CARNEGIE LEARNING ONLINE: WILL IT WORK?

A Thesis

Presented to

The Graduate Faculty

Central Washington University

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

Teaching Mathematics

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by

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July 2014

CENTRAL WASHINGTON UNIVERSITY

Graduate Studies

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ABSTRACT

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The purpose of this study is to determine whether the Carnegie Learning Online Program/Cognitive Tutor Algebra I will increase the End of Course assessment achievement of the researcherôs remedial mathematics students at the Algebra I level. The participants for this study are remedial Algebra I students. The recruitment of participants was determined by the school administrators, and the sample is 107 remedial Algebra I students. The data include end of course assessment results and a journal of student comments/reflections. The researcher removed all identifiers to maintain anonymity and confidentiality.

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INTRODUCTION

The purpose of this study is to determine whether the Carnegie Learning Online Program/Cognitive Tutor Algebra I (CTA) would increase the End of Course (EOC) assessment achievement of remedial mathematics students at the Algebra I level.

The problem driving this study is that many remedial mathematics students at the researcherôs high school fail to advance in their mathematics classes, thus jeopardizing their graduation. Historically, 73.9% of tested students on average fail to meet standard on the stateôs mathematics assessment at the researcherôs high school (OSPI, 2014). For students, the possible consequences include repeating Algebra I classes, dropping out of school, and enrolling in online courses. The researcher worked with these students using the Carnegie Learning approach to help them better achieve at algebra, thus enabling them to take a grade-appropriate mathematics class.

Due to the high failure rate among the remedial mathematics students, including those in Algebra I, interventions have been instituted at the researcherôs high school. These include peer tutoring, teacher tutoring, credit retrieval, and curriculum routing. Credit retrieval, defined as making up a failed credit, has been made available through summer school at the researcherôs high school and a local technical school. Also, other interventions include an alternative mathematics classes and mathematics packets arranged by the school counselors.

In addition to the resources listed above, remedial mathematics students have participated in the online computer program called ñSuccess Maker.ò This program

enhanced student engagement by increasing the number of problems each student completed during the allotted class time, based on visual observations made by the researcher. However, that improvement did not include substantial grade-appropriate transitions by remedial students. The researcher conjectured that using the CTA with her 9^{th}, 10^{th}, and 11^{th} grade remedial mathematics students could improve skills enough to advance them to grade-appropriate levels in mathematics.

A major concern in the researcherôs district is that remedial mathematics courses do not earn graduation credits. Those courses only garner elective credits. Furthermore, without three mathematics graduation credits, as stipulated by the state of Washington, students cannot graduate. The researcher hoped that by completing the CTA, her students could demonstrate an improvement in mathematics achievement, and advance to grade-appropriate levels in mathematics courses, thereby earning graduation credits.

The research questions for this study are:

1. Will the CTA increase EOC achievement in Algebra I for freshman remedial mathematics students?
2. Will the CTA increase EOC achievement in Algebra I for sophomore remedial mathematics students?
3. Will the CTA increase EOC achievement in Algebra I for junior remedial mathematics students?
4. Do the students using the CTA system perceive it as effective in helping them learn algebra?

This action research study is meaningful because of its potential to help close the achievement gap between the population of students who under achieve at mathematics and the population of students who perform at grade level. Based on previous trials done by other schools across the country, such as in Pittsburgh and Milwaukee, both of which can be found at (Carnegie Learning, 2014), the Carnegie Learning Program promises to help close this gap and to provide a much needed solution to the remediation problem (Carnegie Learning, 2014; Z. Rau, personal communication, August 2010). The study at hand will add to the knowledge base of computerized algebra tutorials, as an evaluation of the CTA systemôs effectiveness at the researcherôs school.

REVIEW OF RELATED LITERATURE

Traditional Versus Reform

For decades, traditional versus reform teaching methods and strategies have been at the center of mathematical debates about how mathematics should be taught in the public school system. It is important that both philosophies be considered, although this study is considered to be one of reform with traditional components. Letôs begin by looking at the traditional form of teaching.

In the 1970s, the era of ñNew Mathò had passed and a return to a ñback-to-basicsò philosophy guided mathematics education policies and practices (Schoenfeld, 2004. p. 257). This transitional period was a new era that brought change in mathematics education from the previous years but still was not producing the desired results. This trend focused largely on skills and procedures, much like the traditional curricula preceding the ñNew Mathò age. Assessments from nearly a decade of the ñback-to-basicsò curricula demonstrated that a reform in mathematics education was needed in the 1980s. A main concern for reformists was that students were unable to problem-solve, because the ñback-to-basicsò curricula did not stress aspects of mathematics beyond the core procedures and skills (Schoenfeld, 2004, p. 258). Similar concerns drive the study at hand. Although students in this study were able to demonstrate basic mathematics skills and procedures, they were unable to demonstrate good mathematical problem-solving skills. Hence, the researcher regards the action research here as conforming to a reformist agenda.

The 1980s was a time of reform where problem-solving was implemented in the classroom. However, ñproblem-solvingò at this time meant solving word problems instead of more mechanical arithmetic or algebraic manipulation (Schoenfeld, 2004, p. 258). During this period, problem-solving questions increased in difficulty and more emphasis was placed on the skills needed to solve them as well. When tested using new, higher level problems, less competent students failed to solve them. They used their acquired knowledge, yet insufficient resources, to inefficiently solve the difficult problems (Schoenfeld, 2004, p. 263). Some failed to persist in their problem-solving effort or ceased working on the problem(s), deeming them unsolvable. Others who solved the problems successfully demonstrated a strong knowledge base, productive problem-solving strategies, effective use of meta-cognition, and productive beliefs about themselves and the mathematical enterprise (Schoenfeld, 2004, p 263). Evidently then, although somewhat successful, the reform movement needed improvements that more clearly focused on increasing problem-solving abilities.

Cultural Learning Styles Appropriate to the Researcherôs Classroom

Cultures learn in different ways, but this study will focus primarily on the Hispanic, African American, and Caucasian Cultures. Although each culture may have dominant learning styles, each person regardless of culture, may prefer or learn better under one (or more) styles. Even though the studies below provide some insight into cultural learning styles, they are not strictly generalizable to any particular culture. With

this in mind, it is important to learn basic learning styles for the cultures being studied to help determine whether the CTA will be of any benefit.

How Hispanics Learn

We will begin with how the Hispanic culture learns. The Hispanic culture has a very strong sense of family (Griggs & Dunn, 2007, para. 2). Therefore, if a teacher can tap into the family aspect while teaching mathematics, students may perform better. Also, Hispanics relate to mathematics topics better if they can relate the lesson to personal experience or a familiar topic. Likewise, integrating history of the Hispanic culture helps Hispanic students form connections with mathematics. Creating a safe and accepting classroom environment also helps during the learning process, and Hispanic students learn well through interactive group work and cooperative learning activities (Morgan, Rosenberg, and Wells, 2010, p.11). The emphasis on cooperation to attain a common goal is strongly engrained in that Hispanic culture (Griggs & Dunn, 2007, para. 2). In addition, Hispanic students are more kinesthetic rather than auditory or visual learners as in African American and Caucasian cultures (Griggs & Dunn, 1996, para 6).

How African American Students Learn

As with the Hispanic culture, African Americans may have preferred styles of learning mathematics. African American students, like Hispanics, learn well in group and cooperative settings (Guild, 1994, para. 15). These students also flourish in activity-based and hands on programs (para. 15). Real world word problems that are relevant to the students and visual cues help reinforce the mathematics topic being taught (Neely,

n.d., p. 24). In closing, some African American learning styles include auditory, visual, peer oriented, cooperative, and relevance-based tasks (Giuliani, 2003, p. 25).

How Caucasian Students Learn

According to Johnson-Gerard (2014, para. 3), many Caucasian students prefer to learn in a more traditional learning environment that includes a direct teaching/lecture style lesson and individual practice. Griggs and Dunn (1996, para. 6) claim Caucasians are more auditory and visual, rather than kinesthetic, learners. Caucasian students tend to do well in this learning environment, because they are able to sit for longer periods more comfortably than those in previously mentioned cultures. Also, these students tend to prefer a curriculum that is less emotionally or personally based, but more analytical. Certainly, Caucasians work well in group settings, but as mentioned by Johnson-Gerard (2014, para. 3), many prefer individualized work settings.

According to the National Council of Teachers of Mathematics (NCTM), ñno single study can prove that one method or feature of teaching is better than another for helping students achieve a particular learning goalò (NCTM, n.d., Effective Teaching for the Development of Skill and Conceptual Understanding of Number: What is Most Effective?, n.d., p. 1). In fact, in culturally diverse classrooms, cooperative learning encourages students to learn about other cultures and possible learning styles while completing a common goal (CoopLearn.org, 2007, para. 2). While all cultures may have dominant learning styles and preferred teaching methods; it is imperative that society is reinforced with the understanding that each of the above styles mentioned may benefit many types of learners.

Online Tutorials

Once the researcherôs district purchased the Carnegie Learning Online Program/Cognitive Tutor Algebra I (CTA), as was advised by the researcherôs school mathematics chair, the researcher decided to familiarize herself with online tutorials. During her research, she found that online tutorials are considered a reform approach to mathematics because they often focus on mathematical problem-solving skills. After further, the researcher chose four online tutorials to discuss based on their similarities to CTA. Again, it must be understood that the researcherôs district purchased CTA without consulting the researcher. Furthermore, the researcher was required to implement the CTA in her classroom for the 2010-2011 academic year.

Maths Power

The first online tutorial that will be discussed is the MathsPOWER online tutorial based in Australia. This online tutorial program is purchased on an individual basis and not as a school-wide program. A one year program costs $220 per student, and $420 for the two year program. There are family discounts (MathsPOWER, 2014). This program comes with a lifetime money-back guarantee for all participants who live in Australia. That is, students are guaranteed by MathsPOWER to show marked improvements within three months. Evidently, some demonstrate results in as little as two weeks (MathsPOWER, 2014). Students at the high school level use this program two to three times a week for 25-30 minutes. When beginning each lesson, students do a 5-8 minute on-screen lesson/tutorial to help them orient for their exercises. In the event that students do not comprehend the information during the tutorial, they may replay it. Along with

this program, students have hardcopy worksheets to keep for reference. A student not reaching a 90% achievement rate on the exercises may view the tutorial again. If the student still needs help, he or she may access a phone tutor. YouTube testimonials regarding the success of MathsPOWER cite improvements in test scores after six weeks (MathsPOWER, 2008), and positive comments may be found on the MathsPOWER website. Although this program appears to have many good points, such as those previously mentioned, there is a drawback. Although this program is available to American students, the lifetime money back guarantee is only offered in Australia (MathsPOWER, 2014).

Sylvan

The second program that was considered is the Sylvan Online program. This program has an online package along with site-based learning centers for those who need in-person help. There are over 800 Sylvan centers in the United States, Canada, and abroad (Sylvan Learning, 2014).

With the online part of the program, a student is able to work from his or her own home at his or her own convenience. While the student works, he or she can be in contact with a tutor, who will help with problems and/or questions.

Although this program appears to be a viable option for mathematics achievement, the cost issue still stands. This program can be purchased only on an individual basis and not school-wide (Sylvan Learning, 2014). Therefore, students who still need mathematics help, but are unable to afford the program, will lose out.

Agile Mind

The third program considered here is Agile Mind. This program is gradually working into the mathematics curricula in a district near the researcherôs school. Agile Mind offers programs in mathematics, science/biology, and academic youth development. These programs provide the students and teachers with real time results from various formative assessments, test preps, and learning progressions online. Also, this program is designed to address the content standards of the Common Core State Standards for Mathematics (CCSSM) and other college readiness requirements (Agile Mind, 2014). With this program students are expected to encounter real-world concepts in multiple representations, which helps to enhance and deepen their problem solving skills, while allowing them to be active participants in achieving a deeper and stronger mathematical understanding (Agile Mind, 2014).

Carnegie Learning Online

The final program that was considered is the Carnegie Learning Online Program/Cognitive Tutor (CTA). This program began in 1998 and has been a winner of The Software & Information Industry Association (SIIA) CODiE for Best Mathematics Instructional Solution for the years 2005, 2007, and 2009 (Wikipedia the Free Encyclopedia, 2014, para. 3). The Carnegie Learning headquarters is based in Pittsburg, Pennsylvania and was developed by a team of cognitive science researchers from Carnegie Mellon University.

This program offered on a school-wide basis and was purchase by the researcherôs school (Carnegie Learning, 2014; Wikipedia the Free Encyclopedia, 2014, p. 1). That is,

all students attending a school have access to this program. With fall implementation in the classroom, students receive three days of in-class group work aligned with a Carnegie textbook and two days of computer work to complete online lessons from Carnegie (see Figures 1-3). If a student is unable to finish the computer component at school, he or she may access the program from a home computer. In the event that a student does not show marked improvement over the course of a school year, the company gives the school a full refund for each student, as long as the program was administered correctly (Z. Rau, personal communication, August 2010). So, in summary, all students at a school have access to the program; the school pays for the students to use the program; and the company offers a money-back guarantee for students who do not show a marked improvement in mathematics skill levels. Hence, the additional reasons behind the districtôs purchase of the CTA.

Figure 1 Student CTA computer screen display with traditional problem

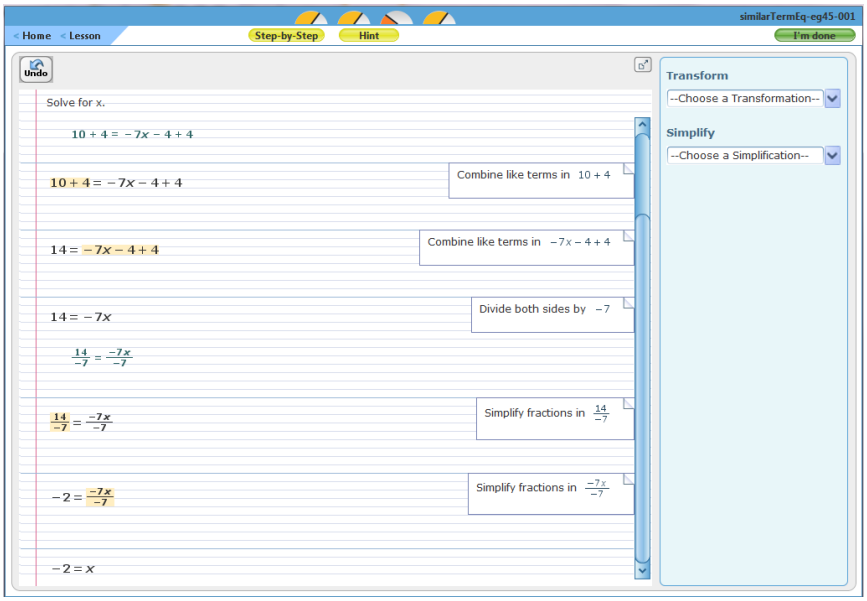


Figure 1 This is an example of a completed traditional student CTA problem.

Figure 2 Student CTA computer screen display with reform/story problem

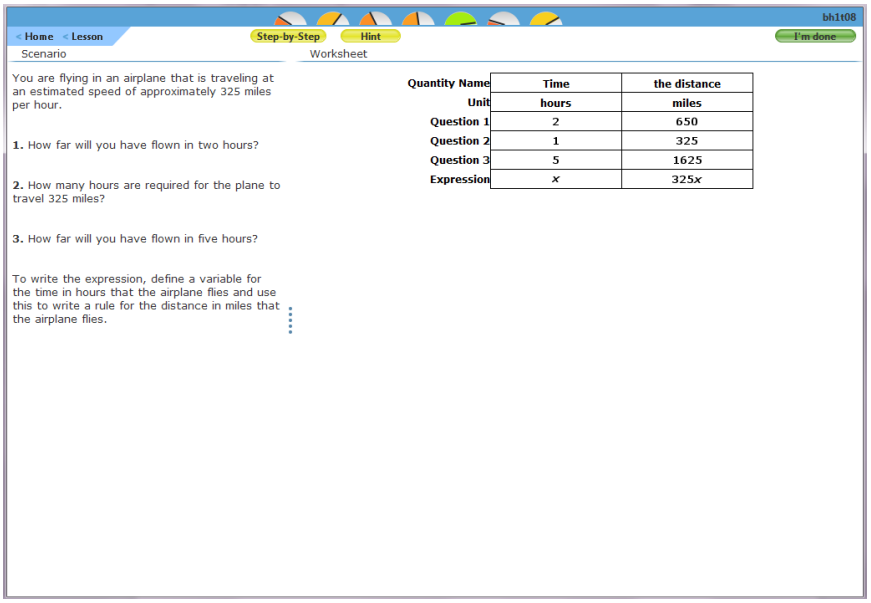
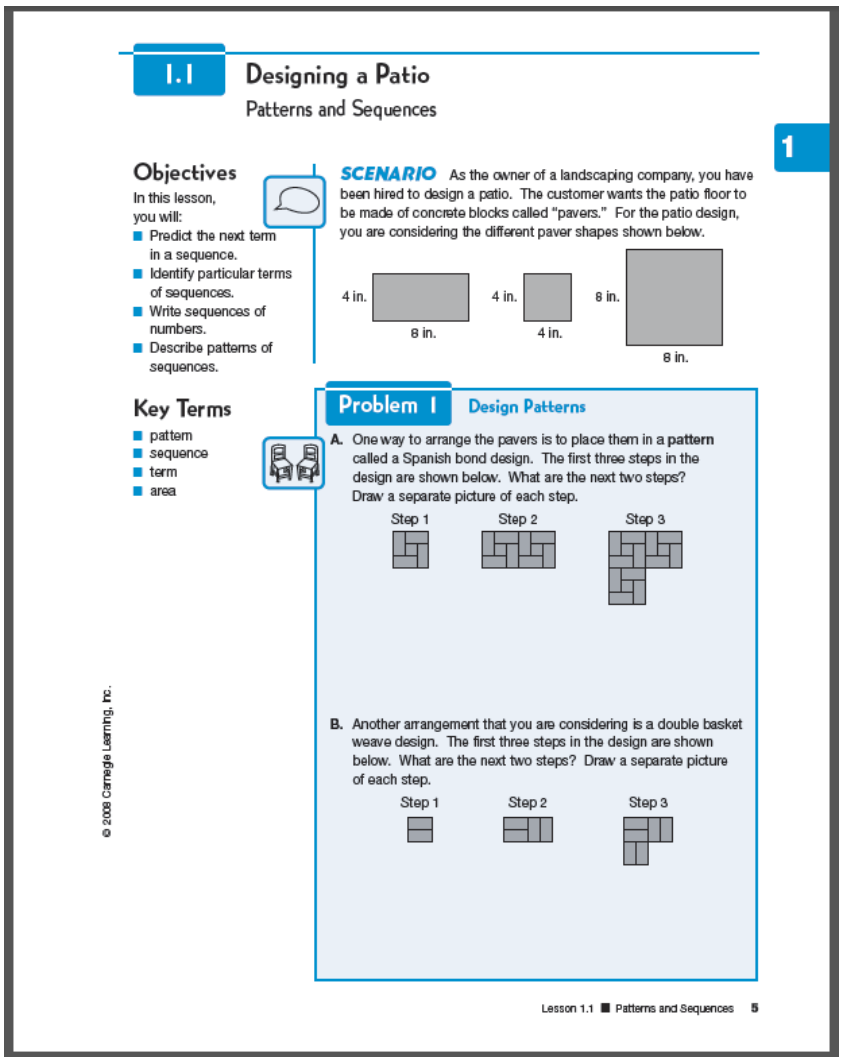


Figure 2 This is an example of a completed reform student CTA problem.

Figure 3 Student Text Page



1.1 Designing a Patio

Patterns and Sequences

1

Objectives

In this lesson, you will:

- Predict the next term in a sequence.
- Identify particular terms of sequences.
- Write sequences of numbers.
- Describe patterns of sequences.

SCENARIO As the owner of a landscaping company, you have been hired to design a patio. The customer wants the patio floor to be made of concrete blocks called "pavers." For the patio design, you are considering the different paver shapes shown below.

4 in. 8 in. 4 in. 4 in. 8 in. 8 in.

Key Terms

- pattern
- sequence
- term
- area

Problem 1 Design Patterns

A. One way to arrange the pavers is to place them in a **pattern** called a Spanish bond design. The first three steps in the design are shown below. What are the next two steps? Draw a separate picture of each step.

Step 1 Step 2 Step 3

B. Another arrangement that you are considering is a double basket weave design. The first three steps in the design are shown below. What are the next two steps? Draw a separate picture of each step.

Step 1 Step 2 Step 3

Figure 3. This is an example of a typical student textbook page.

Although the reviews and awards of the CTA have been positive in nature thus far; however, according to Gabriel and Richtel of *The New York Times* (2011, paras. 2-3), the U.S. Department of Education found that the CTA has unproven results with no statistically significant effects on test scores. Furthermore, ñthe full curriculum can cost nearly three times as much as a typical textbook over six yearsò (Gabriel & Richtel, 2011,

para. 13). Additional research on CTA successes and failures were sought after by the researcher for the mere purpose of helping her form personal conclusions concerning the CTA, but no new research was found.

Armed with this research, the researcher decided that further research study on the CTA must be done to better determine its worth in the classroom, despite the districtôs reasons for purchase. Thus, this action research study will test the validity of the Carnegie program. Over the course of the 2010-2011 school year, the researcher will be implementing the CTA in the researcherôs classroom to determine whether her remedial students at Davis High School will demonstrate an improvement in their mathematics skill at the Algebra 1 level.

RESULTS

This study is an action research piece, in which the researcher changed her mathematics curriculum and measured the effects of that change. The researcherôs goal was to test and determine the effects of the CTA program on her remedial Algebra I students. The researcher used four research methods: 1) a qualitative analysis of student comments/reflections written by the researcher throughout the study, 2) a reflection of teacher interventions used by the researcher to promote student success, 3) an assessment of verbal questions posed by the researcher to her students at the end of the school year, and 4) a quantitative comparison of the researcherôs EOC pass rates for Algebra 1 students against those of her school.

Although this study began as an action research piece, it also evolved into an ethnological research piece. Ethnological researchers use intermediate results for subsequent improvements, which is what the researcher did to improve student success in her Algebra I classes. That is, after reviewing student comments and reflections in her journal, the researcher changed how the CTA was implemented in her classroom to improve student learning.

This action and ethnological research study required over eight months for data collection and analysis. The formal write-up, additional data analysis, and research confirmation required two years. To complete this study the researcher engaged in the

following activities. She researched traditional and reform methods for teaching Algebra and various related literature. She conducted the study on a convenience sample of 107 Algebra I remedial mathematics students, analyzing their EOC test scores, and their comments/reflections about using the CTA. She kept a journal of those student comments/reflections, and she completed the study with a formal write-up of her observations as well. This formal write-up concluded her study providing recommendations for the use of the CTA Program.

The population for the 2010-2011 academic year for the researcherôs high school was 79.8% Hispanic, 1.9% African American, and 13.9% Caucasian culture (ñOSPI Student Demographics,ò 2014). Other cultural subgroups were not highly represented in the researcherôs classroom.

The participants in the sample population of the study were Algebra I remedial mathematics students in the researcherôs classes at a Washington State public high school. The sample population consisted of exactly 107 Algebra I remedial mathematics students out of a total of exactly 612 Algebra I mathematics students (ñOSPI EOC Results by Grade,ò 2014). That is, the treatment group was considered remedial because they were placed in a CTA class and not a Holt class. Ninth graders were placed in a CTA class by their eight grade mathematics teachers. Tenth, eleventh, and twelfth graders were placed in a CTA class because they were either repeating Algebra 1 or they were placed there by their previous mathematics teachers. The researcherôs participants

ranged from grades 9 through 12 with 90.7% Hispanic, 2.8% African American, and 6.5% Caucasian cultures.

Journal Entry Discussion

The first research procedure consisted of analyzing student comments/reflections that the researcher used to obtain data. Upon analysis of the 104 student comments/reflections, the researcher found 68.3% were negative and 33.7% were positive towards the CTA. Of the 104 student comments/reflections, 47 were made by boys while 57 were made by girls. Of these comments/reflections, nine students expressed that if a CTA app were available, more of work would get done, since they could do it on their phones. One student commented, ñIf there was an app for this, I would so get this done.ò

Seventy-one students also expressed their anger, exemplified in comments such as: ñI do what the hint tells me, but it still doesnôt work,ò or ñMy dad helped me for two hours on this problem, and Iôm still stuck on it.ò One of the 33.7% with positive viewpoints stated, ñDoing Carnegie is better than a bunch of book work.ò A breakdown of 104 student comments/reflections by positive or negative comments, disaggregated by gender and sorted by grade, appears in Table 1.

Table 1

Student Comments/Reflections Disaggregated by Positive, Negative, and Gender (n=104)

	Positive 33.7 % (33)		Negative 68.3% (71)	
Grade	Boy 14.4% (*n*=15)	Girl 17.3% (*n*=18)	Boy 30.8% (*n*=32)	Girl 37.5% (*n*=39)
9	3	4	18	14
10	6	7	11	14
11	2	4	3	9
12	4	3	0	2

Note. 104 Student comments/reflections total. Boys made 47 comments/reflections, and girls made 57 comments/reflections. The grade breakdown shows how many students in a specific grade and gender made a specific number of comments/reflections.

Teaching Interventions

The second research procedure was to make motivational changes to the way that CTA was presented and used in classes, based on the 104 student comments/reflections and behaviors. Throughout the course of the school year, the researcher noticed several behaviors that contributed to the decline of student engagement with CTA. Computers not only provided the means for using the CTA, they also were a distraction. Computer games, mathematics help sites that provided students with answers rather than help and guidance, and Google search were just a few distracting sites competing for studentsô attention. After noticing students migrating off task, the researcher began using

alternative methods to help block computer games and motivate students to increase student engagement with CTA.

Computer Distractions

The researcher began her intervention by asking the mathematics pro-tech to block certain sites and remove all pre-installed factory games from the computers. Since other instructors were experiencing similar issues, administrators had no problem sending tech-support to assist with the issues in the researcherôs classroom. However, district tech-support underestimated the intelligence of the students, hiding the computer games only and removing website shortcuts, instead of blocking websites and removing all games. That students were not smart enough to find the hidden distractors was faulty reasoning, as was demonstrated the day after the tech-support visit. With no further support from the district pro-techs, the researcher realized that she needed to resort to other measures to keep students on-task.

Extrinsic Rewards

The next step in the researcherôs intervention was introducing a rewards policy to entice students to keep on task and finish their assignments. The researcher hoped the students would learn Algebra while striving to earn a reward. The researcher began by starting small, handing out one Jolly Rancher candy to each on-task student. This method worked for a few weeks but began to lose its appeal. To maintain gains, the researcher began setting goals for students in the form of requiring a minimum of 10 completed

problems per CTA class to earn daily class points and to receive a jolly rancher candy. After a few more weeks, the students began to meet this goal, so the required number of completed problems per class increased from 10 to 15 with a Jolly Rancher candy reward at the end. This method worked for a while, but students became restless after the increase in the number of required problems. They seemed discouraged when they were unable to meet this requirement due to the difficulty level of the problems. Although this method showed some results, it was clear to the researcher that new methods might better motivate students.

Negative to Positive

The researcher believed that eliminating negative thinking directed toward the CTA was paramount, because ñNegativity quickly spreads from one person to anotherò (Pratt, 2014, para 4). To eliminate negativity, positivity must be introduced. The researcher began by introducing each CTA class with an increased level of enthusiasm to create a positive educational environment. The researcher began by teasing the students to help make class fun. She teased the boys, telling them to get a Carnegie tattoo because girls would see it and think they are smart. When a school dance was near, the researcher teased the students, telling them that they should only be dating other Carnegie students since they are the best students at school. Also, she gave each student a nickname to help them feel part of the class. It turned out that the students used their nicknames in other classes as well.

After the increased level of enthusiasm was implemented in the classroom, the less motivated students seemed to increase their engagement level by completing more problems than before the more positive support. However, their new behavior only lasted for a short time; students again became discouraged with the difficulty level and the semantics of the answer inputs in the CTA. Students complained about the difficulty of entering answers into the CTA program. Consequently, despite small breakthroughs, traces of negativity remained.

As the school year approached its end, the negative behaviors continued but with less potency. Determined to increase student engagement, the researcher resorted to storytelling to break the monotony of CTA periods. Stories were not usually mathematics related, but revolved around something from the news or the researcherôs personal experiences. Although each story only lasted a few minutes, the students seemed refreshed when it ended and returned to their work. This intervention continued for the remainder of the year producing a slightly higher level of productivity and student engagement.

The Challenging Class

Throughout the motivational process, a major issue persisted. One of the researcherôs classes was ñchallenging,ò so the researcher reached out to a Carnegie representative for guidance regarding how to improve performance. The Carnegie representative decided that an evaluation and observation of the class were needed, because she felt the researcher was not motivating the students enough to produce a

successful result. Following the evaluation and observation, the Carnegie Representative stated that she would not be returning to that class and that she would quit teaching if she had to teach that class every day. The researcher was granted permission by the representative to take any necessary measure to improve performance in that class, which, according to the Carnegie Representative, was a lost cause. The Carnegie representative continued to help other Carnegie classes in the school, including the researcherôs classes, but she never returned to the ñchallengingò class. With the school year ending, the only viable option for student success was to assign summer school to the underperforming students in that class.

Studentsô Perceptions of the CTA

The third research procedure consisted of verbal assessments of the CTA program which the researcher used to obtain data. At the end of the school 2010-2011 school year, the researcher verbally asked each student the questions as he/she worked on the CTA and recorded their answers. Questions generating data were the following:

The verbal assessment questions for this study are:

1. Do you think this online tutorial program is helping you learn algebra?
2. Why or why not?
3. Do you like doing your mathematics on the computers?

The response data were recorded in the researcherôs journal. The researcher used her journal log of tabulated results, along with qualitative analysis of emerging themes to determine student perceptions regarding the effectiveness of the CTA program.

On question one, 37.6% of the students answered that CTA was helpful, but 52.5% of the students said it was not, and 9.9% said they did not know if the CTA helped them learn. On question two, studentsô answers revolved around these themes:

1. Carnegie being difficulty to understand (*n*=10)
2. The CTA not helping them learn (*n*=53)
3. Not needing this type of mathematic in the future (*n*=6)

Some who thought CTA helped them learn thought the program expedited their learning, and helped them understand their homework assignments. Responses to question three indicated that 42.6% liked doing mathematics on computers but 57.4% did not. The overall results demonstrated that the majority did not feel the CTA or the use of computers provided them with mathematical benefit.

Statistical Results

The fourth research procedure for this study was the quantitative analysis of Algebra EOC scores for the treatment group. The researcher hoped that the CTA would increases achievement in Algebra I classes. The CTA program was supposed to promote a sizeable achievement in Algebra I mathematics courses, as measured by the Algebra EOC test, the instrument here. The measures used were the Algebra EOC test scores of

the treatment group and the Algebra EOC test scores of the researcherôs school for the 2010-2011 academic year. The test measured mathematical skill levels as stipulated by the Washington state standards. Validity and reliability of the EOC test were assumed, given that it was created by the state of Washington and administered at all Washington state public high schools. Remedial student scores statewide for the previous years, including the 2009-2010 academic year, were used as a baseline for comparison.

Historically, 26.1% of tested Algebra 1 students meet state standards on the state exam. For the academic year 2010-2011, the researcherôs school met standard at a proportion of 31.4% for ninth graders, 39.6% for tenth graders, and 27.3% for eleventh graders (ñOSPI EOC Results by Grade,ò 2014). The treatment group met standard at a proportion of 16.7% for ninth graders, 39.7% for tenth graders, and 14.3% for eleventh graders. Upon analysis of a one-proportion z-test for the treatment group, Algebra EOC results for grades nine and ten show that no statistical significance was found. Results for this research study are found in Table 2. Note: A larger sample size would most likely have shown a significant difference for the ninth grade analysis. Eleventh grade was not tested because the researcherôs school reported to OSPI that only eleven students took the Algebra EOC test, while the treatment group tested fourteen students (ñOSPI EOC Results by Grade,ò 2014). Only 89 of the 107 students in the treatment group were tested due to school/district transfers, drop-outs, and no-shows.

H_0: There is no significant difference between the proportion of EOC test passes of the treatment group and that of the researcherôs school.

H_α: There is a significant difference between proportion of EOC test passes of the treatment group and that of the researcherôs school.

Table 2

School to Treatment Pass Rate Comparison of EOC Results for Academic Year 2010-2011

Grade	School Results % by Grade	Treatment Results % by Grade	*p*-value (Significance)
9	31.4 (*n* = 103)	16.7 (*n* = 2)	.271 (No significance)
10	39.6 (*n* = 109)	39.7 (*n* = 25)	.989 (No significance)
11	27.3 (*n* = 3)	14.3 (*n* = 2)	Not Tested

Note. The 2010-2011 School and Treatment EOC test pass results are sorted by grade. The *p*-values show that CTA treatment had no statistical significance on EOC scores.

In completing this study, the researcher compared her results to a similar study conducted by the U.S. Department of Education and found that her study produced similar results. The U.S. Department of Education conducted six similar studies across the years 2001, 2007, 2008, 2009, and 2010. Their findings showed the following results for the Carnegie treatment group: three studies with a negative, but not a statistically significant negative effect; one study with a statistically significant negative effect; one study with a positive, but not a statistically significant positive effect, and one study with a statistically significant positive effect (U.S. Department of Education, 2013, p. 19).

CONCLUSIONS AND RECOMMENDATIONS

In summary, the literature review highlights three ideas: the CTA has both reform and traditional components, cultural connections are important to student learning, and online tutorials are an alternate avenue to learning mathematics. The researcherôs findings show: the journal entry discussions and student perceptions of the CTA were negative; the teaching interventions produced little success; and the statistical results of the Algebra EOC test for the treatment group were of no significance.

In the years following this study, new problems developed. Cheating among CTA students developed and increased. That is, students at the researcherôs high school developed a large cheating ring where students paid other students to complete their Carnegie chapters on the CTA. Also, students who were not dedicated to the CTA program learned how to progress through the program without learning the curriculum by learning how to play it like a computer game. In addition, the continuous daily technical glitches that come with the CTA program surpassed the daily benefits of using it in the classroom. Consequently, with the yearly upgrades and the slowness of the CTA as well as district budget cuts, the researcherôs school has begun the phasing-out process of the CTA program, leaving fewer CTA classes each year.

In conclusion, it is in the researcherôs professional judgment that the CTA program will not produce statistically significant results in future studies without modifications to the program, such as a CTA App and more CTA in-class time. However, the CTA is most beneficial when students are completely engaged and

dedicated to their own success through the use of this program and follow it through to completion. Only then can this program be beneficial in helping students pass an Algebra I class and/or pass the Algebra EOC. However, neither the researcher nor the U.S. Department of Education found statistically positive results. Thus, if students are not dedicated to their own success through the use of any online program/tutorial, it would be difficult for any online program/tutorial to produce statistically positive results.

When contemplating the possible changes future researchers could make if this study were to be repeated, the following recommendations should be considered:

1. Remove all games from the computers before the first CTA session because they are distractors.
2. Limit computer internet access to help prevent internet distractors.
3. Require each student to take a written exit test after each completed chapter to ensure the legitimacy of the CTA results and to help prevent cheating.
4. Provide more in-class CTA time since there is no CTA App available and some students are unable to complete CTA lessons at home.
5. Take data on whether students persist with CTA based on their perception of it. This data could provide insight into student engagement with the CTA.

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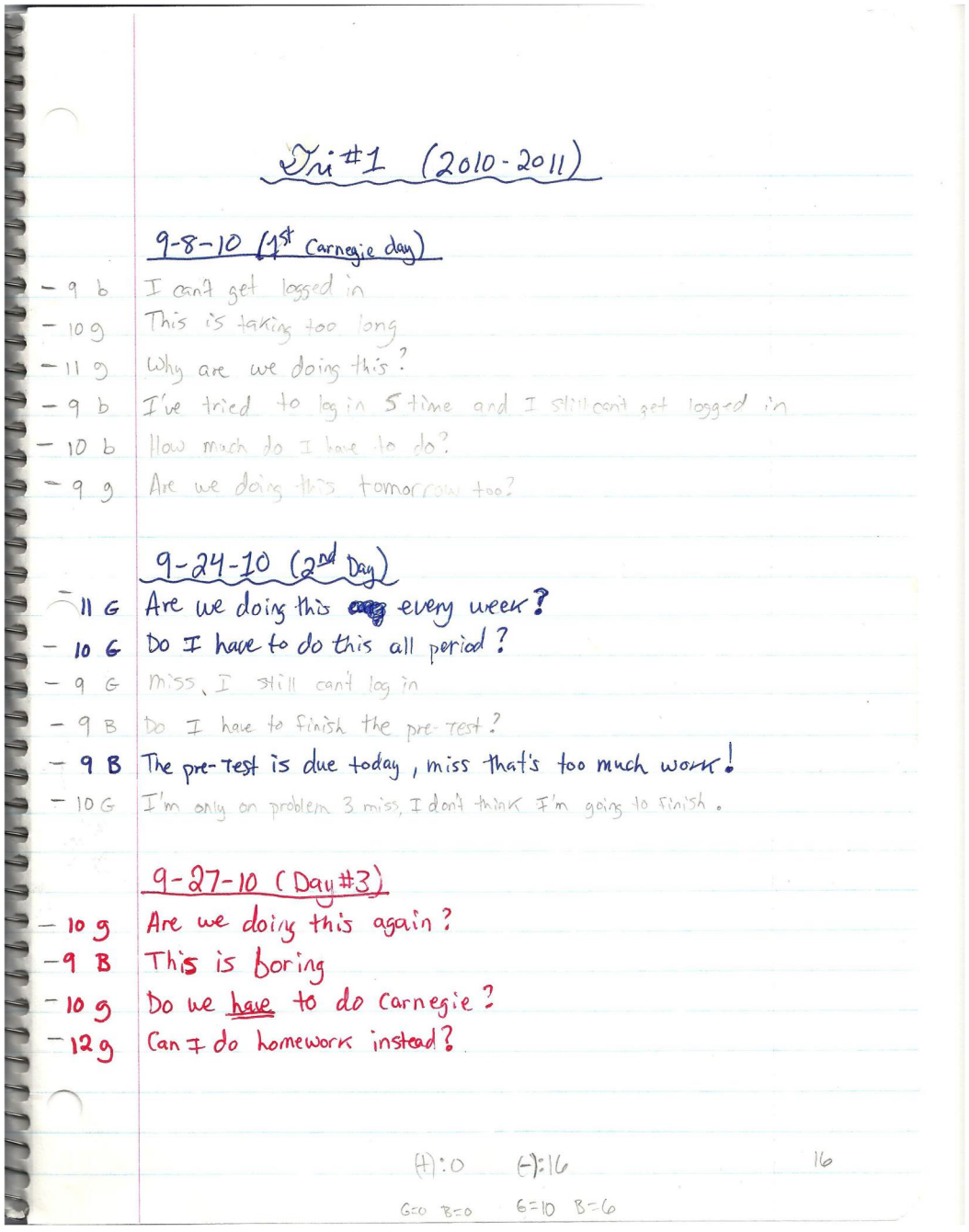
APPENDIX

Appendix A-Researcherôs Journal of Student Comments/Reflections



Tri #1 (2010-2011)

9-8-10 (1st Carnegie day)

- 9 b I can't get logged in
- 10 g This is taking too long
- 11 g Why are we doing this?
- 9 b I've tried to log in 5 time and I still can't get logged in
- 10 b How much do I have to do?
- 9 g Are we doing this tomorrow too?

9-24-10 (2nd Day)

- 11 G Are we doing this every week?
- 10 G Do I have to do this all period?
- 9 G Miss, I still can't log in
- 9 B Do I have to finish the pre-test?
- 9 B The pre-test is due today, miss that's too much work!
- 10 G I'm only on problem 3 miss, I don't think I'm going to finish.

9-27-10 (Day #3)

- 10 g Are we doing this again?
- 9 B This is boring
- 10 g Do we have to do Carnegie?
- 12 g Can I do homework instead?

(+):0 (-):16 16

G=0 B=0 G=10 B=6

10-20-10

-9 b • I don't wanna do Carnegie
-11 g • Why can't we just do book work
+9 g • Miss you should be proud of me, I did Carnegie last night!

10-29-10

- 10 B Carnegie again, we just did it yesterday
- 10 B This is wack
- 10 G I've been on this section [redacted] forever.
- 10 G Miss, I've been tying to log in all period & I still can't get in.

11-3-10

- 10 g I'm never gonna finish all this
- 9 b Do I have to pass the post-test?
- 11 g Why do we have to do Carngie if they don't even do it in college?

11-5-10

- 11 G My dad helped me for 2 hrs on this problem & I'm still stuck on it.
- 10 G Miss, I've used all the hints & I still don't get it
- 9 B Why can't we have a free day, why do we always have to do Carnegie?
- 9 G Yeah miss, let's take a break. This is too much work.
- 9 B If we take today off miss I promise to do like 5 more problems next time.

(+):1 (-):14 15

G=1 B=0 G=8 B=6

11-15-10

+ 12 B Can this just be our final miss, we don't need a test.

- 10 B I'm done. I'm not gonna pass anyway.

+ 12 G Hey, I should get extra credit. I just 90% on my post-test!

11-20-10

+ 9 G mom said I have to finish my Carnegie or I can't get a new phone

(+): 3 (-): 1 4

G=2 B=1 G=0 B=1

Tri #2 (2010-2011)

12-1-10

+ 10 b Can we just do Carnegie & no book work today?
- 11 b If I pay you, will you do my Carnegie for me?
- 10 b Miss, I'm gonna hack into Carnegie & skip myself to the post-Test
+ 12 b Is there an app for this?

12-8-10

+ 9 g I worked on Carnegie All night. I didn't go to bed until 10:30.
+ 9 b Doing Carnegie is better than a bunch of book work.
- 9 b You expect too much miss

12-10-10

- 10 G Can you just skip me to the next chapter, miss?
- 11 G Do I have to finish last tri's Carnegie?
+ 12 G Is there a Carnegie App?
- 11 B This is stupid. Nothing I put in works.

12-17-10 

- 9 g Why do we have to do Carnegie, it's almost Christmas break?
+ 10 b I just wanna get this done. I could if there was an app. It would be faster.
- 10 g I'm so not doing this on break
+ 11 g Can I work ahead during break?
- 10 b Carnegie is not like playing Halo
+ 11 b Do I have to Fish this today or can I work on it during break? 17

(+) G=3 B=5 (-) G=4 B=5 (+): 8 (-): 9

1-18-11

+ 10 g If I do an extra chapter can I get extra credit?
- 10 b Who cares about extra credit, doing an extra chapter is too much work
- 10 g I'll be lucky if I finish this chapter. I'll never use this in life.
- 10 b I'm never gonna finish

1-19-11

- 9 G Carnegie again miss
- 9 G Do we have to do Carnegie everyday this week, it's never gonna help me?
+ 11 B Can we do Carnegie tomorrow too so I can get caught up? I need to finish this.

1-26-11

- 9 b This is so boring & I can't even do it on my phone.
- 9 g Do other classes have to do as much Carnegie as we do?

2-4-11

+ 10 g If I finish all my Carnegie at home, do I still have to do it here?
+ 10 b Carnegie is still better than book work.
+ 9 b If I do just pure Carnegie & nothing else will I pass?

2-14-11

- 12 G Miss, It's Valentine's Day. Do we really have to do Carnegie today?

(+): 5 (-): 8 13

G=2 B=3 G=5 B=3

2-28-11

+ 12 B | If there was an app for this, I would so get this done.
− 9 G | This section is so hard miss.
− 11 G | The hints don't tell me anything. Nothing's working

3-4-11

+ 9 g | Are they doing Carnegie in Summer school
+ 9 B | Mom said I have to come in on Saturday if I don't finish this chapter.
− 9 g | Why do we have to do this miss, I'll never need this in life?
+ 10 B | If you would actually read the question you could do it. It's not that hard.

3-7-11

− 9 G | Are we doing Carnegie next year too?
+ 10 G | Miss that problem is not that hard, he's just lazy.

(+): 5 (−): 4 9

G=2 B=3 G=4 B=0

Tri #3 (2010-2011)

3-14-11 π-day

-11 B I know I did this right, but the computer won't take it.
-9 B My answers never work
-10 B Can I have Holt next year?

3-18-11

-9 b Can't you just skip me miss?
+10 g When I finish this section, I'll be done with all my Carnegie

4-4-11

+11 G I'm all caught up miss, I did my Carnegie during Spring Break.
-9 G I have a life. I don't have time for Carnegie
-9 B I hate Carnegie

4-15-11

-9 b I wanna hit whoever invented Carnegie

4-20-11

-9 B Miss you know no one is doing Carnegie today.

(+): 2 (-): 8 10

G=2 B=0 G=1 B=7

4-29-11

- 10 b This is a waste of time
- 9 g How is this gonna help us
- 9 g I do what the hint tells me, but it still doesn't work.

5-9-11

+ 10 B Can we just do Carnegie for the rest of the year?
+ 10 G If I pass the EOC do I have to finish Carnegie?

5-17-11

- 10 G My brain hurts. I don't want to do Carnegie

5-18-11

+ 11 G I wish I could do this on my phone
+ 11 G We need an app
+ 12 G I'd get this done if there was an app.

5-23-11

- 9 B If I don't get this done, do I have to do Summer School?
- 9 g Is there less Carnegie in Summer School?

(+): 5 (-): 6 11

6=4 B=1 6=4 B=2

5-25-11

-9 b How much Do I have to do to just get a D?

+12 b I still can't find the app. Are you sure there's no app?

5-27-11

-11 G I hate computers. Nothing is working. An app would be better

-10 G can't you just pass me miss?

6-1-11

+10 G Can we do Carnegie all period today, I need to finish.

+10 G Yeah Miss, if you want us to pass we should do this the rest of the year.

+10 B Finally Miss, I'm done!

-10 B Carnegie is not as fun as you think miss.

6-6-11

-11 g Really miss, Carnegie today.

(+): 4 (-): 5 9

G=2 B=2 G=3 B=2