Impact of Computer Assisted Instruction on Achievement in Seventh Grade Mathematics

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Impact of Computer Assisted Instruction on Achievement in Seventh Grade Mathematics

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Action Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Arts in Education

California State University Monterey Bay

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Impact of Computer Assisted Instruction on Achievement in Seventh Grade Mathematics

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Abstract

Increasing mathematical skills in American students has been a top priority. To increase these skills, an effective and easy to implement intervention is sought. Computer Assisted Instruction (CAI) is frequently used as an intervention with promising results. MobyMax, a CAI application was used in this study. This study used two groups and a pretest/posttest to compare students’ achievement scores. The control group (n=28) received traditional Direct Instruction (DI) and the treatment group (n=29) received CAI through MobyMax. Independent sample t-tests were completed to determine the difference in student achievement scores. The results suggest the use of MobyMax increased student achievement compared to those who received traditional DI. Future research could examine the use of MobyMax with other populations.

Keywords: Computer Assisted Instruction, Direct Instruction, Mathematics, Achievement
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Impact of Computer Assisted Instruction on Achievement in Seventh Grade Mathematics

Literature Review

Science, Technology, Engineering, and Math (STEM) are four content areas where most people come in contact everyday. Mathematics is the building blocks of STEM because without math science, technology, and engineering would not be possible (Ceylan & Ozdilek, 2014). Time is an example of mathematics in everyday live since individuals are on a schedule of some sort and need to be able to calculate the time until their next engagement. Currency is another form of mathematics used by society when money is exchanged for items or services. Additionally, math is used in a wide range of jobs such as doctors, engineers, computer programmers, professional athletes, and storeowners. Explicitly taught mathematical skills are required for society to lead comfortable lives.

Lunenburg & Irby (2011) state explicitly taught skills could be accomplished through direct teaching. Direct Instruction/ teaching (DI) is a teacher centered instructional method, where explicit instructions are given to students. Providing a clear learning goal with enough scaffolds and opportunities to practice maximize student learning (Al-Makahleh, 2011). Student engagement increases with the use of proximity in the classroom. Student interactions such as teacher to group, teacher to student, and student to student are three examples where information can be explicitly taught. The last step in the DI process is independent student practice (Wright, Shumway, Terry, & Bartholomew, 2012). Student achievement measurements correlate to assessments given to learners.

Formative and summative assessments can be provided to students in modules, lessons, chapters, or any point in time (Cole, 2011). Summaries, conclusions, discussions, peer teaching, and formal assessments are examples of assessing students (Ediger, 2007). Cole (2011) states the national or state achievement exams serve a purpose to measure student ability. These types of
assessments may not be an ideal way for a teacher to measure ongoing progress throughout the school year (Cole, 2011). Ediger (2007) states a variety of learning opportunities should be available for students to master their learning goals.

Immediate feedback is an opportunity for each student to reflect and improve student achievement (Al-Makahleh, 2011). Duhon, House, Hastings, Poncy, & Solomon, (2015) have found performance feedback has been demonstrated to improve math fluency. Performance feedback is defined as students receiving detailed information in regards to their academic work (Duhon, House, Hastings, Poncy, & Solomon, 2015). Therefore, one way to improve student achievement is to provide students with efficient accurate feedback to allow them to reflect and process (Cepni, Tas, & Kose, 2006).

Analyzing formal assessments such as pretests and posttest is an example of measuring student achievement. Pretests and posttests are used to measure the stability of student test scores between two points of time, to determine if the stability increases or decreases. Mathematical achievement can be statistically analyzed to prove if there was a statistical difference between the pretest and posttest (Cole, 2011). Shapiro, Dennis, & Fu, (2015) have found Computer Adaptive Tests (CAT) and Performance Based Assessments are two new testing methods being implemented by different states.

In recent years, there has been an increase in the use of computers in education. Mistretta (2005) found teachers who used Computer Assistive Instruction (CAI) needed to find effective ways to integrate technology into the classroom to reap the benefits. CAI is the overall use of computers in education, while Adaptive Learning Systems (ALS) is a specific type of adaptive program. Barrow, Markman, and Rouse (2007) found reasons CAI could be more effective than traditional instruction.
CAI and ALS can both offer individualized instruction and allow students to progress when the time is right for them (Yusuf & Afolabi, 2010). Wong (2012) has found successful personalized learning environments will allow each individual to create their own leaning path while providing the necessary skills to understand each concept and increase student achievement. ALS provides students with either interventions or challenges to suit each individual's needs. Technology use in education provides an alternative environment to learn by allowing students the opportunity to get differentiated instruction (Isman, Baytekin, Balkan, Horzum, & Klylcl, 2002).

Furthermore, Shamir and Johnson (2012) found CAI uses a range of resources to assess student achievement. Resources include visual and auditory aspects allowing students to access the content with less difficulty. In addition, Kaousar, Choudhry, and Gujjar (2008) found CAI helps students comprehend the material required to master a concept because students are not able to move to the next topic until mastery is achieved.

Integrating CAI in education can produce higher achievement by allowing students to access more content when compared to traditional teaching (Cepni, Tas, & Kose, 2006). Typically students learn at the pace of the teacher or the pace of the classroom. There are usually three dynamics of student achievement in a classroom, high achievers, mainstream, and low achievers. Each of these groups process information at different rates. With CAI integration, each group is able to access the content depending on their achievement and ability level. Furthermore, CAI and middle school math achievement has been found to have a positive statistically significant effect on student achievement. Tienken (2008) did a quasi-experimental study, which tried to determine if there was a measurable difference in student achievement on the math section of the New Jersey Grade Eight Proficiency Assessment (GEPA) for students
who used CAI and those who did not. Results suggest the use of CAI did have a positive effect on mathematics achievement (Tienken, 2008).

A CAI program called MobyMax integrates a variety of research-based techniques proven to improve student achievement. Techniques used by MobyMax are formative testing, immediate feedback, and DI. MobyMax uses formative assessments by continuously monitoring student progress beginning with the diagnostic placement test. Teachers as well as students are able to see immediate feedback based on all the problems completed. Immediate feedback is an effective strategy because it provides explanations to every problem attempted by the students. When DI is used within MobyMax it provides engagement of all students, pacing of the lesson, checking for understanding, modeling, providing feedback and student monitoring (Principles, n.d.).

**Research Question**

How can integrating Computer Assisted Instruction (CAI) influence mathematics achievement in a seventh grade math class?

**Methods**

**Setting**

The Salinas Union High School District (SUHSD) is located in the city of Salinas, CA. SUHSD is composed of twelve different schools. There are four high schools, four middle schools, a continuation high school, an adult school, an alternative school and a district community day school (California, 2015). Salinas has a population of approximately 156,667 people and has a large agricultural industry (U.S. Census Bureau, 2015).
Participants

The middle school was composed of seventh and eighth grades with approximately one thousand one hundred and ninety four students (School, 2015). Fifty-seven seventh grade students were recruited from two math classes. There were 34 females and 25 males. One class had 17 females and 11 males while the other had 16 females and 13 males. All participants had similar achievement and ability. Eighty one percent of the participants were Hispanic, eight percent of the students were Caucasian, six percent were African American, three percent were Asian and two percent were Arabic. The age range of the participants was from twelve to thirteen years old.

Research Design

This study was a Static-group comparison design with a pretest/post test. A pretest/posttest design was used because students were comprised of groups (class periods) and random assignment of students was not possible. The students in the experimental group used CAI for six weeks, two times a week for thirty minutes. Students used CAI during their regularly scheduled math class. There was no difference in the amount of time both groups spent on their math instruction.

Pretest and Posttest

Glencoe and McGraw Hill created a series of Diagnostic and Placement Tests (Glencoe, 2009). Diagnostic and Placement Test 1 was used as both the pretest and posttest. The diagnostic
test covered content addressing number sense, number relationships, computation and numerical estimation, problem solving, fractions, decimals, percents, area and perimeter.

When the pretest and posttest were administered, students were asked to leave questions they did not know blank. The pretest and posttest each took students about 30 minutes to complete. After the pretest and posttest were given, students were not able to see the results of their test. They were only given the number of correct answers. Students did not receive any feedback regarding their work on the pretest or posttest. None of the problems were used in class during teaching.

**Independent Variable**

The independent variable was the CAI called “MobyMax” computer program. MobyMax was implemented during the participant’s math class. MobyMax is an online resource offering free “math, language, and reading curriculum for K-8 teachers” (MobyMax, 2013). Lessons were aligned to the Common Core State Standards. A Pro version was available for $99. Each student in the treatment group was required to use MobyMax two times a week for 30 minutes at a time. The purpose of MobyMax was to provide students with practice with their basic mathematics skills related to the Common Core State Standards.

MobyMax had a variety of teacher tools. The progress tool gave the teacher feedback on student progress. Reports explained the usage impact on students, student progress, curriculum, and troubled spots. Lessons were chosen based on the student diagnostic test given by MobyMax when students first logged on.
Instructional Procedures

The treatment group received CAI. The control group was the participants who received DI. DI was a lecture / discussion classroom format. Students sat in class and took notes while listening to their instructor. The students in treatment group were the ones who received the CAI “MobyMax”. The researcher taught both the control and treatment groups.

Data Analysis

Independent sample t-tests were completed to determine the significant difference in student achievement between the two means of the (Pretest and Posttest) scores of students who used MobyMax and students who did not use MobyMax. Microsoft Excel was used to perform the statistical analysis needed for this study.

Data analysis was completed to answer the following research questions and the corresponding null hypothesis:

1. Is student achievement greater for students who used MobyMax in seventh grade math?
   
   The following null hypothesis, “The mean of (Pretest) scores for students who received math instruction using MobyMax is no different from the Mean of (Posttest) scores at the 0.05 level of significance,” was analyzed using Microsoft Excel.

2. Is student achievement greater for students who received traditional instruction in seventh grade math? The following null hypothesis, “The mean of (Pretest) scores for students who received traditional math instruction is no different from the Mean of (Posttest) scores at the 0.05 level of significance,” was analyzed using Microsoft Excel.

Results

A total of 29 students received instruction with MobyMax and 28 students received instruction using traditional direct instruction.
Hypothesis Testing Results

The first research question was answered by using an independent samples t-test for the following null hypothesis: The mean of (Pretest) scores for students who received math instruction using MobyMax is no different from the Mean of (Posttest) scores at the 0.05 level of significance. A t-test for independent samples was used to compare pretest and posttest scores for students who received math instruction using MobyMax (treatment group). Table 1 shows the results for the statistical test.

Table 1
MobyMax Pre and Post Test

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean Score</th>
<th>St. Deviation</th>
<th>T-value</th>
<th>Critical value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>29</td>
<td>15.48</td>
<td>6.88</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posttest</td>
<td>29</td>
<td>19.45</td>
<td>5.68</td>
<td>0.02</td>
<td>0.05</td>
</tr>
</tbody>
</table>

The mean was (M= 15.48) for the pretest scores (n=29) with a standard deviation of (sd=6.88). The posttest scores (n=29) had a mean of (M=19.45) with a standard deviation of (sd=5.68). The t-test value obtained was 0.02 at a 0.05 significance level. The obtained value (t=0.02) was less than the critical value of 0.05 therefore led to the rejection of the null hypothesis, showing there is a significant difference between the means of the pretest scores and the posttest scores.

The second research question was answered by using an independent samples t-test for the following null hypothesis: The mean of (Pretest) scores for students who received traditional math instruction is no different from the Mean of (Posttest) scores at a significance level of 0.05. A t-test for independent samples was used to compare pretest and posttest scores for students...
who received traditional math instruction (control group). Table 2 shows the results for the statistical test.

Table 2

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean Score</th>
<th>St. Deviation</th>
<th>T-value</th>
<th>Critical value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>28</td>
<td>18.93</td>
<td>6.99</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posttest</td>
<td>28</td>
<td>21.07</td>
<td>6.13</td>
<td>0.23</td>
<td>0.05</td>
</tr>
</tbody>
</table>

The mean for the pretest was (M=18.93) for students who received traditional instruction (n=28) with a standard deviation of (sd=6.99). The posttest had a mean of (M=21.07) for traditional instruction (n=28) with a standard deviation of (sd=6.13). The t-test obtained value was (t=0.23) at a 0.05 significance level. The obtained value (t=0.23) was greater than the critical value of 0.05 leading to accepting the null hypothesis, showing there is not a significant difference between the means of the pretest and the posttest.

**Inter-Rater Reliability**

The pretest and posttest inter-rater reliability was for 120 items. Rater 1 had a score of 120, while Rater 2 had a score of 119. The Inter-rater reliability was an observed percentage of 99%. Therefore, the Inter-rater reliability had a high agreement.

**Discussion**

The purpose of the study was to determine if student achievement was greater in seventh grade math classes for students who received instruction with MobyMax than for students who received traditional direct instruction. This study included 29 students who received instruction with MobyMax and 28 who received traditional direct instruction.
Results indicate the use of MobyMax made a difference on participants’ scores on the posttest. The results based on both of groups’ shows the participants who received math instruction using MobyMax was higher than for the participants who received traditional math instruction. One of the main differences between the two groups of participants was the amount of time students were allowed to work on a topic. The participants who used MobyMax were able to spend as much time as they needed to master the topic before moving on to a new topic. The participants who were taught by the teacher using DI had to go at the pace of the teacher. At times, participants were not allowed sufficient time to fully master the topic being taught before the teacher was moving on to the next topic.

A second difference was the students who used MobyMax were provided with instant feedback. Cepni, Tas, & Kose (2006) discovered providing students with immediate feedback allows students to self-evaluate and reflect. As soon as a participant types in their answer and hit enter they are able to know if their responses were correct. Students who were taught with DI were not able to receive feedback until the teacher went over the assignment. There was a possibility students were solving the problems incorrectly and did not know until the teacher went over the correct answers.

MobyMax uses a variety of the research-based techniques mentioned by Shamir and Johnson (2012). Two examples include immediate feedback for each student and mastery for each topic. Incorporating these techniques has been helpful for student learning. MobyMax gave students the tools needed for them to either master the concept or were provided with explanations to fix their mistakes immediately.

Incorporating technology in classrooms creates a different learning environment for students, by providing students with differentiated instruction. Students who used MobyMax were able to watch videos on the topics they were learning. Videos could be paused or re-
watched as many times as the student needed to understand the concept. Students who had DI were not able to pause the teacher and have them repeat what was explained. Technology allows students to take control of their own learning by providing them with 21st century skills.

MobyMax or other similar programs could be considered another tool such as a textbook, which could impact teachers, learners, parents, and policyholders. Teachers could assign work on MobyMax thereby enabling students to work from home and potentially get help from parents. Educational policyholders could save money with textbook purchases with the use of MobyMax or an equivalent program.

A recommendation for future studies is to have a larger sample size. A second recommendation is to have two different tests for the Pre-Diagnostic and Post-Diagnostic test results. A third recommendation could be to have subgroups of participants broken up by specific criteria such as gender. The situation for this study was not ideal due to time constraints as well as the fact the publisher does not have a variety of diagnostic tests to measure student ability. A limitation from this study was having a small sample size. Future studies should have two different forms of assessments as well as a larger sample size.

As integral as technology has become these past few years, it is important for educators to look for ways to appeal to the technology-savvy student population found in classrooms today. Integrating technology will engage and motivate students and may potentially lead them to higher achievement.
References


doi:10.1007/s10864-014-9203-y


MobyMax - online math and language curriculum. (2013, June 10). Retrieved from
http://www.edtechroundup.org/reviews/mobymax-onlinemath-and-langauge-curriculum


Diagnostic and Placement Test 1

Name ______________________
Date ______________________

This test contains 30 multiple-choice questions. Work each problem in the space on this page. Select the best answer. Write the letter of the answer on the blank at the right.

Part 1

1. Which set of numbers is in order from least to greatest?
   a. 721, 691, 522, 718, 709  
   b. 522, 691, 718, 709, 721  
   c. 522, 691, 709, 718, 721  
   d. 721, 691, 522, 718, 709

   1. ________

2. What is 8,342 rounded to the nearest hundred?
   a. 8,340  
   b. 8,300  
   c. 8,400  
   d. 8,000

   2. ________

3. 354 + 78 = _?
   a. 322  
   b. 332  
   c. 422  
   d. 432

   3. ________

4. 402 – 49 = _?
   a. 353  
   b. 363  
   c. 451  
   d. 453

   4. ________

5. A color printer can print six pages per minute. How long will it take to print 24 pages?
   a. 2.4 min  
   b. 3 min  
   c. 4 min  
   d. 6 min

   5. ________
6. Two classes set a goal of collecting a total of 500 cans for the food drive. Mr. Hart’s class collected 123 cans. Ms. Zani’s class collected 237 cans. How many more cans are needed to reach the goal?
   a. 114
   b. 140
   c. 263
   d. 360

7. \( 8.4 - 3.73 = ? \)
   a. 3.11
   b. 4.67
   c. 4.77
   d. 5.1

8. \( 2.3 + 8.101 = ? \)
   a. 1.0401
   b. 8.124
   c. 10.104
   d. 10.401

9. What is 1.324 rounded to the nearest whole number?
   a. 1
   b. 1.300
   c. 1.5
   d. 2

10. Which improper fraction is equivalent to \( 2\frac{3}{5} \)?
    a. \( \frac{6}{5} \)
    b. \( \frac{10}{5} \)
    c. \( \frac{13}{5} \)
    d. \( \frac{17}{5} \)
11. Which decimal is equivalent to the fraction \( \frac{7}{100} \)?
   a. 0.007
   b. 0.07
   c. 0.7
   d. 7.0

12. Which fraction is equivalent to 0.3?
   a. \( \frac{3}{10} \)
   b. \( \frac{3}{100} \)
   c. \( \frac{3}{10} \)
   d. \( \frac{30}{10} \)

13. What is a good estimate of 79.1 – 69.5?
   a. 9.6
   b. 10
   c. 10.4
   d. 150

14. What is the area of the rectangle below?
   a. 4 cm\(^2\)
   b. 15 cm\(^2\)
   c. 21 cm\(^2\)
   d. 36 cm\(^2\)

15. Which number is greater than 0.7?
   a. 0.15
   b. 0.65
   c. 0.09
   d. 0.72
16. Which decimal represents $\frac{3}{5}$?
   a. 0.03
   b. 0.3
   c. 0.06
   d. 0.6

17. Keira was paid $2.50, $3.75, and $4 for baby-sitting on three evenings. What is the total amount she earned baby-sitting?
   a. $7.29
   b. $9.25
   c. $9.80
   d. $10.25

18. Tom had an 8-foot piece of rope. He used $5\frac{1}{2}$ feet of rope to tie a young tree to a stake. How much rope was left over?
   a. $2\frac{1}{2}$ ft
   b. $3\frac{1}{2}$ ft
   c. $4\frac{1}{2}$ ft
   d. $5\frac{1}{2}$ ft

19. If $x = 10.05 - 2.4$, then $x = \ ?$
   a. 7.65
   b. 8.1
   c. 8.65
   d. 9.81

20. On a day in 2005, one U.S. dollar was equal to 0.825606 Euro, and 10 U.S. dollars equaled 8.25606 Euros. On that day, what was the value of $11$ in Euros?
   a. 9.07166
   b. 16.51212
   c. 18.25606
   d. 90.81666
21. What is 99.96 rounded to the nearest tenth?  
   a. 0.9  
   b. 1.9  
   c. 99.10  
   d. 100.0  

22. What is the least common denominator (LCD) of $\frac{3}{4}$ and $\frac{1}{6}$?  
   a. 2  
   b. 10  
   c. 12  
   d. 24  

23. Which decimal is equivalent $10 \frac{5}{100}$?  
   a. 10.005  
   b. 10.05  
   c. 10.5  
   d. 15  

24. Which number expresses 2.75 as a mixed number in simplest form?  
   a. $2\frac{3}{4}$  
   b. $2\frac{15}{20}$  
   c. $2\frac{75}{100}$  
   d. $2\frac{75}{10}$  

25. On average, 53.3 customers enter Food Haven grocery between 8:00 A.M. and 9:00 A.M. About 55 customers enter between 9:00 A.M. and 10:00 A.M. Estimate the total number of customers entering Food Haven between 8:00 A.M. and 10:00 A.M.  
   a. 2  
   b. 50  
   c. 58.8  
   d. 110
26. What is the area of the figure below?
   a. 24 in\(^2\)
   b. 46 in\(^2\)
   c. 56 in\(^2\)
   d. 640 in\(^2\)

27. Which list of decimals is in order from least to greatest?
   a. 0.1, 0.14, 0.05, 0.08, 0.32
   b. 0.1, 0.05, 0.08, 0.14, 0.32
   c. 0.1, 0.05, 0.08, 0.14, 0.32
   d. 0.05, 0.08, 0.1, 0.14, 0.32

28. Which number represents one hundred three and eighteen thousandths?
   a. 130.18
   b. 103.18
   c. 103.018
   d. 103.0018

29. Sara bought a paperback book for $7.79. She gave the clerk a $10 bill. About how much change should she get?
   a. $1
   b. $2
   c. $3
   d. $4

30. Rene is making a border across the top of a bulletin board that is 51 inches long. She uses pieces of red paper that are \(8\frac{1}{2}\) inches long, placed end to end. How many pieces of paper will she need?
   a. 4
   b. 6
   c. 42\(\frac{1}{2}\)
   d. 59\(\frac{1}{2}\)