrooms.

NLVM. The National Library of Virtual Manipulatives (NLVM) was used with students suffering from learning disabilities. The focus was using the computer and online resources to help solve area and perimeter problems. Students with learning disabilities have issues with solving problems that have many steps. Their brains do not work well enough to transfer long-term and short-term working memory, and there tends to be more barriers than just the math aspect of the problem.

The use of manipulatives in instruction is considered helpful for those with learning disabilities. Satsangi and Bouck (2015) stated, "When compared alongside concrete manipulatives increased skill attainment for each student using virtual manipulatives (p. 175)." The cognitive load theory presents that it is lacking a link to the physical movements of concrete manipulatives and the ideas taught.

Students of this study were given a laptop computer and mouse alongside a paper and pencil to help them solve problems regarding perimeter and area problems. The use of the CAI in this case was the computer and the NLVM website. The results of the CAI showed that there was an increase with all of the participants involved. The statistics also backed up the increase showing it was highly effective on area problems more than the perimeter-based problems. With the use of the manipulatives, students could more easily move and make shapes, which provided an increased comprehension of the figures effects (Satsangi & Bouck, 2015).

Some of the limitations at the time were with the construction and variety of shapes that could be used. Only 90-degree angles were allowed, and students were unable to manipulate shapes that had obtuse or acute angles. Also noted was a relationship that was established with the program and researchers working with these students. This relationship with a one-on-one grouping allowed students learn with the technology.

Online Algebra I from Class.com. A study performed by American Institutes for Research (AIR) in 2012 worked with the impact of standards moving concepts of Algebra I into the eighth-grade classroom when it had most recently been at the high school in ninth-grade. While this study is not in an intervention classroom the findings could suggest some transfer to those enrolled in an intervention classroom. The underlying reasoning was to help improve students' knowledge, but allow them to work at their own pace and level. Similar to the previous post on ALEKS, it gives students the lessons in an order that made sense to their base knowledge of the content.

The curriculum had many intertwining components. The most integral component was the computer with the web-based content. An on-line teacher and an on-site instructor were offered as a part of the class. The study showed that only 25% of the students worked with the online teacher; however, when needed, the teacher would respond was within the day (Heppen, 2012). The on-site instructor was not required to have a math background. They were utilized daily and more than what was expected with the students in the course.

The Algebra I online math curriculum was also a large use of technology in the form of 1:1 and web-based systems. While the students enrolled were not in need of a low-level intervention, they were studied to show what the program could do with a higher-level student.

Achievement levels of the students improved and the online course was not detrimental to their achievement.

Table 1

Literature Summary

AUTHORS	TITLE	PARTICIPANTS	METHODS	FINDINGS
Axtell, McCallum, Mee Bell, Poncy, (2009)	Developing Math Automaticity Using a Classwide Fluency Building Procedure for Middle School Students: A preliminary study	36, 12-15-year-old students	Thirteen students in the control group, 23 in the intervention. Eighteen school days, 45 minutes each day.	The DPR had a significant higher mean score with the intervention than the control. *M=52.13, SD=31.56 versus M= 25.15, SD 13.44.*
Poncy, Skinner, O'Mara (2006)	Detect, Practice, and Repair: The effects of a classwide intervention on elementary students' math-fact fluency	14 low-achieving elementary students		21.7 correct digits in 2 minutes as a baseline to 41.0 correct digits over a 6-week period.
Kroeger & Kouche (2006)	Using Peer-Assisted Learning Strategies to Increase Response to Intervention in Inclusive Middle Math Settings	150 seventh-grade students with diverse understandings	Three days a week in block scheduling, over several months. Used PALS as a support to current instruction.	
Tienken & Maher (2008)	The Influence of Computer-Assisted Instruction on Eighth Grade Mathematics Achievement	121 eighth-grade students, 163 control students	Experimental group used drill and practice websites and slide presentation software. Software included practice with operations, fractions, geometry, data analysis, and algebra.	No significant improvement for those receiving CAI and drill and practice to those that did not (*p < .05),* with ANCOVA for 95% confidence.

Table 1 (continued)

AUTHORS	TITLE	PARTICIPANTS	METHODS	FINDINGS
Seo & Bryant (2012)	Multimedia CAI Program for Students with Mathematics Difficulties	Four second and third grade students	Use *Math Explorer* to provide strategies for mathematical word problem-solving.	Question number 3 with maintaining tasks after 3 to 6 week follow-up. Three of the four students maintained their intervention level attainment. The average accuracy percentage total score of 11%.
Dunleavy & Heinecke (2008)	The Impact of 1:1 Laptop Use on Middle School Math and Science Standardized Test Scores	54 Experimental, 113 control group.	Math and science pre and post-tests. Randomly assigned to 1:1 laptop classes in the same middle school.	No significant changes on math achievement, therefore, no statistical description is provided.
Shapley, Sheehan, Maloney, & Caranikas-Walker (2011)	Effects of Technology Immersion on Middle School Students' Learning Opportunities and Achievement	21 technology immersion schools (n=2,644) versus 21 control schools (n=2,882).	Follow a three-level hierarchical growth model to check the growth of students for technology immersion. Twenty-one schools immersed their students with technology in their courses. Twenty-one maintained no technology presented to students in their coursework.	Growth from 7th and 8th grade math students, both advantaged and disadvantaged, *M=51.82 to 53.02* advantaged 8th graders, *M=47.33 to 47.39* disadvantaged. *M=51.28 to 51.81* advantaged 7th graders to *M=46.79 to 47.40* disadvantaged.
Gross & Duhon (2013)	Evaluation of Computer-Assisted Instruction for Math Accuracy Intervention	3 girls in elementary school with math fact and skill deficits.	A computer program with visual and auditory feedback. An accuracy based program with a 2-minute timer and random math skill problems.	One student reached 93% accuracy, a growth of 27%. Another reached 91%, a growth of 25%, and the last achieved 72% accuracy, growth of 34%.

Table 1 (continued)

AUTHORS	TITLE	PARTICIPANTS	METHODS	FINDINGS
Hmelo-Silver (2004)	Problem-Based Learning: What and how do students learn?			No statistical findings.
Zemel & Koschmann (2013)	Recalibrating Reference Within a Dual-Space Interaction Environment			No statistical findings.
Schoppeck & Tulis (2010)	Enhancing Arithmetic and Word-Problem Solving Skills Efficiently by Individualized Computer-Assisted Practice	113 students from 4, third grade classrooms	Seven weeks of one-hour training sessions in groups of 7 to 9 students. No specific help on the problems.	The *M* adjusted pretest to post-test was 40.1 to 48.1 in the control group and 37.4 to 56.1 in the training group.
Spradlin & Ackerman (2010)	The Effectiveness of Computer-Assisted Instruction in Developmental Mathematics	Intermediate algebra students from 4 classes at an eastern US university.	Two control group classes, two experimental group classes with supplementation of ALEKS.	For method of instruction hypothesis the result was no significant difference in method of instruction.
Hakverdi-Can & Sonmez (2012)	Learning How to Design a Technology Supported Inquiry-Based Learning Environment	Twenty-two pre-service teachers in Turkey.	Prepare a WebQuest to be viewed and reviewed online by classmates.	No numerical statistical evidence was given.
Maloy Edwards, & Anderson (2010)	Teaching Math Problem Solving Using a Web-based Tutoring System, Learning Games, and Students' Writing	Five classrooms with 125 students in fourth grade.	Ten weeks of minimum instruction as math or computer instruction and an additional 4 weeks as an individual self-selected option.	A calculated t value of -12.58 making it a highly significant gain with p < .01.

Table 1 (continued)

AUTHORS	TITLE	PARTICIPANTS	METHODS	FINDINGS
Satsangi & Bouck (2015)	Using Virtual Manipulative Instruction to Teach the Concepts of Area and Perimeter to Secondary Students with Learning Disabilities	Three high school students.	Four phases including a baseline (5-6 sessions), intervention (5-10 sessions), maintenance (3 sessions), and generalization (3 sessions) over the course of 2+ weeks.	One student reached 100% accuracy after a baseline of 0% with the instructional virtual manipulatives. A second student scored 3.3% accuracy across six sessions, and scored above 80% on all but one session. The third student had a baseline of 0%, and then averaged 68.9% accuracy.
Heppen (2012)	Broadening Access to Algebra I: The impact on eighth graders taking an online course	242 students across 11 course sections.	A complete online course including material, interactive textbooks, direct instruction, guided practice, and problem sets with immediate feedback on quizzes and tests. Also included demonstrations, audio clips, and interactive applets.	85% of the course units were completed. 43% of the online students completed the course entirely. Students end of 8th grade algebra scores in treatment schools was 447.17 compared to the control group at 441.64, with $p < .001$.

Chapter 3: Conclusions and Recommendations

Conclusion

The math strategies highlighted in this paper are not all encompassing, but a few mainstream traditional methods and technology-based pieces that have been replicated. All of these methods could have overlaps in other curriculum.

Traditional methods like Detect-Practice-Repair, students using this method can learn to increase their automaticity of math facts. My argument against this is that this method may not help in the construction of other skills needed later on in math. If you were to ask any math teacher if they would want their students to have the skills of knowing basic facts, they would reply yes. However, if you were to also ask the same teachers about how or why they know their math facts, they might not understand the question. Having conversations about the math and understanding the basic concepts of why 5 plus 5 equals 10 or 7 times 4 equals 28 are different than simply knowing the facts.

There are many times the methods in teachers who teach math have been developed through their experiences in a system of teaching how they learned. This system is one where facts need to be known, however or at times without possibly understanding why. In the future growth of the student if there is not a conceptual understanding of why 5 plus 5 equals 10, then it may be hard to grasp new content based on the principle of the math, not just the procedural knowledge. The teachers that do not spend time on the why and how are then perpetuating the deficiencies of math, which leaves out the basis for understanding the concept.

In the current status of our classrooms it seems hard to believe that the teachers that want to incorporate their lessons using technology cannot because of the funding available. Budget

cuts in some districts might make this a tough task. Fortunately there is a trend toward outfitting

classrooms with technology to be used with the class in various forms. Some districts and

schools have outfitted all or most of their students with the 1:1 initiative. Providing a piece of

technology like an iPad or computer device into the students' hands for educational purposes.

Other means by which teachers have presented their material is to project it onto a screen or

board in the classroom itself. PowerPoint is one of those programs that allows the use and

manipulation of materials to get to the students. Furthering the use of presentations, students can

also have access to those presentation materials in the form of notes for future use.

    Just like a comedian will learn about to whom they are performing, it is just as important

for a teacher to know the audience they are presenting to. The students in an intervention class

will have differing levels of competence in math. Students could also be at contrasting levels in

the use of technology; more specifically, how students are able to use the technology and be

successful in their learning. Some of the cooperative math and technological tools including

ALEKS, Merlin's Math Mill, WebQuest, 4MALITY, and NLVM are just a few options in our

world today.

    While the ALEKS program is a self-assigning curriculum based on an initial assessment,

the student will continue to grow with continual use. Our math intervention classrooms in

seventh- and eighth-grade currently use this program. The belief is that ALEKS is not a stand-

alone product. Our intervention classes have a licensed math instructor as the proctor. Students

are able to voice their questions to the teacher in times where they do not understand the program

or what the questions may be asking. Likewise, this is not a curriculum; rather, another

application for students to use and get immediate feedback as well as a comparison of ways to

show how to complete the problems. What this program lacks is the attention to multiple methods of solving some of the problems. The responses are sometimes too rigid and procedural. Without the help and knowledge of the instructors in the class, students may fall in despair and lack the motivation to continue to improve their achievement.

In contrast, the use of 4MALITY and the National Library of Virtual Manipulatives (NLVM) in an intervention math classroom can be helpful as integration into the content, but not as a stand-alone program. These programs, with the assistance of the classroom teacher, have shown to improve the growth of individuals in the class within their study. This is not to say that the use of non-virtual manipulatives are bad or unproven, but the idea that one device can be used to help reach multiple students in the class may prove to be more worthy than the counterparts. Researchers review educational websites and apps and state their use can help students in different ways. The discussion, however, is in how the programs are matched to the students and their own failures. A teacher needs to be able to help students identify what their needs are and how they can be improved or remedied.

Implications for Practice

Throughout this process there have been many different aspects of mathematical and educational strategies to help students grow more on their achievement tests with the use of technology. As time goes on others will report their results on strategies and techniques used in their own classrooms. There is one underlying result of the components that was discussed in this paper. The teacher is the most integral part for the learning of the students of the classroom. Whether traditional or technological, any strategies used in the classroom can only be as good as the teacher operating with them.

Summary

   As an educational society, we will continue to try and navigate through the newest trends that will boast student achievement. The use of technology is here and now. Let us not get lost on one of the most integral components in the classroom, the instructor. The instructor will help to balance the exposure of the technology medium, whether the course is using technology as a presentation medium, a supplement, a fully embedded use, or no technology at all. As Confrey (2006) stated about high priorities in our long-term demands: "develop and deploy new technologies to support learning and engage students" (p. 4). We need to continually support our instructors who work tirelessly to incorporate information in a manner to engage our students. The ultimate question to answer is, does the use of computer-assisted instruction produce an increase in an individual student's growth? Using math strategies assisted by the use of technology has shown that it can be a positive learning experience by students at multiple grade levels and varying levels of understanding.

Recommendations for Future Research

   As future research is conducted, it can be presumed that much of it would be on the very content and answer to this question. Does the use of computer-assisted instruction produce an increase in an individual student's growth?

   The use of technology in classrooms will undoubtedly continue in the future. As I have assembled my thoughts, I believe the next direction to go would be to try and focus the specific categories with a higher volume of participants across a variety of demographics. When looking at how different areas of our country have capabilities to do things with their students that others cannot in regard to technology, you also have to look at what can be done in those areas without

the use of technology. Technology is not a means for definitive improvements, rather a possibility to improve students' understanding and knowledge of a skill.

While working with the broader demographic, I would like to see instructors have a similar background to the demographic they are working with. This could help to limit the outside variability in what an instructor with knowledge in only a specific area can impart on their students.

I would also like to see the use of the technology as the medium of instruction and make sure the teacher component exists for the students. Without the interaction between student and teacher, you start to lose one of the most exciting reasons for learning and peer interaction. Our world is ever-changing in the realm of technology. This does not mean that our communities cannot work to make certain our students still learn basic principles of life concurrently with their understanding of content knowledge in our schools.

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