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The role of app development and mobile computing in motivating the secondary mathematics classroom

Jennifer Lee Marquez
The University of Texas Rio Grande Valley

THE ROLE OF APP DEVELOPMENT AND MOBILE COMPUTING IN MOTIVATING THE SECONDARY MATHEMATICS CLASSROOM

BY

JENNIFER LEE MÁRQUEZ

A THESIS PRESENTED TO THE GRADUATE FACULTY OF THE COLLEGE OF SCIENCE, MATHEMATICS AND TECHNOLOGY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

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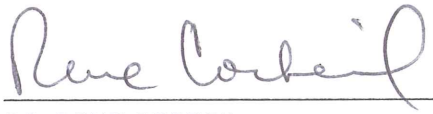
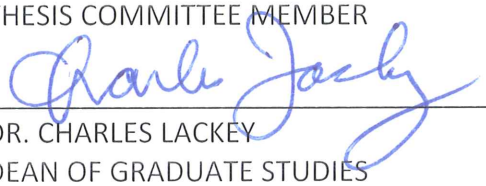
APPROVED BY:

DR. MAHMOUD QUWEIDER
THESIS DIRECTOR

DR. JUAN IGLESIAS
THESIS COMMITTEE MEMBER



DR. RENE CORBEIL
THESIS COMMITTEE MEMBER



DR. CHARLES LACKEY
DEAN OF GRADUATE STUDIES

GRADUATE SCHOOL

UNIVERSITY OF TEXAS AT BROWNSVILLE

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To my parents and best friends, Juan and Norma L. Medina, David and Juanita Márquez, Heather Medina and Gabriela Peña.

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ABSTRACT

AN INCREASING AMOUNT OF HIGH SCHOOL STUDENTS ARE INTERESTED IN DEVELOPING THEIR OWN MOBILE APPLICATION. INCORPORATING MOBILE DEVELOPMENT INTO THE CLASSROOM CAN INCREASE STUDENT ENGAGEMENT IN THE FIELDS OF SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS. IN THIS PAPER I PRESENT A STUDY DONE WITH A GROUP OF SOPHOMORE LEVEL STUDENTS WHO CREATED THEIR OWN MATHEMATICS APPS WITH NO PROGRAMMING EXPERIENCE. THE AIM OF THIS STUDY IS TO ASSESS THE KNOWLEDGE GAINED AND MOTIVATIONAL APPEAL OF SECONDARY MATHEMATICS STUDENTS TAUGHT BASIC STATE OF TEXAS EXAM CONCEPTS WITH THE USE OF THE PROPOSED MOBILE DEVELOPMENT LABS. STUDENTS IN THIS STUDY USED ALGEBRAIC AND GEOMETRIC MODELS TO DESCRIBE SITUATIONS, GEOMETRIC TRANSFORMATIONS, PROPORTIONS, AND USED PROBABILITY MODELS. STUDENTS PRACTICED THE CONCEPTS AND THEN CREATED A MOBILE APPLICATION RELATED TO EACH CONCEPT TAUGHT BY THEIR TEACHERS. USING MIT’S APPINVENTOR, STUDENTS EASILY DEVELOPED GAMES BY PUTTING PUZZLE PIECES TOGETHER. AN INCREASE IN CONFIDENCE WAS OBSERVED AND 43% OF THE STUDENTS INCREASED THEIR BENCHMARK SCORE. THE RESULTS OF THIS STUDY DEMONSTRATE THAT STUDENTS ARE MOTIVATED TO LEARN THEIR MATH CONCEPTS BY DEVELOPING MOBILE APPS.

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CHAPTER 1

INTRODUCTION

Science, Technology, Engineering and Math scores must be improved in order to have a future filled with an innovative, skilled, and knowledgeable workforce. Executive recruiters or human resources professionals will attest to say the talent and skills for a STEM job is just not there to be had. There is little to no supply to meet the growing demand to fill STEM jobs [11]. According to Jan Cuny, computing has become ubiquitous and IT innovation drives our economy. IT jobs consistently rank at the top of "best job" lists in the United States [8]. The United States is encountering two major shifts that will shape this country's future, an economic and a demographic shift. The fastest growing segment of jobs involves computing [11]. These jobs must be filled with talented and skilled individuals. One of the fastest growing populations in the United States is Latinos. Despite the fact that they are a growing portion of the US workforce, they are underrepresented in the growing STEM economy. [5]. Hispanics in the United States are found to hold 7% of undergraduate computer science and engineering degrees and only 1% hold doctoral degrees [12]. The fast growing Hispanic population looking to obtain good careers and stable professional jobs should be engaged and motivated at a young age to take part in the future STEM jobs being created [29]. Our education system is currently working on better preparing the future STEM professionals with rigorous STEM course to fulfill the demand [23]. This study targets Hispanic economically disadvantaged students struggling to meet adequate progress in their STEM courses.

In Texas high schools, mathematics departments prepare students for Algebra I, Geometry and Algebra II STARR exams or the State of Texas Assessments of Academic Readiness. Secondary students must successfully complete End of Course exams for core course taken in order to graduate from a public high school. Core subject teachers use, CSCOPE, a curriculum support system that is used throughout the state of Texas to teach students subject concepts. Math Models and Applications teachers use MMA CSCOPE to guide their daily lessons. District curriculum assessments are practice STAAR exams created by curriculum and instruction leaders who have analyzed the readiness and supporting standards needed to successfully complete an end of course STAAR exam. DCAs are administered during the mid-Fall semester, Early Spring semester and a final one in late spring semester. The results are analyzed to find any progress or need for improvement. Results can also highlight or target any significant change between the assessments. Students in this study were introduced to the App Inventor Program between the second and third DCA administration. Students agreed to be a part of the program or study and understood they would learn math lesson and use the mathematics to create an app. These students made the treatment group studied to find the effects the App Inventor Program would have on knowledge gained and motivational appeal while taught basic state of Texas exam concepts. This study presents app development and mobile computing to increase engagement, maintain interest, and improve class performance in STEM courses.

CHAPTER 2

BACKGROUND

For the last few years East Asian countries and some European countries have outperformed United States students in Math and Science on International Exams such as TIMSS [22]. The last few years have witnessed an increased interest in STEM education because the United States would like to stay competitive amongst developed countries. “Studies have repeatedly shown that early exposure to science, technology, engineering and math (STEM) subjects is important in convincing students to think about STEM careers.”[20]. Mrs. Louise Robinson, president of the Girls’ Schools Association, shared her vision of how schools could prepare children for life in the 2020s in a keynote speech. Her call came days after Education Secretary Michael Gove announced plans for a new hi-tech computer science curriculum with the same status as traditional subjects [30]. Mrs. Robinson expressed “computer games such as ‘immune attack’, where players attempt to stop the body from being taken over by a virus – could be used to assess factual knowledge as well as decision-making and logical thinking” [6]. Educators know it is important to have today’s youth interested in pursuing STEM careers and many have created programs to encourage students to study any of the STEM fields. The studies include students of all ages but the large majority focus on middle school to first year undergraduate students. The following studies reach out to schools to increase the number of STEM majors, work with Hispanic students to major in the STEM fields, and use technology applications to entice students into the STEM fields.

2.1 Motivational STEM Programs

The need to engage students to pursue STEM careers has sparked the creation of hands on technology based programs for elementary students, undergraduate students and many more for high school students. According to a study by Bolkan, students who use mobile devices for school work are more likely to express an interest in STEM subjects. A study by the Verizon Foundation found fifty five percent of students surveyed told interviewers that devices helped them learn math and science better [4]. Elementary and middle school students in Virginia got a chance to experience the STEM fields by participating in a three year program aimed to keep 10 to 13 year olds interested in the STEM fields. Educators and researchers in this study provided summer courses for low income middle school urban students. During this summer program, students learned and participated in Lego Robotics competitions, learned about game products, and created games on four Science themes. Overall the results found students significantly increased their knowledge and skills required to use technology [13]. The study also found students had a better attitude toward technology than their comparison peers. This project reached out to young middle school students who might not understand the importance of a career choice but are exploring their STEM career options. Students enrolled in college know the importance of a STEM career but need to be motivated into choosing a STEM field as their major. In a study funded by the National Science Foundation, researchers used scholarships to motivate students into computer science courses [2]. In order to help the declining number of computer science bachelor degrees, researchers presented students with videos of professionals

using their skills in socially relevant ways and showed them how computing skills make them more marketable in any field of study. Researchers concluded that if students are attracted into these fields early enough, some of them may discover they like the science of computing and problem solving, and continue on to more advanced courses [20]. Some of these college students were not given the chance at an earlier age to experience a computer science course but now we find one in ten high schools offer some kind of computer science course [7]. Reaching out to middle school and undergraduate students increases the number of STEM majors but the audience ready to make a career choice would be students at the high school level.

2.2 Encouraging Hispanic High School Students

High school level students have the opportunity to be part of STEM outreach programs and some programs focus on encouraging Hispanic students to study any of the STEM fields [28]. Hispanics in the United States are found to hold 7% of undergraduate computer science and engineering degrees and only 1% hold doctoral degrees [12]. These statistics have driven researchers to try programs aimed at encouraging the Hispanic population through field trips, science fairs and summer camps as well as programs that offer scholarships and the use of robotics to encourage student [17].

In San Jose California, The Latino College Preparatory Academy is a public high school that is succeeding to encourage Latino high school students into choosing computer science as a major [28]. The students attend a special charter school that targets low-income, Latino students to attend college and attain computer science

degrees. The study conducted measured student interest in 20 STEM, business and humanities subjects. Standardized test scores were correlated with factors affecting choice in computer science as major finding positive results for Hispanic students. This is an excellent school for minority students and the mentors or guardians who encouraged the students to attend this academy understand the importance of STEM careers [28]. This academy has targeted the fastest growing minority group to focus on the field predicted to need the most employees [29].

A study conducted by A. Gates and S. Hug, finds Hispanics have the highest growth rates among all groups in the United States and remain underrepresented in computing careers [12]. They go on to find a small number of Hispanic faculties and a lack of Hispanic role models and mentors have maintained a cycle of underrepresentation of Hispanics in the STEM fields. The study addresses the barriers by initiating a peer mentoring program that pairs undergraduate with graduate students to collaborate on a project and created pre computer science courses that involve computer graphics and animation to engage students. Undergraduate students in this study had engaging courses to keep the student interested in computer science.

2.3 Motivating Students by Programming

Computer Science projects have been used to encourage and retain students of all ages in the STEM fields, such as game design and programming, mobile game development and smartphone app development. In a study conducted in Virginia, students were offered to participate in a National Science Foundation sponsored summer program focused on game programming [21]. The goals included providing

opportunity to middle school student to learn about game product technologies, computer graphics and programming, game creation, and completing their games for educational communities as well as to share their learning experiences. This study concluded that interactive game design activities have and will continue to offer exciting opportunities for the students to stay engaged in innovative, inventive, and inquiry-based science and technology-based learning. This conclusion may be empirically conformed as students usually enjoy gaming. The creation of smartphones has facilitated game development in the mobile environment. Mobile game development has been used as a motivational tool to engage students early in the curriculum [2]. Similarly, recent research has reported that using mobile devices as part of the coursework may help students see a connection between Computer Science and real-world technology [24].

In another study, beginner computer science majors were taught how to develop mobile games as a motivational tool to engage computer science students in their computer science curriculum [2]. Researchers felt they could increase retention rates in computer science courses if student would see a connection between computer science and real world technology. Mobile games were chosen for the beginner classes because mobile games are built on a small scale. Researchers noted computer game development has been used to connect computer science with interdisciplinary studies such as the arts and humanities [21]. Mobile development can be used in many more courses including mathematics and science. Mobile games were found to increase

retention rates and mobile app development should provide the same results as well as instant gratification and a positive social impact for participants.

2.3.1 App Inventor

One of the least expensive ways to create mobile games is through MIT's App Inventor. Some studies have concluded to find this platform to be simple for non-computer science majors or beginner programmers [14]. Declining enrollment and interest in the computing fields has prompted instructors to come up with new, fresh, appealing ways to attract and retain students in the field of computer science. In a study conducted by Michigan researchers, MIT's Scratch, App Inventor and Lego Mindstorm were used to keep students interested in early level computer science courses [25]. The percent of students majoring in computer science reached a peak in the year 2000 then showed a decline before later reports showed a quick spike in the year 2010. The number of STEMs majors increased by an average of 1% according to the NSF [20]. Students should be motivated to learn STEMS concepts and this study found success in using App Inventor and other mobile development platforms.

MIT's App inventor was also used to tech K-12 teachers how to make their curriculum more engaging while creating a variety of mobile apps for Android mobile phones. Mobile games are the most popular apps downloaded daily. Developing apps is now a skill most employers want from a programmer [18]. Universities are teaching courses that exercise this skill. The question most instructors face is which platform they will use to teach their mobile development course. A study by Citrix found the leading

mobile platforms in North America to be Windows Mobile (7%), Android (35%) and iOS (58%) [9]. A study by Gronli compared the development environments for the most popular platforms and found Windows and Android provide a good development environments and have good emulators that facilitate development [15]. An article by Mark H. Goadrich analyzed Google's Android and Apple's IOS by looking at their hardware or operating system requirements, their software development kits, instructor resources and finally their "Hello, World!" apps. IOS was found to have a modest upfront cost for university standards. Secondary schools that do not have all the funding needed to develop in IOS had to choose Google's Android platform. This study concluded either platform would allow students to learn their concepts and have students oversubscribe to the courses [14].

CHAPTER 3

METHODOLOGY

3.1 Motivation

The United States is losing its competitive edge in math and science while the rest of the world rises ahead. “Our knowledge capital, which fuels innovation and economic growth, is at risk” [20]. It is imperative to have students find a passion for the STEMS fields and increase the number of STEMS graduates in the United States. College graduation rates among minorities will increase because of strategies put in place today and the STEMS fields need to be the preference among these students. A recent report by the National Bureau of Economic Research found that students who are interested in being computer science majors are not prepared for the rigorous math and science course work of colleges and universities [27]. Teachers must equip students with the knowledge to be academically prepared for the challenging classes in all STEMS fields. Science, Technology, Engineering, and Math education must be engaging for our future work force to be skilled, knowledgeable, and innovative. Math scores must increase for all students including minority groups such as the fast growing Hispanic students [29]. I strongly believe there is a need to motivate high school students into majoring in any STEMS field for a motivated appreciation for mathematics paves the way to engaged students. Ideally, development of these applications should be done through an uncomplicated development environment. Therefore, to fulfill this need, I propose that students can be encouraged to find mathematics enjoyable when they are tasked to develop mathematic mobile applications.

3.2 Hypothesis

The aim of this study is to engage economically disadvantaged Hispanic students to increase their motivation by participating in mathematic mobile apps. Studies have been developed to analyze the impact of mobile apps on computer science. However, no study has analyzed the effects on mathematics courses. It is imperative to know if students taught with motivational apps will perform better than students taught in a traditional manner. Students can be motivated to learn mathematics at the secondary level if they are taught their grade level math skills with hands on projects that include MIT's App Inventor program. Research suggests all students can achieve success in their math classes if teachers use a learning model that attract the attention of the students with the projects or applications they will complete at the end of the lesson [13].

3.3 Design

High school students are capable and ready to design and develop mobile applications that illustrate and help practice their math skills with no prior coding experience. In order to prove students are motivated by mobile computing, three Math teachers at Harlingen High School chose twelve sophomore special population, Hispanic students enrolled in geometry and a math models course to participate in mobile development labs. These teachers taught their students curriculum concepts then sent the selected students to a lab where they completed their assignments and participated in project based mobile development labs. The lab teacher taught reality based math lesson using the state mandated CSCOPE lessons. The students were responsible for completing the lesson assignment, quiz and lesson review with the help of their peers

and lab teacher. Finally, a custom GUI was created and a mobile application was developed. The procedure can be seen in Figure 3.3.1.

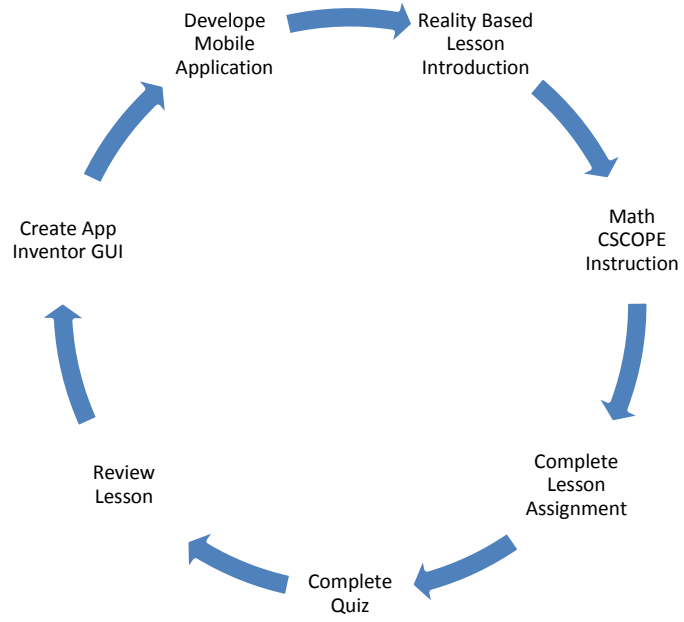

Figure 3.3.1: Mobile Math Apps Model

The factors in this study included sophomore level, economically disadvantaged sophomore level MMA students with a need to pass their STAAR exam. In order for the school to meet AYP, there must be a 57% passing rate amongst these students. Three sophomore level special population classes were split into two groups of participants, the mobile development group and the non-mobile development group. The mobile development group consists of twelve students who use hands on mobile app development labs to learn math. The non-mobile development control group took part in a traditional math class. After one semester of three lessons, fall semester DCA results were analyzed and compared to a DCA taken during the spring semester.

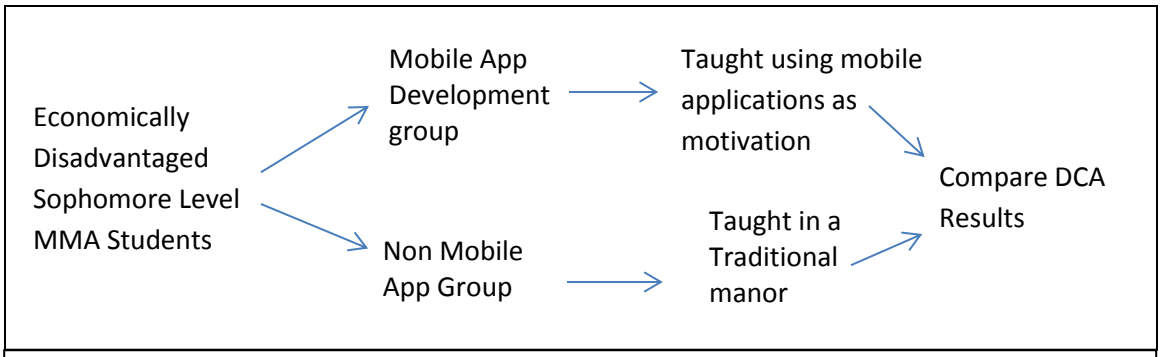

Figure 3.3.2: Procedure Design Diagram

3.3.1 School

The study was developed at Harlingen High School located in Harlingen, Texas which has two thousand five hundred and eighty enrolled students. 90% of those students are Hispanic, and 72% are classified as economically disadvantaged. Harlingen High is ranked Academically Acceptable by the Texas Education Agency's accountability rating system [16]. HHS has been diligently working towards Exemplary status but has not yet met the Adequate Yearly Progress (AYP) standards to accomplish their goal. Analysts have targeted Hispanic, economically disadvantaged sophomore level students as the group in most need of meeting state exam standards [26]. There are twenty five mathematics teachers and six of them are Math Models and Applications teachers. MMA teachers teach CSCOPE curriculum lessons and during this study, they taught lessons in Direct/Indirect Variation, Transformations, and Probability. Students positively respond to new school policies such as Bring Your Own Device and applaud the repeal of the no cell phone policy. HHS Students welcome any lessons that incorporate technology and gadgets.

Students at HHS are enrolled in eight courses that meet Monday through Friday with average classroom sizes of twenty five students. All math classrooms are equipped with tools and equipment such as document cameras and calculators to deliver mathematics lessons. Some classrooms are equipped with iPods, iPads or laptop carts. Participants in this study or cohort are taught lessons by their teacher in their regular Math Models classrooms Monday through Thursday and meet in a computer science lab on Fridays. The computer science classroom lab is equipped with all the tools found in a math classroom and additionally has thirty laptops, thirty iPods and ten iPads available for students. All participants in this study initially walk into the computer science classroom, sit at an assigned desk and review curriculum lessons for fifteen minutes with a certified math and computer science teacher. The mobile app participants then work on the lab for fifteen minutes by completing a module assignment at their desk. The module consists of ten to twelve questions about the lessons covered that week. Once all twelve participants help each other accurately complete their assignment, they take a laptop from the desk next to them and log into their personal Gmail account to complete their apps lab.

3.3.2 Participants

The participants in this study are first time sophomore level students taking Geometry and MMA concurrently. All twelve of the experimental group participants are of Hispanic decent and considered economically disadvantaged. These students scored below average on their first District Curriculum Assessment or practice STAAR exam. Initially, students were given a survey to ask them about their interests. None of the

students indicated mathematics was either interesting or their favorite subject. All students did agree they were interested in mobile phones and technology.

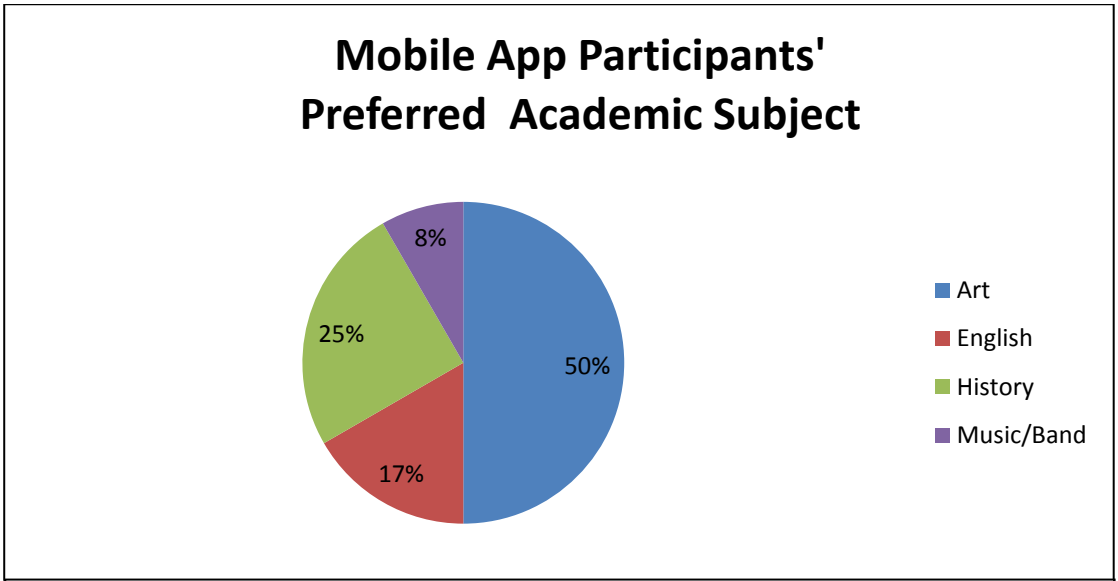

Figure 3.3.3: Participant Results

In order to participate in this study, MMA students attended the lab on the last day of the week and concluded a lesson recap of the week with the completing of a daily work assignment. The students were allowed to ask the lab teacher or their peers for help on the assignment until they obtained a perfect score or complete understanding of the concepts. Once all the lesson material was complete, the students took a short quiz and then were allowed to begin their app. In order to complete their mobile lab assignments, students were asked use an existing Gmail account or created an account for this study. Once the students logged in to their account, they started their mobile app development by logging in to MIT's App Inventor website. Participants were given a step by step guide to creating the graphical user interface of the mobile app directly correlated with the lesson covered that week by their MMA teacher. The

GUI is created by dragging and dropping labels, buttons, and other mobile device features onto a virtual screen or canvas. After completing their GUI, students completed the programming given the programming guide. Participants programed the mobile applications by using the App Inventor Blocks Editor. This editor allows student to drag and drop objects in the shape of a puzzles into logical, visual code methods. Once the development is complete students are able to download their newly created math application onto their android mobile device.

CHAPTER 4

RESULTS

A total of 46 sophomore level students participated in this study aimed at motivating special populations students improve their mathematics scores. The experimental and control groups of participants were selected by three Math Models and Applications teachers. The teachers were selected by the Harlingen High School Mathematics Department Chair. The selected teachers were asked to participate because they taught MMA sophomore level courses. The teachers provided student scores of the District Curriculum Assessments and course averages. Students were given initial and final surveys to assess student level of motivation and attitude toward mathematics and technology.

	Population		Ethnicity	Special Populations	
Gender	Number	Percent (%)	Hispanic/Latino	Economically Disadvantaged	At Risk
Female	1	8	1	1	1
Male	11	92	11	10	11

Table 4.0.1: Student Population

4.1 Initial Survey

With the support and technology provided by the Harlingen High School math department, the students were able to participate in Mobile Math Apps program during their Math Models and Applications class. An initial survey was given to the participants

when they started the program. They were asked to fill out the survey to their best ability. The average responses are shown below.

Initial Survey Items (1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree)			
Mathematics	Mean	App Inventor	Mean
I understood the math concepts covered at the CS lab.	1.8	I am familiar with App Inventor.	1.0
I am motivated to learn more about how mathematics is used in reality.	2.8	The apps I regularly use require math.	1.0
I enjoy projects that incorporate math and technology.	3.2	I will use the apps I created outside of school.	2.5
I am motivated to learn more about Computer Science.	3.4	I will create apps using App Inventor after the program.	2.5

Table 4.1.1: Initial Survey Results

4.2 Mobile Development Process

Through the mobile app development projects, students applied the math skills learned in the classroom to create math mobile apps that help visualize and practice their skills. Every Friday for three months, students walked in to a computer science lab and listened attentively during a five minute lecture review of the math lesson they were taught in their MMA classroom. Students then worked together to flawlessly complete a daily work assignment. After the assignments, students completed three math app modules. The first app students designed and developed was “Mole Mash”, in which students were able to see how the number of misses is inversely related to their score. Transformations, was the next module students covered and they designed and developed the game named “Pong” to practice these skills. During this project, students experienced the translation of the paddle they created and the rotation of the

pong ball in their game. The last module covered was probability and students created a "Magic 8 Ball" app where they calculated the probability of each statement they added to their game would appear on the screen.

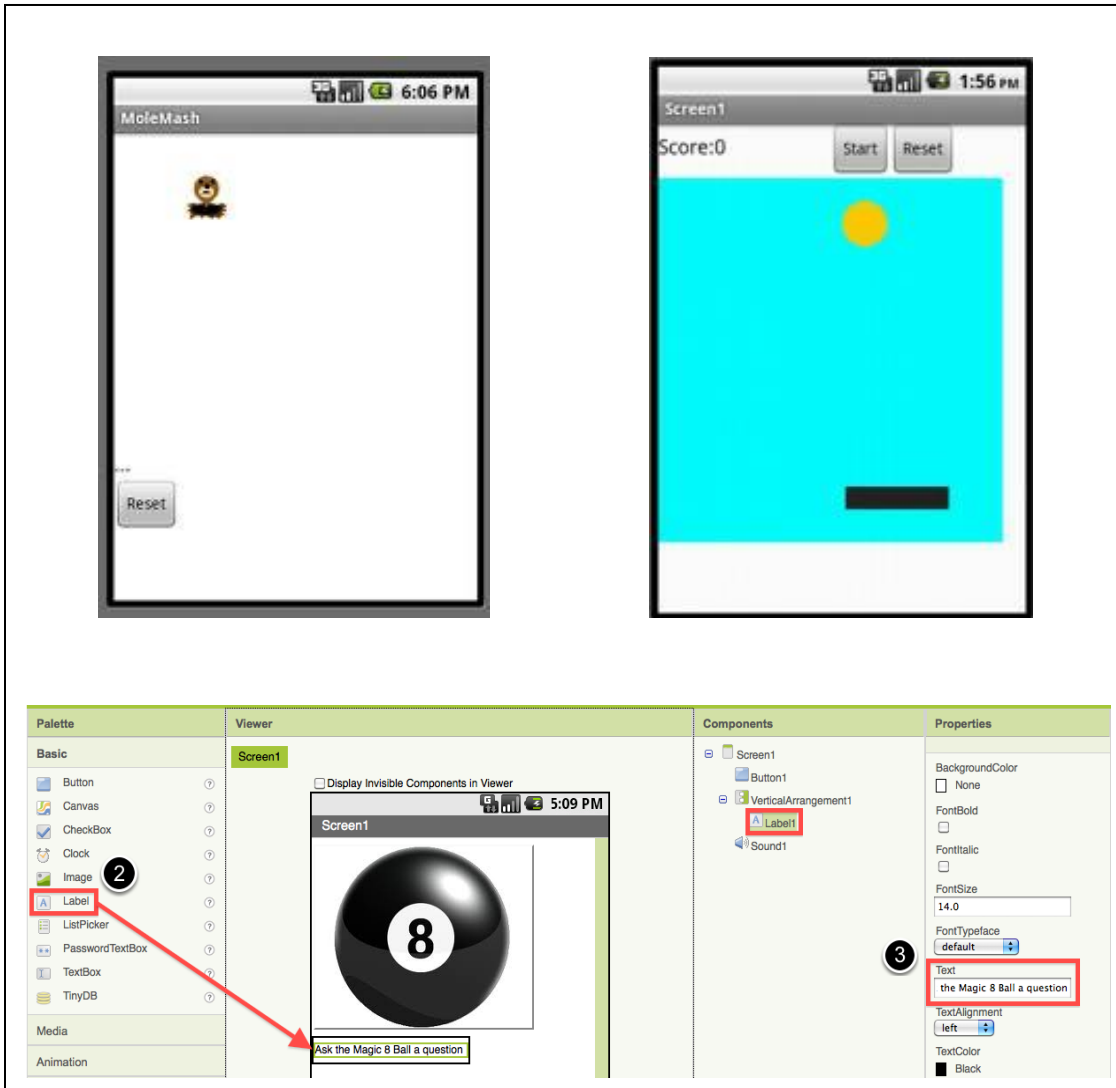

Figure 4.2.1: Mobile Applications Developed

4.3 Final Survey

The students who were able to complete all or nearly all of the program sessions were given a final survey. Four students were not able to complete the study due to

personal and disciplinary issues. One student moved to another school district, two students were suspended during the time of the study and another student refused to leave his classroom to complete the lab assignments. The results indicated the students were satisfied with the program. The following is a table of the responses given by the students in the final survey.

Final Survey Items (1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree)			
Mathematics	Mean	App Inventor	Mean
I understood the math concepts covered at the CS lab.	3	Working with App Inventor was simple.	3.5
I am motivated to learn more about how mathematics is used in reality.	4.9	The apps I created helped me visualize math we covered in class.	4.6
I enjoy projects that incorporate math and technology.	4.3	I will use the apps I created outside of school.	3.5
I am motivated to learn more about Computer Science.	3.4	I will create apps using App Inventor after the program.	3.5

Table 4.3.1: Final Survey Results

4.4 District Assessments

District curriculum assessments are practice STAAR exams put together by curriculum and instruction leaders who have analyzed the readiness and supporting standards needed to successfully complete an end of course STAAR exam. Students took a DCA in October, February and April. Each DCA is aligned with the core subject's readiness and supporting standards taught in the months prior to the DCA.

All students enrolled in a math course took DCAs and 63% of the students in this study scored higher than the passing standard on their October DCA. The participants

started the Mobile App program on January 25th and took a DCA the first week of February. The scores for the February DCA showed a decrease in scores when compared to the October DCA and 25**%** of the cohort earned a passing score. The next DCA was taken on April 8th and the results showed only 38**%** of all 44 students in the study met the passing standard.

4.4.2 Mobile Developer Participant DCA Scores

The mobile development app group took a DCA exam in the fall semester and the results showed 75% of the students passed with a score of 70 or better. The early spring exam showed lower passing scores for all students who took the DCA. The mobile development group saw a 33% passing rate for the February exam, a week after the study started. The April exam revealed a higher passing rate for all students and the mobile developer group had 42% of the developers pass with a score of 70 or better.

	October		February		April	
	Pass	Fail	Pass	Fail	Pass	Fail
Male	8	3	4	7	5	6
Female	1	0	0	1	0	1
	75%	25%	33%	67%	42%	58%

Table 4.4.1: District Curriculum Assessment Results

Some of the mobile developers were not able to pass the April DCA but were able to score higher on the April exam than on the February exam indicating some improvement on reviewed concepts. A comparison of the mobile developer's February

and April assessments were examined and the results are shown below. The mobile developers group had four out of twelve students score higher on the April exam than on the February exam. Two students showed no change in their score and three student's scores were inconclusive.

	Increased	Decreased	No Change	Inconclusive	Total
Male	3	3	2	3	11
Female	1	0	0	0	1
	4 (33%)	3(25%)	2(17%)	3(25%)	12

Table 4.4.2: A Comparison of February and April DCA Results

4.4.3 Course Averages

Students in this study were enrolled in a Geometry and MMA course. Every participant's report card grades were recorded and later compared to find any differences in their course grades during this study. The table below shows the grade changes between marking period two and marking period three. The table below shows the outcome for the control group participants in this study. The students' course grades increased for 32% of the students. 26% found their third term grade was lower than the second term. 18% of all students' grades stayed the same and 24% of the students either did not complete the third semester or were added to the course during the third semester and a comparison was inconclusive.

	Increased	Decreased	No Change	Inconclusive	Total
Male	3	3	4	6	16
Female	8	6	2	2	18
	11 (32%)	9(26%)	6(18%)	8(24%)	34

Table 4.4.3: Changes between Marking Periods 2 and 3 for non-mobile developers

The grades of the mobile developers were analyzed separately during this study. The table below shows the grade changes between marking period two and marking period three. The table below shows the outcome for the twelve participants in this study. The students' course grades increased for 33% of the students. 25% of the students found their third term grade was lower than the second term. 17% of all students' grades stayed the same and 25% of the students either did not complete the third semester because of discipline problems outside of the classroom or moved to another school. The students in this study completed daily work assignments in class as usual Monday through Thursday but would submit their last grade of the week at the computer science lab. Students turned in all assignments in a timely manner and the assignments turned in at the lab were immediately scored and rechecked for accuracy. The students had to submit flawless work and any corrections to problems they were not able solve on the first attempt. After all necessary attempts were complete; the assignment score was accepted and immediately submitted to their teacher through email as a daily work grade. Students took unit tests in their respective classrooms with their assigned teacher.

	Increased	Decreased	No Change	Inconclusive	Total
Male	3	3	2	3	11
Female	1	0	0	0	1
	4 (33%)	3(25%)	2(17%)	3(25%)	12

Table 4.4.4: Changes between Marking Periods 2 and 3 for Mobile Developer Group

CHAPTER 5

DISCUSSION

The Science, Technology, Engineering, and Mathematics fields require analytic and problem solving skills we are teaching in the classrooms today but many students do not feel compelled to master these skills and lack motivation. The group of students in this study lacked motivation for their mathematics course and in the end expressed they liked learning mathematics when they were shown how it works in reality. All participants agreed they enjoyed the App Inventor program and found it was easy to learn. The teachers and the department chair stated App Inventor was a great tool for hands on projects and a workshop for teachers should be scheduled in the future. The students benefited from the experience but many aspects of this study should be corrected before this study is replicated.

The main step to be revised when replicating the program would be the method of obtaining the sample. The sample size should be increased and should be completely random. The number of students in the treatment and control groups should be increased and not include too many of one particular gender or blocked. The random sample should continue to include the target population such as economically disadvantaged or at risk. Randomization would allow us to balance the effects of any uncontrollable or unknown variation.

Once the students are chosen, administrators should be fully supportive of the study and agree on making participation in this study mandatory if the student is

chosen. Full support from administrators will facilitate data retrieval of all participants. Some of the information being accessed would be attendance and phone records. Parents should be contacted and aware of the program their child will be a part of. Full support from parents is important and essential to better guarantee student attendance and ensure they will benefit from all lessons in the program.

The number of days the treatment group meets with at the lab should be increased to include at least 4 hours a week. These hours will allow students to complete the programming labs without being rushed or decrease the time for creativity. To achieve better results, the lab teacher's conference period must be used to teach lessons and the development of the apps. Teaching every day during the conference period will guarantee the students have understood the math concepts before they begin creating the app.

The lab teacher should create YouTube videos for every lesson, demonstrating the math concepts in the curriculum and another video explaining the process of creating the apps. A step by step approach to creating the app should be presented on this video as well as a complete explanation on how the app development relates to the math concepts. After all the lessons are covered the lab teacher should have access to the DCA results of all participants. This study was only able to obtain the results for the experimental group. A better analysis could have been made using all DCA reports. Once all the data results are analyzed, the lab teacher must ensure they receive final surveys from all participants.

The initial and final surveys could have had better questions such as, “How much do you enjoy science, technology, mathematics or engineering on a scale from 1 to 10.”, and “Do you know what computer science is?” These changes would eliminate any bias, and the random condition, a 10% condition as well as a success fail condition will be met. A more precise, larger, data driven sample will allow more significant results.

CHAPTER 6

CONCLUSION AND FUTURE WORK

The mobile app workshops introduced students to the development of mobile device applications while engaging them in learning math curriculum concepts tested on the STAAR. Forty-six Hispanic economically disadvantaged, math students were exposed to the STEM field of Computer Science and they enjoyed their participation. Indirectly, this project intended to reveal the STEMs fields as interesting, fun and useful in everyday life. The results showed the labs were motivationally appealing to the students.

Students not normally motivated to attend a math course were taught math concepts with the help of MIT's App inventor program, a drag and drop development environment [19]. This project helped participants increase their knowledge about mathematics in general and gave insight on the amount of mathematics in each application created. The students were surprised to find the mathematics is needed to create simple mobile games. Pre and post surveys and comments revealed Mobile Math App projects motivated special population students into learning about mathematics and technology. The students enjoyed attending the mobile computing labs and expressed they preferred more hands-on mobile app development labs in their math classroom. They enjoy using computers and the latest technology in their daily lives and felt at home learning one part of Computer Science. Some of the comments students wrote on their survey included, "I didn't know it took so many math lessons to make a game" and "Can I make an app if I haven't taken Computer Science A?" They had

never experienced creating mobile applications and were excited to know they could show their new skills and apps to friends. The most interested students asked if the program could continue until the end of the school year. This program sparked a creativity and thirst for app making and students continued visiting the lab every Friday after the end of the program with their teacher's permission.

The enthusiasm the students show for developing apps has prompted App Inventor mobile workshops for math teacher to be scheduled for next semester. The teachers will participate in trainings on how to incorporate app development into their hands-on projects for their subject area. A study by Liu, Lin, and Phillip finds there is an increasing amount of students who want to create their own apps. In their study, teachers are trained how to use App Inventor through a one week workshop. Teachers should be trained because mobile technology greatly captures student attention, allows for better engagement and improves student achievement [18]. Teachers should be aware of the latest technology and how to incorporate it into their lessons and projects to ensure student participation and motivation.

The development of mobile applications and mobile technology are shifting towards wearable technology. A recent report from CNN asked Stuff Magazine's Editor Will Findlater to analyze the top trends from the world's largest technology show, Mobile World Congress. Findlater reported the top trends in mobile technology to be, getting the whole world connected, wellness and wearables, large screens, and the new gadgets for future gaming [10].

Teachers should be aware of new technology trends and if possible know how to use the latest gadgets as they appear on the market. Knowledge about the trends will minimize the digital divide students are used to experiencing between them and their teachers. Workshops and trainings should keep teachers up to date with the latest in current and future technology. If financially possible, the teachers can use the technology in their classroom. Once teachers are familiar with the new technology, they can incorporate them in their lectures, to engage students into their lessons. Any subject teacher can make a connection between reality and the latest technology. Teachers can then use their new found knowledge and gadgets to impress and motivate students to participate in daily lessons. Students are easily intrigued when presented with the latest gadgets. Students dream of the day they can purchase the latest technology, and teachers can give them early exposure to these ideas and give them insight on how their daily life can benefit from them. Hands-on projects with the latest gadgets are enjoyed by students because they can test out their theories and get instant feedback. There are many form factors developers are working with today that teachers should be aware of and they are mobile phones, tablets, watches, and Google glass.

Google Glass is a wearable computer with an optical head mounted at top of your right eye. Glass was developed to provide seamless technology that can share the world through the user's eyes. This device can take pictures and record video, as well as give directions and send text messages just the way a mobile phone does except, in a simpler manner. Two other features include access to Google Hangouts and Google's search engine all through the command of the user's voice. The developers chose the

design of glasses to free up your hands, ears and eyes as much as possible. Users will no longer have to hunch down to view or interact with their device. Looking up and straight forward, users will get answers and pictures instantly without having to touch or type anything.

Teachers can use devices such as Google glass to create hands-on projects for their any subject. Some examples of projects include ones that need research, GPS navigation, pictures, or video. Once teachers engage their students with these mobile technologies they can share their ideas with other teachers. Teachers should then develop workshops for their coworkers and create a network of hi-tech efficient teachers in their community.

REFERENCES

[1] Allison, N., August, S., M. Hammers, Working Together: Words and Math, ACM Consortium of Computing Science and Colleges, v.26 n.4, p.197-203, April 2011.

[2] Adams, J. and R. J. Pruim. Computing for STEM majors: enhancing non CS majors' computing skills. In Proc. SIGCSE 2012, pages 457--462, Raleigh, NC, March 2012.

[3] Android App Inventor from MIT Center for Mobile Learning, http://appinventor.mit.edu.

[4] Bolkan, Joshua. "Middle School Students Using Smartphones More Interested in STEM." The Journal, 29 Nov. 2012. Web. 11 Apr. 2014.

[5] Bureu of Labor Statistics, 2012 Employed Persons by detailed occupation, sex race and Hispanic or Latino Ethnicity, http://www.bls.gov/cps/cpsaat11.pd

[6] Clark, Laura., “Star Trek schools’ of the Future Will Allow Children to Learn from Home via Skype and Computer Games, Schools Chief Predicts.” *Mail Online*. Associated Newspaper, 19 Nov. 2012. Web. 11 Apr. 2014

[7] CodeOrg (2013, February 26). What most schools don’t teach. Retrieved March 12, 2014, from http://www.youtube.com/watch?v=nKIu9yen5nc.

[8] Cuny, J. (2010) CHANGING WHAT'S HAPPENING IN HS AND INTRODUCTORY COLLEGE CS: [Accessed: March 23, 2013].

[9] Dilger, D., “Citrix details Apple's iOS, iWork lead in enterprise adoption”, Apple Insider,http://appleinsider.com/articles/13/03/28/citrix-details-apples-ios-iwork-lead-in-enterprise-adoption.

[10] Findlater, Will. “Key Trends from the World’s Biggest Mobile Technology Show.” CNN. Cable News Network, 13 Mar. 2014. Web. 11 Apr. 2014.

[11] Fraser, Edie. “The Root of Real Jobs: Filling the STEM Talent Gap.” The Huffington Post. TheHuffingtonPost.com, 28 Nov. 2012. Web 11 Apr. 2014.

[12] Gates, A., Hug, S., Thiry, H., Adjouadi, M., Beheshti, M., Alo, R., and J. Fernandez (2011). “The Computing Alliance of Hispanic-Serving Institutions: Supporting Hispanics at Critical Transition Points,” ACM Transactions of Computing Education, 11(6). doi: 10.1145/2037276.2037280.

[13] Giti Javidi , Ehsan Sheybani, Making youth excited about stem education, Journal of Computing Sciences in Colleges, v.26 n.1, p.140-147, October 2010

[14] Goadrich, Mark H., and Michael P. Rogers. “Smart smartphone development: ios versus android.” Proceedings of the 42nd ACM technical symposium on Computer science education. ACM, 2011.

[15] Gronli, T., Hansen, J., Ghinea, Gheorghita , Android vs Windows vs Java ME: a comparative study of mobile development environments, ACM,2010.

[16] High School, har.com/school/campus-Harlingen-High-School-031903001.html, last accessed 2014.

[17] K. Roy. “App Inventor for Android – Report from a Summer Camp,” in Proceeding of the 42nd SIGCSE Technical Symposium on Computer Science Education, February 2012.

[18] Liu, J., Lin, C., Potter, P., Hasson, E., Barnett, Z., and Singleton, M. 2013. Going mobile with app inventor for android: a one-week computing workshop for K-12

teachers. In Proceedings of the 44th ACM technical symposium on Computer Science education (SIGCSE '13). ACM, New York, NY, USA, 433-438.

[19] Massachusetts Institute of Technology, http://appinventor.mit.edu/, 2012.

[20] National Math and Science Initiative (2014). *Increasing the Achievement and Presence of Under-Represented Minorities in STEM Fields*. Retrieved from nms.org/Education/TheSTEMCrisis.aspx

[21] Parilla, L., "CORONA: Teachers hope video games teach math skills", The Press Enterprise,http://www.pe.com/local-news/riverside-county/corona/corona-headlines-index/20121129-corona-teachers-hope-video-games-teach-math-skills.ece, November 29, 2012.

[22] Provasnik, S., Kastberg, D., Ferraro, D., Lemanski, N., Roey, S., Jenkins, F., & ... Westat, I. c. (2012). Highlights from TIMSS 2011: Mathematics and Science Achievement of U.S. Fourth- and Eighth-Grade Students in an International Context. NCES 2013-009.National Center for Education Statistics.

[23] Report to the President – Prepare and Inspire: K-12 Education in Science, Technology, Engineering and Math (STEM) for America's Future, Presidents Council of Advisors on Science and Technology. September, 2010.

[24] Stan Kurkovsky, Engaging students through mobile game development, Proceedings of the 40th ACM technical symposium on Computer science education, March 04-07, 2009, Chattanooga, TN, USA [doi>10.1145/1508865.1508881]

[25] Suleyman Uludag , Murat Karakus , Stephen W. Turner, Implementing IT0/CS0 with scratch, app inventor forandroid, and lego mindstorms, Proceedings of the 2011 conference on Information technology education, October 20-22, 2011, West Point, New York, USA [doi>10.1145/2047594.2047645]

[26] Texas Education Agency. (2011, December). 2011 Adequate Yearly Progress (AYP).Retrieved from http://ritter.tea.state.tx.us/ayp/2011/distcampfinal11.pdf

[27] The Condition of College and Career Readiness 2012. Retrieved from http://www.act.org/research/policymakers/cccr12/index.html.

[28] Thomas G. Zimmerman , David Johnson , Cynthia Wambsgans , Antonio Fuentes, Why Latino High School Students Select Computer Science as a Major: Analysis of a Success Story, ACM Transactions on Computing Education (TOCE), v.11 n.2, p.1-17, July 2011 [doi>10.1145/1993069.1993074]

[29] U.S. Census Bureau, Population Division, Table 4. Projections of the Population by Sex, Race, and Hispanic Origin for the United States: 2010 to 2050

[30] Watters, A., “Should computer science be required in k-12 classrooms?” The Mind Shift, http://blogs.kqed.org/mindshift/2011/12/should-computer-science-be-required-in-k-12/ December 15, 2011.

[31] Wolber, D. 2011. App inventor and real-world motivation. In Proceedings of the 42nd ACM technical symposium on Computer science education (SIGCSE '11). ACM, New York,NY,USA,601--606.DOI=10.1145/1953163.1953329 http://doi.acm.org/10.1145/1953163.1953329