MyMathLab Educational Intervention to Enhance Student Performance in Calculus I at Historically Black Colleges and Universities

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MYMATHLAB EDUCATIONAL INTERVENTION TO ENHANCE STUDENT PERFORMANCE IN CALCULUS I AT HISTORICALLY BLACK COLLEGES AND UNIVERSITIES

A Dissertation

Submitted to the Graduate Faculty of Louisiana State University and Agricultural and Mechanical College in partial fulfillment of the requirements for the degree of Doctor of Philosophy

in

The School of Education

by

Sheila D. DeRouen
B.S. Southern University and A&M College, 2002
M.S., Southern University and A&M College, 2006
August 2018
This dissertation is dedicated to the foster child that never thought she could. To the elementary school child that was told that she could not read! To the teenage mother that was publicly ridiculed for her choices and began to question her worth. For the single mothers and children raised by single mothers. To my amazing parents and family that saw in me what I did not see in myself. You all taught me that I am not just ordinary, but extraordinary. This body of work is for you.
Acknowledgments

To God be the glory! I am so grateful to God for the plan He had for my life! It is because of Him that I have been able to succeed and persevere through this journey. I thank Him for placing people in my life to motivate and nourish me when I needed it most. I give Him all the honor and the praise!

My greatest gratitude goes to my amazing parents, Raymond and Julia Duplechain. The two of you adopted me as a baby and loved and encouraged me to do things that I thought were impossible. You all have worked tirelessly, without complaint, to meet my physical, emotional, psychological and educational needs! You all literary did whatever it took to ensure that I had a solid foundation. This work would not be possible without nourishment and all the love you all continue to give me. I am because of you!

My extraordinary husband, Bradley, thank you for supporting me through the late nights, always praying with and for me, remaining positive, and never allowing me to give up! In my darkest hours, you have been my rock. I will never forget the dinners you cooked, and the hot cups of tea that you made during the midnight hours to keep me awake. God has a great plan for us.

To my children, Jordain and Bradley, Jr. I want to thank you all for your love, patience, support and understanding! The two of you motivate me each day to push harder than I did the day before.

Jordain, where do I begin! I had you at the tender age of seventeen, and you were six months old when I finished high school, six years old when I finished college, and nine when I finished my master’s degree! Although I have been in school most of your life, I want you to know that everything I have done was to make a better life for you and I. My desire to raise
you in a better world than the world I grow up in, fueled me to learn more. Today you will watch me cross a graduation stage for the fourth time in your life!!! Oh, what an amazing feeling that will be for me. Hopefully you know that my love for you has helped me endure and keep my eyes on the prize. I hope this journey has been as rewarding for you as it has been for me. Every late night, running from class, dance practice to cheerleading, has been worth it. Remember, trust Him and He will direct thine path. Proverbs 3 5-6.

To my wonderful godmother, Sheila V. Sims, my kindred spirit! I am not sure if you will ever know how grateful I am that God chose me to be your namesake. You have loved and encouraged me from the day we met. You have spent many sleepless nights worrying and praying for me on my journey in life. I could never say thank you enough for loving me to the finish line!

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To my committee, Dr. Mitchell, Dr. Kennedy, Dr. Lawson and Dr. Wilks, thank for your expertise and support. I always knew you all were a telephone call or email always. I cannot say thank you all enough for giving me this opportunity. I am a stronger woman because of this journey.

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Abstract

According to the Obama Administration, we need a workforce that is going to be STEM ready because this is the only way that the U.S. will be able to compete on a global level with other nations. Louisiana will demand a total of 66,250 STEM jobs by 2018, up from 61,610 in 2008, according to Georgetown University (Carnevale, Smith, & Melton, 2014). By 2020, sixty-five percent of the nation’s jobs will require post-secondary education. According to the National Center for Education Statistics, the attrition rate between first- and second-year college students is 24.5% (2017).

The purpose of this study is to explore the effectiveness of computer assisted instruction, MyMathLab, in teaching Calculus I to increase academic achievement for students majoring in a STEM discipline at HBCUs. Research in this study was conducted by a quantitative study quasi-experiment design with one independent variable and one dependent variable. This study investigated the differences in the final course grade of Calculus I students that used the computer assisted instructional tool, MyMathLab and students who did not use the MyMathLab or any assisted instructional tool. For the purposes of this study, passage rate was defined by student’s letter grade. The historical data collected span over a seven-semester period, with a total of six hundred twenty-six participants, at an HBCU in the southeastern region of the United States. The results of the Wilcoxon two-sample test equals 103,064, which is the sum of the Wilcoxon scores for the students who used the MyMathLab. The sum is greater than 90,288, which is the expected value under the null hypothesis of no difference between the two groups of students. The one-sided p-value is less than alpha 0.0001, which shows the students who used MyMathLab are significantly more than those students who did not use the MyMathLab software.
"To raise new questions, new possibilities, to regard old problems from a new angle, requires creative imagination and marks real advance in science."
-Albert Einstein

**Chapter 1: Introduction**

In the 21st century, historically black colleges and universities (HBCUs) have been forced to question how they are going to adapt to the increasingly science and technology-oriented society in which we live. HBCUs, like many other institutions of higher learning, are faced with the challenge of finding strategies by which they can utilize current resources and faculty to maximize their science and technology development. To add this growing concern, the Bureau of Labor (2011) has reported that there will be more jobs within the next ten years in Science, Technology, Engineering and Math (STEM). Using a quantitative research design, this study conducts an analytical approach to incorporating computer assisted technology to assist the considerable number of students who have difficulty passing college level calculus I (a gateway course for all STEM majors) at an HBCU in the southeastern region of the United States. The results of this study will assist HBCUs in understanding the importance of technology. The results will also help policy makers understand the importance of creating policy along with funding allocation for technology in postsecondary institutions of higher learning. Last, but certainly not least, this research will assist the workforce with potentially having higher graduation rates from minorities in STEM disciplines from HBCUs.

Louisiana will demand a total of 66,250 Science Technology Engineering and Math jobs by 2018, up from 61,610 in 2008, according to Georgetown University (Carnevale, Smith, & Melton, 2014). Eighty-three percent of these jobs will require postsecondary education and training by 2018. (See Figure 1.1) By 2020, sixty-five percent of the nation’s jobs will require post-secondary education. According to the National Center for Education Statistics, the attrition
rate between first- and second-year college students is 24.5% (2017). Unfortunately, one of the most prominent barriers to post-secondary education in Louisiana is cost, but more importantly is training. Many people lack the qualifications to be eligible to apply for many of the vacant STEM jobs. That said, it is critical that students majoring in science, technology, engineering or math are successful in their pursuit of a college degree because the demand for postsecondary graduates is growing across the country, and specifically in Louisiana.

![Table of Educational Distribution of STEM Jobs in Louisiana (2018)](image)

**Figure 1.1. Educational Distribution of STEM Jobs in Louisiana (2018)**

Source: Georgetown University Center on Education and the Workforce, STEM Background

In 2015, there were 9.0 million STEM workers in the United States. About 6.1 percent of all workers are in STEM occupations, up from 5.5 percent just five years earlier. Employment in STEM occupations grew much faster than employment in non-STEM occupations over the last decade (24.4 percent versus 4.0 percent, respectively), and STEM occupations are projected to grow by 8.9 percent from 2014 to 2024, compared to 6.4 percent growth for non-STEM occupations. STEM workers command higher wages, earning 29 percent more than their non-STEM counterparts in 2015.
The chart above shows the projected percentage increases in STEM jobs across the United States by 2020. One may notice that there will be a huge demand in all the positions listed in the chart. The United States has evolved into a global leader, in part, this shift can be attributed to the work of engineers, scientist, mathematician, and computer scientist. American will need more analytical and innovated thinkers to fill jobs in STEM. So American students need to be taught at very early ages how to challenge themselves and think outside the box. This thought process can be carried on throughout the individuals’ life, and potentially lead to careers in STEM.

Despite the demonstrated national need for workers, there is a shortage of individuals trained in these areas, especially women and ethnic minorities (BHEF & The Business-Higher Education...
Forum, 2006). Historically Black Colleges and Universities (HBCUs) have contributed meaningfully to addressing the void of qualified STEM educators and researchers (Allen & Jewell, 2002). It has been noted that a majority of students in the United States do not reach adequate levels of proficiency in STEM courses (Kuenzi, 2008). Yet, with qualified faculty, and proper resources, the number of students that successfully pass STEM courses can increase significantly. This research study intends to find out if incorporating computer assisted instruction, MyMathLab, as an intervention to assist college professors in teaching college students the necessary material to meet Calculus I course requirements at HBCUs will improve student performance. In this study, student performance is defined as final course grade.

The Bureau of Labor Statistics (BLS) produces employment projections that allow us to provide predictions about how different occupations will grow over time. Our previous report stated that STEM jobs were expected to grow 17.0 percent from 2008 to 2018, compared to just 9.8 percent for non-STEM jobs. While there are three years remaining in that projection window, STEM jobs have increased by 14.0 percent since 2008, while non-STEM jobs have grown only 1.7 percent.

What is STEM?

There is no universally agreed-upon definition of STEM. Experts generally do agree, however, that STEM workers use their knowledge of science, technology, engineering, or math to try to understand how the world works and to solve problems (Vilorio, 2014). Their work often involves the use of computers and other tools. STEM occupations are identified in a variety of ways.

STEM fields are closely related and build on each other. For example, math provides the foundation for physics and physics, in turn, for engineering. Engineers can apply their
knowledge of physics to make high-tech devices that are useful for testing theories in physics.

Advances in physics may then lead to advances in engineering and technology, particularly, why I refer to Calculus I as the gateway course to all STEM degrees.

Table 2. Selected STEM occupations with many job openings, projected 2012-22 many of these STEM occupations are related to technology (U.S. Department of Labor, 2014). For example, it is projected that computer user support specialist¹ will demand 658,500 jobs by 2022.

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Job openings, projected 2012-22</th>
<th>Employment 2012</th>
<th>Projected 2022</th>
<th>Median annual wage, May 2013</th>
<th>Typical entry-level education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software developers, applications</td>
<td>218,500</td>
<td>613,000</td>
<td>752,900</td>
<td>$92,660</td>
<td>Bachelor's degree</td>
</tr>
<tr>
<td>Computer systems analysts</td>
<td>299,600</td>
<td>520,600</td>
<td>648,400</td>
<td>$81,190</td>
<td>Bachelor's degree</td>
</tr>
<tr>
<td>Computer user support specialists¹</td>
<td>196,900</td>
<td>547,700</td>
<td>658,500</td>
<td>$46,620</td>
<td>Some college, no degree</td>
</tr>
<tr>
<td>Software developers, systems software</td>
<td>134,700</td>
<td>405,000</td>
<td>487,800</td>
<td>$101,410</td>
<td>Bachelor's degree</td>
</tr>
<tr>
<td>Civil engineers</td>
<td>120,100</td>
<td>272,900</td>
<td>326,600</td>
<td>$80,770</td>
<td>Bachelor's degree</td>
</tr>
<tr>
<td>Computer programmers</td>
<td>118,100</td>
<td>343,700</td>
<td>372,100</td>
<td>$76,140</td>
<td>Bachelor's degree</td>
</tr>
<tr>
<td>Sales representatives, wholesale and manufacturing, technical and scientific products²</td>
<td>111,800</td>
<td>382,300</td>
<td>419,500</td>
<td>$74,520</td>
<td>Bachelor's degree</td>
</tr>
<tr>
<td>Network and computer systems administrators³</td>
<td>100,500</td>
<td>366,400</td>
<td>409,400</td>
<td>$74,000</td>
<td>Bachelor's degree</td>
</tr>
<tr>
<td>Mechanical engineers</td>
<td>99,700</td>
<td>258,100</td>
<td>269,700</td>
<td>$82,100</td>
<td>Bachelor's degree</td>
</tr>
<tr>
<td>Computer and information systems managers³</td>
<td>97,100</td>
<td>332,700</td>
<td>383,600</td>
<td>$123,950</td>
<td>Bachelor's degree</td>
</tr>
<tr>
<td>Industrial engineers</td>
<td>75,400</td>
<td>223,300</td>
<td>233,400</td>
<td>$80,300</td>
<td>Bachelor's degree</td>
</tr>
<tr>
<td>Architectural and engineering managers³</td>
<td>60,600</td>
<td>193,800</td>
<td>206,900</td>
<td>$128,170</td>
<td>Bachelor's degree</td>
</tr>
<tr>
<td>Web developers</td>
<td>50,700</td>
<td>141,400</td>
<td>169,900</td>
<td>$61,160</td>
<td>Associate's degree</td>
</tr>
<tr>
<td>Electrical engineers</td>
<td>44,100</td>
<td>166,100</td>
<td>174,000</td>
<td>$89,180</td>
<td>Bachelor's degree</td>
</tr>
<tr>
<td>Computer network architects</td>
<td>43,500</td>
<td>143,400</td>
<td>164,300</td>
<td>$95,380</td>
<td>Bachelor's degree</td>
</tr>
</tbody>
</table>

¹ Unless otherwise specified, occupations typically require neither work experience in a related occupation nor on-the-job training to obtain competency.
² In addition to the education specified, this occupation typically requires moderate-term on-the-job training for workers to obtain competency.
³ In addition to the education specified, this occupation typically requires 5 years or more of work experience in a related occupation.


Figure 1.3. Selected STEM occupations with many job openings, projected 2012-22

¹ In addition to the education specified, this occupation typically requires moderate-term on-the-job training for workers to obtain competency.
Vilorio also said, STEM occupations are projected to grow faster than the average for all occupations. And wages in these occupations were generally higher than the median for all occupations in May 2013 (Vilorio, 2014).

STEM includes professionals as well as workers in support jobs, we find that several STEM workers have less than a four-year college degree; 20 percent have completed an associate degree or at least some college, and 7 percent have a high school diploma or less. While opportunities exist for STEM workers with lower education levels, the proportion of these workers has declined somewhat since 2010, when those with some college but less than a bachelor’s degree made up 23 percent of the STEM workforce and those with a high school diploma or less made up 9 percent (U.S. Department of Commerce, 2017).

According to the U. S. Department of Commerce, STEM occupations are growing at 17%, while other occupations are growing at 9.8%. STEM degree holders have a higher income even in non-STEM careers (2017). Science, technology, engineering and mathematics workers play a key role in the sustained growth and stability of the United States economy and are a critical component to helping the United States win the future. The United State Department of Labor said that by 2022, the computer and mathematical occupations group is expected to yield more than 1.3 million job openings (2013). However, unlike in most occupational groups, more job openings will stem from growth than from the need to replace workers who change occupations or leave the labor force. Although every occupation within the computer and mathematical occupations group is expected to experience job growth over the next decade, the rate of growth varies by occupation.

Employment of computer and information technology occupations is projected to grow 13 percent from 2016 to 2026, faster than the average for all occupations (U.S. Bureau of Labor
Statistics, 2018). These occupations are projected to add about 557,100 new jobs. Demand for these workers will stem from greater emphasis on cloud computing, the collection and storage of big data, and information security. The median annual wage for computer and information technology occupations was $84,580 in May 2017, which was higher than the median annual wage for all occupations of $37,690.

Most important, software developers and programmers are expected to add 279,500 jobs by 2022, accounting about 4 out of 10 new jobs in the computer and math occupations group. **Figure 1.3** shows a comparison between computer and mathematical occupations from 2012 to 2022. It shows a growth in the educational requirements for students. This data mirrors the data shown in Figure 1 that is specific to Louisiana; yet this table shows the occupational demand on a national scale.

<table>
<thead>
<tr>
<th>Education level</th>
<th>Employment 2012</th>
<th>Employment 2022</th>
<th>Projected change, 2012–2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bachelor’s degree</td>
<td>2,893.1</td>
<td>3,415.2</td>
<td>522.1</td>
</tr>
<tr>
<td>Some college, no degree</td>
<td>547.7</td>
<td>658.5</td>
<td>110.8</td>
</tr>
<tr>
<td>Associate degree</td>
<td>316.1</td>
<td>356.6</td>
<td>40.6</td>
</tr>
<tr>
<td>Master’s degree</td>
<td>31.1</td>
<td>39.2</td>
<td>8.2</td>
</tr>
<tr>
<td>Doctoral or professional degree</td>
<td>26.7</td>
<td>30.8</td>
<td>4.1</td>
</tr>
</tbody>
</table>


**Figure 1.4.** Computer and mathematical occupations employment by educational level

Figure 1.5 below is a comparison of the unemployment rates for bachelor’s Degree or Higher workers in STEM and Non-STEM Occupations. This data was charted from 1994 to 2015. Here you will see that the unemployment rate for STEM workers is lower than Non-STEM workers. There is still a demand for STEM workers, so someone considering majoring in STEM will not have to question if he or she will be able to find employment in their field.
Understanding Importance of Calculus in STEM Education

In the United States and elsewhere, first-year college and university mathematics courses often function as a bottleneck, preventing large numbers of students from pursuing a STEM career (Tinto, 1975). In the STEM fields, it is essential for students to be able to apply their knowledge of change to analyze and make sense of various phenomena, from the marine biologist to mathematician that must convert a real-life problem into a mathematical formula.

Why HBCUs?

There are several reasons why HBCUs should be explored, especially science and technology. HBCUs have demonstrated success at their mission of educating and graduating students. While most of blacks attend traditionally white institutions, defined as educational institutions with predominantly white student populations, HBCUs account for most black students that graduate in many fields (Allen, Epps, & Haniff, 1991; Hoffman, Snyder, & Sonnenberg, 1992). On the
average, HBCUs have been proportionately more successful (compared to majority institutions) in graduating students in science and math fields (Thomas, 1991; Trent & Hill, 1994).

Perhaps more important is the need for America to maintain its economic edge and competitiveness. National demographics are changing. In the last decade, the minority population increased by 35%. As Shirley Jackson pointed out, while the non-Hispanic white population grew only 3.4%, the Hispanic population grew by 58%, Asian Americans by 50% and African-Americans by 16%. Since our traditional science, mathematics, engineering, and technology (STEM) workforce is nearly 82% white and more than 75% male, it appears unlikely that we can replace it with a similar population (Jackson, 2004).

As the Deputy Director of the National Science Foundation, Joseph Bordogna, stated, it is NOT about the total number of scientists and engineers the nation may or may not need. It is about including a larger proportion of women, underrepresented minorities and persons with disabilities in the scientific workforce, no matter the size of that workforce. The United States needs a robust and varied mix, and that means broadening participation (Committee on Equal Opportunities in Science and Engineering, 2004).

Data on HBCUs reveal a growth trend amongst African American students graduating from science and engineering fields in post-secondary schools (National Science Foundation, 2004c). Statistics show a growing percentage of foreign born students at the graduate level in the United States, while the number of white American students at the graduate level has remained consistent. There has been little growth in native born supply of labor over the last decade; much of the increase has come from minorities (National Science Board, 2004b). This means that without an increase in domestic students, the estimated shortage of science and technology workers will not be filled by Americans. The United States had been turning to a foreign labor
supply to meet their excess needs in science and technology (National Research Council, 2001). Thus, given the changing demographics, the increase in science and engineering as fields of study by African American students and other minorities makes them an interesting phenomenon to study.

**HBCUs Enrollment**

HBCUs play a pivotal role in graduating African Americans in higher education (Brown & Davis, 2001). Students that attend HBCUs leave with a sense of pride and gratitude. Often, these students, also known as alumni, play a vital role in recruiting African American students to enroll at their institutions (Fleming, 1999). (Owens, Shelton, Bloom, & Cavil, 2012) stated the following universities between 2001-2009 graduated the most African Americas in STEM disciplines compared to predominantly white institutions (PWI). North Carolina A&T State University, Morgan State University and Florida AM University graduated the most students in engineering. Grambling University, Alabama State University and Florida A&M University graduated the most students in Computer Science. Xavier University, Howard University and Jackson State University graduated many students in biomedical science. Morehouse College, Spelman College and South Carolina State University graduated the largest number of mathematics/statistics majors. Although I did not mention all 105 HBCUs, these are just a few of the top producing STEM programs for 2001-2009 graduates at HBCUs.

Mentorship was important to student retention and persistence at the HBCU (Palmer, 2008). The same study. African American students’ peers played a role by helping them to be persistent and network socially or academically (2008). Students at these institutions said they see their classmates doing well, which motivates them to do well academically. African American
students that attend HBCUs believe they have been well prepared and report having high career aspirations compared to students that attend PWIs.

Minority students are more likely than any other student to either drop out or change majors, which results in lower degree completion rates. The U.S. Department of Education said several factors have been found to lead to lower retention rates for these at-risk students—feeling of isolation (2002). According to Miller, delayed enrollment, working while attending school, and having at least one parent without a college degree are all contributing factors to low completions rates (1990). Susan Choy believes that poor self-esteem in STEM leads to poor self-efficacy, the belief that one can perform or participate in certain behavior or activity (2002).

Historically Black Colleges and Universities (HBCUs) are known to combine positive influences on African American students and retention in a supportive environment with strong remediation plans to significantly increase African American retention rates. (Jackson, 2001; Pascarella, 1991) So the infusion of MyMathLab as an intervention to increase student passage rates at UD will not be abnormal to their culture of being academically supportive to student’s needs. Since HBCUs are known for nurturing the whole student, they are constantly changing the method of instruction to meet student’s needs.

**Understanding Historically Black Colleges and Universities**

Historically black colleges and universities play a critical role in American higher education. They produce a disproportionate number of African American baccalaureate recipients and are the undergraduate degree of origin for a disproportionate share of Ph.D.’s to blacks. These institutions perform miracles in elevating disadvantaged youth to productive citizenship. **If they did not exist, we would have to invent them.**

---William H. Gray, III

Prior to the Civil War, there was no structured higher education system for black students. Public policy and certain statutory provisions prohibited the education of blacks in various parts of the nation. The Institute for Colored Youth, the first higher education institution for blacks,
was founded in Cheney, Pennsylvania, in 1837. Today, there are 102 HBCUs located in 19 states; 51 are private and 51 are public (2017). Black colleges and universities were created, funded and supported by both Blacks and Whites because of legal segregation. This forced a separation between Blacks and Whites in almost all aspects of life in the southern part of the United States, where most Blacks resided. Most of the colleges and universities that were created to teach higher education to Blacks during the segregation era started with elementary and high school level education. Over time, they gained accreditation and became competitors with other majority colleges and universities who opened their doors to Black students. The majority of HBCUs that survive still serve a predominantly Black population. However, most HBCUs are small, serve a population that has been identified as more academically challenged, and are generally underfunded. Thus, the question is legitimately raised as to what HBCUs have to offer and why they should be selected as targets of study.

There are several reasons why HBCUs should be explored and why the number of STEM degrees awarded at an HBCU should be explored. HBCUs have demonstrated success at their mission of educating and graduating students. While most of Blacks attend traditionally white institutions (defined as educational institutions with predominantly White student populations), HBCUs account for most black students that graduate in many fields (Allen & Nesha, 1991) (Hoffiman, Snyder, & Sonnenberg, 1996).

Moreover, HBCUs have become essential in educating African Americans over the years. Historically Black Colleges and Universities are particularly critical to meeting the STEM challenge, as engines of economic growth and leaders of advancement for generations of African Americans. That's why the President Obama’s Administration instituted policies that provide $850 million over the next decade to renew, reform, and expand programs to ensure
students have the opportunity for educational and career success at HBCUs (College-Ready Students and Student-Ready Colleges: Remarks of Deputy Secretary Tony Miller at the Historically Black Colleges and Universities Conference, 2010). Over the past seven years, the Obama Administration's efforts have resulted in unprecedented levels of public-private collaboration in STEM education, policies and budgets focused on maximizing Federal investments to increase student access and engagement in active, rigorous STEM-learning experiences, and meaningful efforts to inspire and recognize young inventors, discoverers, and builders.

The unique relations that come out of HBCUs really makes this a unique environment for students. According to Positive News from HBCUs (2015), black students are more likely to feel supported and be engaged in work after graduation if they attend a historically black college or university. Graduates of HBCUs are significantly more likely to have felt supported while in college and to be thriving afterwards than are their black peers who graduated from predominantly white institutions, according to the newest data from an ongoing Gallup-Purdue University study (Seymour & Ray, 2015). More than one in three black HBCU graduates (35%) strongly agree that they had a professor who cared about them as a person, a professor who made them excited about learning and a mentor who encouraged them to pursue their goals and dreams; only 12% of black non-HBCU graduates strongly agree they had all three experiences.

On the next page, Figure 1.6 is a graph of total number of STEM degrees that are awarded in 2009. The data shows that HBCUs produce slightly more STEM graduates than all other types of institutions.
Statement of the Problem

The problem facing many industries is the supply and demand of qualified workforce. STEM fields are among the few job growth areas in the United States today. Students’ low success rate in college calculus is a contributing factor to high attrition rates from STEM degree programs. Many students are coming to college underprepared for college level mathematics. Often, these students must take developmental mathematics and earn a grade of C or better to be prior to taking calculus I. In fact, most students that are required to take developmental math multiple times. The failure rate of college level Calculus I mathematics is hindering the number of STEM graduates at many institutions. Improving developmental mathematics education in community colleges: A Prospectus and early progress report on the Statway Initiative said fewer than half of college students enrolled in a “credit-bearing” college mathematics course completes it successfully (2010). So, it is critical that institutions put things in place to help students with
their mathematical deficiencies. Faculty pedagogy, curriculum design, and student assessment practices are the dominant sources of problems for students who eventually switch from STEM to other majors (Tyne, 2016). However, Seymour, E; Hewitt, N (1997) says, an underlying reason is the conceptual difficulties that students have that are not adequately addressed over the course of their mathematics career. The conceptual difficulties are carried throughout the students’ lives; which poses major problems at the collegiate level. Students that have conceptual differences typically score low on standardized exams but manage to progress through school. Once these students enter college with the intent to major in STEM, math challenges become prevalent. At times, these students are at a cross road and are forced to change majors because they cannot grasp the mathematic concepts required to pass Calculus I, which is normally the first required course for all STEM majors.

The experience of conceptual difficulty at points classes, which might not constitute an insuperable barrier to progress if addressed in a timely way, commonly sets in motion a downward spiral of falling confidence, reduced class attendance, falling grades, and despair-leading to exit from the major. (Seymour & Hewitt, 1997, p. 35)

Most undergraduate students that attend HBCUs come to college underprepared in mathematics because often the students did not understand the math concepts in secondary school. This study will examine the use of computer assisted instruction, MyMathLab, to teach Calculus I at HBCUs.
Justification

Even though our nation's HBCUs make up just a very small percentage of United States institutions, three percent of colleges and universities have produced 27 percent of African-American students with bachelor's degrees in STEM fields. In 2011, HBCUs conferred one-fourth of the bachelor's degrees in education awarded to African-Americans. Xavier University, an HBCU, awarded more undergraduate degrees in the biological and physical sciences to African-American students than any other university in the nation (Fiegener & Proudfoot, 2013). Overall, HBCUs continue to lead the nation in graduating Black STEM students.

On the next page, Table 1.1, is a listing of the top 20 United States baccalaureate-origin institutions of 2008-12 awarding bachelor’s degrees in Science and Engineering. Eight of the top twenty institutions are HBCUs, one of which is located in Louisiana. The majority of the top institutions are predominantly white institutions, that have been ranked in the two twen ty to offer degrees in science and engineering to black students. The author finds this interesting because HBCU only produce a small portion of these graduates, yet this table indicates that the majority of black students that are interested in science and engineering are enrolling at institutions other than HBCUs. This data is alarming to the author, and justifies why it is important to investigate what is happening at HBCUs to ensure that these colleges can increase the number of STEM graduates in the near future.
Table 1.1. Top 20 Academic Institutions Awarding Science & Engineering Degrees

<table>
<thead>
<tr>
<th>All Institutions</th>
<th>225,537</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top 20 institutions</td>
<td>33,974</td>
</tr>
<tr>
<td>University of Phoenix, Online</td>
<td>3,105</td>
</tr>
<tr>
<td>Ashford University</td>
<td>2,582</td>
</tr>
<tr>
<td>Georgia State University</td>
<td>2,307</td>
</tr>
<tr>
<td>University of South Florida, Main Campus</td>
<td>2,085</td>
</tr>
<tr>
<td>University of Maryland, College Park</td>
<td>1,987</td>
</tr>
<tr>
<td>Howard University</td>
<td>1,946</td>
</tr>
<tr>
<td>North Carolina A&amp;T State University</td>
<td>1,874</td>
</tr>
<tr>
<td>University of Florida</td>
<td>1,685</td>
</tr>
<tr>
<td>Florida A&amp;M University</td>
<td>1,676</td>
</tr>
<tr>
<td>Troy University</td>
<td>1,569</td>
</tr>
<tr>
<td>Florida State University</td>
<td>1,533</td>
</tr>
<tr>
<td>Spelman College</td>
<td>1,503</td>
</tr>
<tr>
<td>Hampton University</td>
<td>1,377</td>
</tr>
<tr>
<td>Ohio State University, Main Campus</td>
<td>1,318</td>
</tr>
<tr>
<td>University of Maryland, University College</td>
<td>1,305</td>
</tr>
<tr>
<td>Southern University and A&amp;M College</td>
<td>1,273</td>
</tr>
<tr>
<td>Morgan State University</td>
<td>1,256</td>
</tr>
<tr>
<td>Alabama A&amp;M University</td>
<td>1,226</td>
</tr>
<tr>
<td>Rutgers University, New Brunswick</td>
<td>1,187</td>
</tr>
<tr>
<td>Virginia Commonwealth University</td>
<td>1,180</td>
</tr>
<tr>
<td>Other institutions</td>
<td>188563</td>
</tr>
</tbody>
</table>


After carefully review of the 2020 occupational demand institutions need to produce more graduates to meet the demand. STEM education creates critical thinkers, increases science literacy, and enables the next generation of innovators. Innovation leads to new products and processes that sustain our economy. This innovation and science literacy depends on a solid knowledge base in the STEM areas. Most jobs of the future will require a basic understanding of math and science.

**Purpose of the Study**

The purpose of this study is to explore the effectiveness of computer assisted instruction, MyMathLab, in teaching Calculus I to increase academic achievement for students majoring in a STEM discipline at HBCUs. Students that major in a STEM discipline are required to take
rigorous courses throughout their collegiate career to satisfy degree requirements. Often students are not completing these programs because many cannot get past the first required math course, Calculus I, which can be referred to as a gateway course to all STEM degree programs. In this study, the researcher intends to do an assessment to track students’ perceptions of computer assisted instruction at University of Duplcechain. It has been observed, the gap in the literature shows that there is research on precalculus and the use of MyMathLab at secondary schools and community colleges; yet there is limited research done on this technology and calculus I and its impact on students that attend HBCUs.

According to the US Department of Education (2012), technology infuses classrooms with digital learning tools, such as computers and hand-held devices, expands course offerings, experiences, and learning materials, which supports learning 24 hours a day, 7 days a week. It also builds 21st century skills; increases student engagement and motivation; and accelerates learning. Technology also has the power to transform teaching by ushering in a new model of connected teaching (2010). Use of technology can help to improve and enhance the acquisition of knowledge and skills because learning with and about technology is essential for students to gain the competencies to function well in a 21st century society and workforce. Moreover, technology can serve as a valuable tool for districts, schools, and teachers to support reforms. Because technology is intrinsically motivating to many students and highly customizable, it is particularly well suited to support student-centered learning (Zhao & Frank, 2003).

Today’s average college graduate has spent less than 5,000 hours of their lives reading, but over 10,000 hours playing video games, not to mention 20,000 hours watching television (Prensky, 2001). Computer games, email, Internet, cell phones and video conferencing are integral parts of their lives. According to (Prensky), students today are called digital natives
(native speakers) of the digital language of computers, video games and the Internet.

Observably, technology has changed the world we live in. In the last ten years, what we knew about technology has changed. Ten years ago, we were adapting to portable cell phones and now everyone is lost if he/she do not have a smartphone at their disposal. According to Internet World Stats (2008), the United States of America is the leading country in internet usage, with approximately 210 million users amounting to 69.7% of the population. Technology in the classroom has changed as well. Ten years ago, if someone spoke of technology in the classroom, the person was speaking of physical computers that was a specific software package installed in a schools’ library or a digital projector that was connected to the ceiling of a classroom. Currently, educators around the world are using tablets as opposed to textbooks, smartboards as opposed to chalk boards, computers, smartphones, digital recorders, web streaming and an array of other digital media to deliver instruction.

If we go back twenty years ago, most would think of technology as a luxury and not a necessity. We went from land telephone lines to cordless telephones to mobile phones, not to mention the impact that technology brought to education.

**Significance of the Study**

This research may add to the body of knowledge on the integration of technology in post-secondary education, particularly the effective use of computer assisted instruction to improve student success in STEM disciplines at HBCUs. The results of this study may be used to support advocacy regarding technology use in higher education classrooms at Historically Black Colleges and Universities, as well as these results may be used by policymakers to advocate on behalf of technology integration to state and federal agencies. These results may also assist software development companies as they work to develop products that will enhance learning
and ultimately increase graduation rates for students that were in courses that integrated technology into the curriculum. Last, but most important, this research may assist college administrators as they work to develop course curriculums that will ensure that all students are meeting learning outcomes.

After carefully reading literature, the researcher did not find any published work on MyMathLab used with Calculus I students at HBCU’s, yet there was an abundance of literature on MyMathLab and developmental mathematics in grade schools and community colleges. So, this study is truly significant to the success of higher education because students in four-year institutions also have deficiencies in mathematics courses as well. More importantly, African American college students graduate from college at lower rates than any other nationality. According to the United States Department of Education (2016), the nationwide college graduation rate for black students stands at an appallingly low rate of 42 percent, although, the reviewed literature suggests that students taking developmental mathematics could possibility have better success rates with the use of mastery learning, which is a teaching strategy.

**Conceptual Framework**

**The Research Site**

Research in this study takes place at a masters’ large programs institution in the southeastern region of the United States. The research was conducted on a sample of the population due to limitations, including constraints on access, funding resources, and time. For anonymity, the institution in this study will be identified as University of Duplechain.

University of Duplechain is a comprehensive institution, fully accredited by the Southern Association of Colleges and Schools Commission on Colleges offering graduate, professional, and doctorate degree programs. UD has a total undergraduate enrollment of 5,347, its setting is
urban, and the campus size is 964 acres. It utilizes a semester-based academic calendar. UD offers a total of nine bachelor’s degree programs in STEM: biology, chemistry, computer science, physics, electronic engineering technology, civil engineering, electrical engineering, mechanical engineering, and mathematics.

**The Course**

To graduate with one of the nine Bachelor of Science, BS, degrees from University of Duplechain in one of the STEM disciplines approved by the state governing board. Students must complete the coursework in the school’s catalog specific to the discipline located in with a grade of C better and maintain a grade point average of 2.5 or better on all attempted coursework. or One course that is required for all STEM disciplines is Math 264-Calculus I, which is a 4-hour credit course. It is designed to be the first math course of the calculus sequence of three courses. Topics include revisit to some basic functions, the derivative at a point, the derivative function, higher derivatives, product and quotient rule of differentiation, chain rule of differentiation, and applications of derivatives. Prerequisites: A grades of ‘C’ or better in Math 134 and 140, or consent of the department.

**The Instructor**

This study reviewed data from eight semesters. Each semester there were four sections of Math 264. Two of the four sections were taught by professors that understood the benefit of computer assisted instruction, and both committed to teaching those sections with the assistance of MyMathLab. All sections were taught by a qualified mathematics professor.
The Student

The College of Sciences and Engineering at University of Duplechain provides students with technological skills and opportunities that stimulate professional, educational and personal growth. UD undergraduate students that have a declared major of biology, chemistry, computer science, physics, electronic engineering technology, civil engineering, electrical engineering, mechanical engineering, and mathematics are required to take Calculus I in their degree program. The students in this study enrolled in Calculus I at UD between Fall 2014 to Fall 2017.

Summary

In summary, the institution to be investigated is a masters’ large programs HBCU institution within the southeastern region of the United States. While most of Blacks attend traditionally PWI, HBCUs account for most Black students that graduate in many fields (Allen & Nesha, 1991), (Hoffiman, Snyder, & Sonnenberg, 1996). According to (New, 2015), black students are more likely to feel supported and be engaged in work after graduation if they attend a historically black college or university. The next chapter will detail the review of literature that will focus on two different theories to develop the theoretical framework. The focus of chapter 2 will be the following: 1.) how do students learn and what professors need to understand about adult learners, 2.) cognitive theory of multimedia learning (CLM) and its impact on student learning, 3.) a review of learning style models and connections to research, with a focus on mastery learning, 4.) computer assisted instruction which can also be referred to as computer software, with focus on MyMathLab.

Research Questions

The study aims to investigate if there is a difference in the Math 264 passage rate with the use of computer assisted instruction, MyMathLab, and lecturing, traditional teaching method.
Questions:

1. Do students who were taught Math 264 using mastery learning along with MyMathLab have a higher passage rate, than those students taught Math 264 with mastery leaning without the use of MyMathLab?

2. Do students that previously took Math 264 where MyMathLab was used perceive that the value of the MyMathLab resources assisted them in advanced math courses?

Null Hypothesis:

1. There is no difference in the passage rate of students that were taught Math 264 using mastery learning along with MyMathLab and those student that were taught Math 264 with mastery learning without the use of MyMathLab.

2. There is no difference in former Math 264 students’ perception of MyMathLab resources from students that previously enrolled in Math 264 where MyMathLab was used.

Policy Implications

The target audiences to which the findings are directed are higher education policy makers, HBCU administrators and software developers. HBCU academic affairs administrators involved in creating policy, HBCU science and technology departments, and federal and state government agencies that are interested in identifying potential niches for support of science and technology development are also included in the target audience. Policy implications of this study are relevant, as the findings will help federal agencies better understand strategies for science and technology development and HBCUs will have models of strategy that are effective and productive.

The other targeted group is software development companies. The findings of this dissertation can be used by software companies to aid them as they develop more course ware to accompany
college textbooks. It is essential that all college textbooks have complimentary courseware for classroom use. In this case, the courseware complements the instruction and serves as an intervention to help students’ bridge the gap with mathematics skills.

Definition of Terms

**Adult learner** A person who is 18 years or older who is involved in some form of learning environment (Clark & Caffarella, 1999).

**Computer assisted instruction** (CAI) If refers to any computer program that supplements or aids traditional instruction through videos, drill-and-practice, graphics, homework problems, instant feedback, test, self-pace, and one-to-one interaction (Spradlin, 2009). In the common in education for both terms, CBI and CAI, to be used interchangeably.

**Computer learning system** A computer software provided by some textbook publishers to complement a textbook. The software includes videos, homework tests, tutorials, and online tutoring (Spradlin, 2009).

Traditional methods of instruction refer to instructor-led lectures without the inclusion of any technology-based material.

**Technology**-based methods of instruction include the use of any technology media resource.

**Precalculus** is an advanced form of algebraic math and a student’s gateway to calculus and college-level mathematics.

**Calculus I** is the first course of a three-course sequence. The concept of limit is introduced, and is used to develop the concepts of continuity and derivative. These are studied from a symbolic, graphic, and numeric perspective for a wide variety of basic functions and combinations thereof. Applications are included. Definite and indefinite integrals, and the Fundamental Theorem of Calculus are introduced.
Multimedia learning refers to learning from words and pictures.

Multimedia instruction is the presentation of material using both words and pictures, with the intention of promoting learning.

Khan Academy is a large and popular open educational resource (OER) with the mission of providing a free, world-class education for anyone, anywhere.

Digital native is typically categorized as someone from Generation Y, a person born between the late 70's and early 90's. They are considered “native speakers” of common technological advances like the computer, IPod, cell phone, computer programs like Adobe Photoshop and gaming systems like Xbox 360, (Prensky, 2001).

OER – Open Education Resources (OER) are teaching and learning materials that may be used freely and reuse at no cost, and without needing to ask permission.

TPACK model (Technological Pedagogical and Content Knowledge) is a framework for understanding technology integration for education.

Elements of the Document

Figure 1.7 on the next page is a graphical representation demonstrating the order of the chapters and the major elements of this dissertation. The down arrows, which is represented as ▼, represents each chapter, beginning with Chapter 1 and ending with Chapter 5. The document symbol □, which connects to each downward arrow represents the elements of each chapter. Within the document symbol are bulleted list of subheadings of each chapter.
Figure 1.7. Elements of the Document
Chapter 2: Review Of Literature

The purpose of this study is to understand if there is a relationship between instructional method with the use of technology and final course grades for students enrolled in college level Calculus I. The researcher also seeks to understand if the use of technology has impact on student perception after technology has been used in a college course. Chapter 2 is a review of prior literature from two literary bases that make up the theoretical frame work of this study. One concept is on the importance of STEM education and workforce demand for a more educated workforce. The second concept is, the significant impact HBCUs have on students majoring in STEM. Last but most important, is technology and its relationship with teaching and learning. This research is relevant to academia because it is critical that new teaching strategies be developed to increase student passage rates in college level mathematics courses. Also, the gap in the literature shows that there is research on teaching and learning of mathematics students and the use of MyMathLab at secondary schools and community colleges, yet there is limited research done on this computer assisted instruction and calculus I and its impact on student’s success for STEM majors that attend HBCUs.

Colleges and universities have become increasingly important to society for multiple reasons. HBCUs, were designed to prepare students for employment, but more importantly education for African Americans was intended to give us an opportunity to be on an equal playing field with white Americans, without there being fear of retaliation.

The researcher understands that teaching mathematics is a gift given to some, but not all educators. An effective mathematics professor can explain abstract concepts to students in ways that the students can understand, which is not always easy for students. Math concepts can be taught through real life examples, lecturing from a textbook, one-on-one learning, collaborative
learning or computer assisted instruction. It is essential that professors develop teaching strategies in mathematics to teach students basic math concepts. Teaching and learning are not effortless jobs as according to Galbrith (2003) pointed out: the model and complexity of the teaching and learning process are confined in the individuality and idiosyncrasies of those who take on the role of teacher and learner (2003, p. 9). Prior to this study, existing literature suggested that a mode of instruction, mastery learning delivered through MyMathLab might make learning more effective for students by providing instant feedback, easy access from any computer with internet access, videos, an e-book, and a system with infinite patience that could supply real world examples (Miranda, 2014). This study will go further and examine the Cognitive Theory of Multimedia Learning along with Mastery Learning with the assistance of computer software.

In this chapter, the researcher will discuss the theoretical framework for the study that is based on the Cognitive Theory of Multimedia Learning (CTML) by Mayer, and Theory of Mastery Learning by Carroll. These two theories combined and delivered with computer software, Computer Assisted Instruction (CAI), MyMathLab is the guide to conducting this research. The researcher posits that the essence of effective teaching resulting in top student performance is a combination of each of these two theories. As mentioned in the introduction, incorporating computer assisted instruction into the classroom will enhance curriculum development and ultimately, student learning. The CML Theory states that people learn better with words and pictures, then words alone. Bloom’s learning for mastery (1968) says teachers should teach in small increments then assess what has been taught. Bloom said teaching into small units of instruction, with frequent formative testing, comprehensible instructions and adequate time will yield the best student outcome. The researcher felt that both theories delivered
through computer assisted instruction, MyMathLab, are critical to student success. The new theory that has been developed from Myer’s and Bloom’s theories is known as DeRouen Theory. The DeRouen Theory is a combination of the two existing theories that are delivered through a computer assisted instruction tool, MyMathLab. The researcher understood the importance of producing more STEM graduates to meet the workforce need, and this new theory was ideal to implement during this study to assess if students taking a Calculus I would perform better with the assistance of this teaching method with the MyMathLab component. Figure 2.1 below shows the theoretical framework of this study.

Figure 2.1. Theoretical Framework
How Students Learn

Different learning theories explain how students learn. Different ideas are based on various assumptions and are appropriate for describing some learning situations but not others. According to (Shuell, 1986), theories of learning can inform teachers and the use of different instructional resources including technology, but ultimately the learning activities in which the student actually engages (mental, physical, and social) determine what a student learns in the classroom (Shuell, 1986). Traditionally, learning has been viewed as something that occurs within an individual. Individuals may contribute and learn in groups, but it is the single person that learns or absorbs the information. Knowledge resides in the community of people that creates it and is distributed among members of the community and the various environmental affordances available to the group (Shuell).

Studies have shown that the use of information technology across different curriculum subjects can have the beneficial motivational influence on the students learning and achieving better grades than using the conventional teaching method (Yuan, Lin, Li, & Li, 2005). A study conducted by (Mikusa, 2015) investigated student self-efficacy about the use of technology. He reported that a computer assisted instruction helped high school students develop more interactions among themselves and that it grasped students’ interest during the course. Keeping the attention of high school students can be difficult, especially if the subject area is not something the student is interested in. The technology component helps to engage students and bring their attention into focus on the concepts being taught. Similarly, (Brush & Saye, 2008) noted that technology assisted learning environments “can support a more disciplined inquiry into ill-structured problems”, which implies that the use of technology fosters students’ interactions among them and with the curriculum material to make inquiry happen.
Other research studies also addressed students’ attitudes toward multimedia-assisted instruction. Price et al. (2008) assessed educational outcomes among students learning with traditional lecture versus CD-ROM. Although they found students preferred traditional lecture instruction, they suggested that when given the option of total self-instruction, students who knew they learned well using this type of teaching chose it but there were always students who preferred the traditional lecture method of instruction.

By incorporating various technology-based instruction methods in their courses, many researchers attempt to identify effects of these methods on students’ learning. A typical measurement is two folds: comparing pretest and posttest scores of treatment groups (Buzzell, Chamberlain, & Pintauro, 2002) (Price, Lukhard, & Postel, 2005) and analyzing students’ academic performance (Bartlett & Strough, 2003). This study will not look at pretest and posttest grades, yet both are critical in assessing student performance in the classroom. Different results on students’ knowledge acquisition were reported in studies comparing pretest and posttest scores. Some studies concluded that students’ knowledge increased after they were exposed to technology-mediated instructional methods (2005) while others found no significant differences between pretest and posttest scores of treatment groups (Buzzell, Chamberlain, & Pintauro, 2002).

One major component of an individual earning a college degree is to successfully pass required courses by mastering the course learning outcomes. Many students do not complete degrees in STEM because the required courses can be challenging, or the student understand the concepts. The infused technology into the curriculum can enhance student learning and understanding of concepts.
Learning Theories

A critical component of student success in college or any grade level for that matter, is for the student to understand how he or she learns. The learning style of the student has a major impact performance. It is critical that college students understand how they learn best, regardless of how long this discovery process takes! An individual’s learning style can make the difference between passing and failing because once the learning style is acknowledged, the student will be able to take the necessary steps to learn the course material. Below the researcher will discuss different learning theories that have been developed of the years. The development of different learning theories has helped parents and educators understand students more. Once the professional in the room understands how and why a student learns the way he or she does, they will be able to better serve them.

There are several different learning theories that have been developed by researchers, they are behavioral, cognitive, and constructive learning theory. Researchers have spent an extensive amount of time crafted into words, the way people learn. The articulation of how humans learn, and the work done by researchers has evolved into we know as learning theories. These theories have These learning theories are the bases of the theoretical foundation for exploring “how students learn”. However, how students learned more than twenty years ago is different as compared to today’s twenty-first century learners (Ertmer and Newby, 2013). Although the principles of the theories, behavioral, cognitive, and constructive, remain essential to its contributions to the practices of teaching and learning in education, changes in educational reform and advanced technology have sparked an adoption of new teaching strategies (Kay, 2010). The way students learned and were taught forty years ago has drastically changed because of the technology available today.
There are thousands of reasons that a researcher would use to define the changes in the way students learn in the twenty first century. Yet reasons affecting the learning process today, all of which were much less prevalent in 1993, are 1.) proliferation of the internet; 2.) the emergence of a new kind of student who thinks and learns differently than previous generations; and 3.) adoption of a variety of new teaching methods, which builds on the principles of constructivism (Ertmer and Newby, 2013).

Recent changes in education reform requires that students acquire twenty-first century skills: problem solving, critical thinking skills, and creativity before entering the workforce (Kay, 2010). Specific to mathematics, mathematical practices have been created to support and enhance math instruction in grades K-12 classrooms. Although most states have rebranded Common Core, the standards and mathematical practices have remained the same or similar for the states that will continue to implement them. According to the Center for American Progress (Marchitello and Wilhem, 2014), Common Core Math is grounded in cognitive science and incorporates practices that have been proven to improve student learning and achievement, such as: scaffolding, grand expectations, research-based practices, traditional and conceptual teaching strategies, collaboration, and project-based learning (Marchitello and Wilhelm, 2014).

Moving forward, the literature will expound on the theoretical perspectives of behavioral, cognitive, and constructive learning theories and highlight how the theories align to the eight mathematical practices that have been created to meet the instructional needs of today’s learners. The mathematical practices are: 1.) Make sense of problems and persevere in solving them; 2.) Reason abstractly and quantitatively; 3.) Construct viable arguments and critique the reasoning of others; 4.) Model with mathematics; 5.) Use appropriate tools strategically; and 6.) Attention to precision.
Behavioral Learning Theory

Behavioral learning theory relates to the learner’s ability to understand the “what” of the subject matter using methods that require rote memorization, identification and association that will result in positive or negative reinforcements (Skinner, 1976, Ertmer and Newby, 2013). Behaviorists attempt to prescribe strategies that are most useful for building and strengthening stimulus-response association using instructional cues, practice, and reinforcement. (Ertmer and Newby, 2013, p.43). For instance, when a student is given a problem on a flashcard, for example, (2 + 2), and the student responds with an answer (say, four), the problem is the stimulus, and the answer is the response. Further, if the teacher rewards the student with praise, the student will continue to work with dedicated effort. This scenario is identified as positive reinforcement.

The three elements, stimulus, response, and the association between the two, create learning through positive reinforcement. The strength of this learning theory is that it encourages incentives and rewards for students when they respond positively to an objective’s task (Ertmer and Newby, 2013, page 44). Therefore, behavioral learning is driven by producing observable and measurable outcomes defined by methods and strategies, such as drills and timed math facts tests in which students can quickly respond to the objectives and, therefore, receive incentives that encourage them to continue toward achievement. Furthermore, direct or “teacher-centered” instruction tends to lead the instructional framework within a behavioral dominate classroom.

Some behaviorists’ approach to teaching includes the following:

- Breaking materials into small units or steps
- Providing immediate and/or frequent feedback
- Using reinforcements to strengthen the behavior the teacher wants to encourage
- Use reinforcements to motivate students
- Teach to the stated learning objectives in small chunks and pace the lesson to achieve the goal using drill and practice techniques

(Driscoll, 2005)
Fluency support, also known as “Sprints”, is an essential component of Common Core Math and is evidence of behavioral learning and motivation in today’s classroom. The CCSS for Mathematics call for students to obtain and demonstrate conceptual understanding, problem solving, and procedural skill and fluency speed and accuracy in calculations (CCSS, 2014, p. 4). During Sprints, students are given a worksheet of math facts (i.e.: addition, subtraction, multiplication, and division of whole numbers or fractions, operations with integers, and simplifying expressions). With their worksheets faced down, the teacher announces a time to start the drill. At the call to “go”, students flip the worksheet over and dive into solving the problems, much like time multiplication tests in the 1980s. Teachers assume the role of coaches, and a rousing routine fuels students’ motivation to do their personal best (CCSS, 2014, p. 5). This practice is one way for students to demonstrate perseverance in solving problems within a given allotted time, which leads back to the first mathematical practice, make sense of problems and persevere in solving them. When the time is called, the teacher calls out the answer, and as the students get them correct, they respond with “yes”. The teacher accesses the number of students getting the correct answers by evaluating the sounds of “yes”, eventually the “yes” becomes fewer as the problems become more challenging. Throughout this process, the teacher praises students for doing well, answers students’ questions about problems, and begins the process again with another Sprint, this time checking for improvements. Most teachers, however, incorporate kinesthetic movement in their Sprint activities as students can get out of their seats and exercise (i.e.: jumps, leg lifts, or shoulder rolls) while recalling math facts.
Cognitive Learning Theory

Research on the science of learning has consistently demonstrated that prior knowledge is critical to determine how students learn new concepts (Marchitello and Wilhelm, 2014). According to the Center for American Progress (Marchitello and Wilhelm, 2014), Marilla Svinicki of the University of Texas stated that students’ prior knowledge affects how they receive and organize additional information, and without the necessary knowledge, students face significant challenges in learning new material.

Cognitive learning theory views learning as a mental process in which learners gain knowledge through previous knowledge. Cognitivists believe learners develop learning through receiving, storing, and retrieving information (Ertmer and Newby, 2013, 45). This mode for learning primarily focuses on the learners’ ability to gain knowledge from already existing knowledge. Instructional explanations, demonstrations, illustrative examples, using a variety of contexts, and matched non-examples are all influential in directing student learning. The student is the center of instruction, and learning is meaningful as it relates to concepts that already exist (Driscoll, 2005).

The professor plays a critical role in Cognitive learning because this individual is responsible for facilitating the class by ensuring that all planning material is taught, and students are assessed accordingly. There are three different methods of cognitive approaches that are looked at in the classroom setting. The are 1.) Delivery of instruction in an organized matter-The matter in which a new skill or new information is presented determines the connections in how students make sense of it.
If the information presented is not delivered in the most organized manner, it would hinder the learning process. With consideration, it is helpful to use graphic organizers and concept maps to enhance the students’ structural knowledge (Driscoll, 2005).

2.) Rehearsal information involves “practice until perfect”. Using cognitive learning theory, knowledge is gained by previous knowledge. Therefore, students are encouraged to practice in a variety of contexts. It is important for the teacher to know that students bring various learning experiences to the learning situation, which can impact learning outcomes (Ertmer and Newby, 2013, p. 54).

3.) Enhancing students’ encoding and memory- Helping students learn to process information places them in the top tier of cognitive theory. When students possess the ability to process information, they are better able to apply the concepts as well (Driscoll, 2015). Cognitive learning theory is distinctively illustrated in an active, engaged math classroom using practices of knowledge scaffolding. When modeled and implemented appropriately, teachers introduce new information on top of students’ prior knowledge then ask students to think critically about the problem or task (Marchitello and Wilhem, 2014). According to The Center for American Progress (2014), the past two decades of evidence reveal that students learn best when they can relate innovative ideas they are learning to what they already know.

The bases of mathematics are systematic. For a teacher to effectively teach, the teacher must effectively plan the course, then teach the course as planned, and then assess the students are what has been taught. One may say that the teaching should be easy, but teaching humans is a very detailed process that is not intended for the average person. The teacher must model the math concept through guided practice, providing support with examples to students as they solve the problems. While students work, the teacher provides feedback and closely monitors
students’ progress (Cadieux, 2011). This study will look at incorporating multimedia to teaching for mastery, which means the teaching will assess students after small lessons are taught, instead of teaching several lessons and regardless of if the student performance on assessments, the student is taught the next lesson in the sequence.

In other words, after presenting more challenging problems that students begin to work on successfully, the teacher gradually releases them from guided instruction. At that point, students work independently with mastery which can be much easier with the use of computer software. Mathematical practice 1.) Making sense of the problem and persevering in solving is also evident in scaffolding. Scaffolding aligns to this mathematical practice in that students, prior to the teachers’ gradual release, attempt problems that they have not been taught explicitly how to solve, when only being provided the background for figuring out how to solve these problems.

**Constructivist Learning Theory**

Constructivist learning theory is learning based on experience. Generally, this type of learning is acquired through experimental learning, self-directed learning, and reflective practices (Driscoll, 2005). When compared to behavioral and cognitive learning theories, constructivists do not transfer knowledge from the external world into their memories, rather they build personal interpretations of the world based on their own individual experiences and interactions (Ertmer and Newby, 2013). To apply constructivism to the learning process, the teacher operates as the facilitator and supports students’ access to gaining more information as they take the lead in discovery. These students function as the interpreters of their own experience in constructing and building their capsule of knowledge; they create meaning as opposed to acquiring it (p. 52). The goal of instruction is not to ensure that individuals know
facts, rather that they elaborate on and interpret information (p. 57). A Constructivist’s classroom will entail the following approaches to learning:

- Demonstration of multiple representations of reality.
- The information should be presented in a variety of diverse ways for different purposes and contexts.
- Emphasize authentic tasks in a meaningful, rather than abstract context.
- Application to real-world events or scenarios supported by different student perspectives.
- Use of thoughtful reflection on experience among peers in collaborative grouping/discussion (p. 58).

**Social Constructivist Theory**

Social Constructivist Theory, a subcomponent of Constructivist Theory, is a learning theory that places a greater emphasis on social interactions. This learning theory is highly associated with learning within teams and groups; students do not adopt learning on their own. Social Constructivist Theory encourages active dialogue and rich, meaningful discussions among peers (Vygotsky, 1978). The following behaviors are observed in a Social Constructivist’s classroom:

- Inquiry based learning and active discussions
- Discovery talks that allow the teacher and students to explore misconceptions and untrue ideas
- Encourage dialogue between students and teachers to encourage and develop understanding
- Learn through questioning and collaboration with peers (Vygotsky, 1978).
- Common Core State Standards for Mathematical Practices significantly align to the Constructivist learning theory.
The Mathematical Practices that are evident in this learning theory are 3) Construct viable arguments and critique the Reasoning of Others, 4.) Model with Mathematics, 5) Use Appropriate Tools Strategically, 6.) Attend to Precision. The target of the practices is to support the curriculum and pedagogy of mathematics by helping students structure habits of mind for reasoning about mathematics. Further, the practices encourage student communications about real-world mathematics, creating effective collaborations within small groups. Constructivist learning theory, a student-centered approach to learning, links to current math practices in that it encourages students to question and critique others’ justifications, and promotes students’ ability to explain their reasoning, draw conclusions about mathematics, and communicate them effectively using precise definitions and the language of mathematics.

**Cognitive Theory of Multimedia Learning**

Here is one theory that has not been mentioned, yet it is a key component to the theoretical framework of this study. The incorporation of technology in the classroom can be quite useful, as “the use of virtual environments for collaboration and learning can result in the unprecedented flow of ideas, leading to higher levels of productivity.” (Chandra, Theng, Lwin, & Foo, 2009, p. 2) The framework of this study is based on the Cognitive Theory of Multimedia Learning (CTML) by Mayer. The principle known as the “multimedia principle” states, “people learn more deeply from words and pictures than from words alone” (Mayer R. E., 2009, p. 47). However, simply adding words to pictures is not an effective way to achieve multimedia learning. Humans can only process a certain amount of information in a channel at a time, and they make sense of incoming information by actively creating mental representations (Mayer R. E., 2002) According to Mayer’s cognitive theory of multimedia learning, the brain does not interpret a multimedia presentation of words, pictures, and auditory information in a mutually
exclusive fashion; rather these elements are selected and organized dynamically to produce logical mental constructs (Mayer R. E., Multimedia Learning, 2009). Furthermore, Mayer underscores the importance of learning (based upon the testing of content and demonstrating the successful transfer of knowledge) when additional information is integrated with prior knowledge. This theory (Multimedia learning. Cambridge, 2001) proposed several assumptions regarding the relationship between cognition and learning from dual representation information formats. Three of these assumptions are pertinent to learning from multimedia learning materials. First, the dual-channel assumption proposes that working memory has two channels for visual/pictorial and auditory/verbal processing and that the two channels are structurally and functionally distinct (Clark & Paivio, 1991). Second, the limited capacity assumption states that each cognitive channel has limited capacity for information that can be processed at one time (Baddeley, 1986). Third, the active processing assumption explains that humans actively engage in the cognitive processes to select relevant verbal and non-verbal information from the learning materials, organize the selected information into cognitive structures, and integrate these cognitive structures with the existing knowledge to construct a new (or update an old) mental representation (Mayer, Bove, Bryman, Mars, & Tapangco, 1996).
Presenting information in a way that makes use of existing organizing structures (schema) or that helps students organize the information can greatly assist the learner in incorporating information into Long Term Memory. The brain processes information using two channels—visual and auditory. When information is presented using both channels, the brain can accommodate more additional information. By taking advantage of this multimodal processing capability and technology-based tools, students’ learning can be enhanced through multimedia instruction (Mayer R. E., Multimedia Learning, 2009).

**Mastery Learning**

One may ask what mastery learning is and where did the term arrive from. The interest in mastery learning dates to the 1920s but it was not until the 1960s that it gained popularity. The theory of mastery learning comes from cognitive psychology, specifically from the theory on mastery teaching (Carroll, 1963), from the principles of andragogy (Knowles, 1984), and the use of the use of computer assisted instruction (Knowlton & Simms, 2009). MyMathLab reported success may be based on two implicit premises. Although these do not seem to be explicitly
identified in any of the literature produced by the publishers or in the very limited professional literature on MyMathLab, they are the efficacy of mastery learning and of computer assisted instruction in producing academic achievement. Therefore, the independent variable in this study is the instructional method examined in this study.

Carroll’s model of school learning (1963) led to the development of mastery learning theory. The main variable behind Carroll’s model is time. Carroll claimed that students differ in the amount of time they need to learn a given task and that when students are given the time they need and if they persist they will reach the “criterion level of achievement”. He introduced five key variables for school learning, three of which involve time. He defined each variable as follows.

1. Aptitude is a variable or set of variables that determine the amount of time a student needs to learn a given task, unit of instruction, or curriculum to an acceptable criterion of mastery under optimal conditions of instruction and student motivation.

2. Opportunity to learn is defined as the amount of time allowed for learning.

3. Perseverance is defined as the amount of time a student is willing to spend on learning.

4. Quality of instruction refers to the presence of well-defined goals for students coupled with the presence of adequate time and materials for them to reach these goals.

5. Ability to understand instruction refers to the learner’s ability to understand what the learning objective is and to determine how to achieve it.

An individual’s aptitude, opportunity to learn, and perseverance are all related to time according to Carroll’s model. The use of CAI, specifically, MyMathLab provides students with the
opportunity to learn 24 hours a day, 7 days per week when using a computer with Internet access.

**Learning for mastery**

From Carroll’s model of learning two methods of mastery learning were developed. The first method was Bloom’s learning for mastery (1968), which breaks down teaching into small units of instruction, with frequent formative testing, comprehensible instructions and adequate time. Instructors present the material and students move in a regulated environment. Formative tests serve as a diagnostic tool to help teachers understand students’ strengths and weaknesses. Students who reach mastery of the task at hand should be informed that the learning is adequate and should be allowed to move to the next unit. However, Bloom recommended that those students who do not achieve mastery should be granted additional time and/or extra assistance in the form of group study or one-on-one tutoring. After these accommodations take place, a second formative test would be given to measure each student’s progress. This process is repeated until the student achieves mastery of the task. Bloom claimed that when these learning and teaching strategies are exercised, over 90% of the students can master the subject. Furthermore, students with low level of ability and knowledge will benefit the most with an instructional program based on mastery learning (Bloom, 1968).

There have been so many things said about Carroll’s theory of mastery learning, however, implementing and applying the theory may be a challenge for some educators. Whereas, for others it may appear simply. According to Boggs and Shore (2004), instructors using mastery learning face four challenges: (a) creating multiple versions of each test, (b) grading multiple versions for all students at various stages of the course, (c) scheduling time for students to take different versions of test to assess for levels of mastery, and (d) teaching students who are at
various levels in the course. Computer assisted instruction is the tool that addresses and facilitates all these four challenges, making mastery learning a practical theory for educators (Vezmar, 2011).

**Technology**

Technology has not only changed our daily lives, it has changed how institutions of higher learning educate students. Colleges across America are utilizing technology to deliver instruction because the use of technology is natural to most students. Oddly enough, college students today, would not understand the use of chalk boards as opposed to smart boards. Most college students today, have grown up using technology in their daily lives, so utilizing it in the classroom is expected. Today, 64% of kids have access to the Internet via their own laptop or tablet, compared to just 42% in 2012, and those accessing via a shared, family computer in a public space dropped from 70% in 2012 to 54% this year (Influence Central's Consumer Insights Group). (Smartphones & the Dramatic Reshaping of American Families) also stated that 38% access the Internet via their phone, up from 19%, and 26% have access via a gaming console, a jump from 2012 when 19% did so. These statistics along with others on the use of technology and students continues to grow. It is apparent that technology use in the 21st Century is utilized by everyone, hence the reason why it should be standardized in the classroom.

The impact of educational technology has been met with much skepticism for many years due to a lack of evidence that it has been effective in improving student learning and its perceived excessive cost (Cuban, 2001). Federal school technology initiatives alone, for example, increased from $21 million in 1995 to $729 million in 2001 (O'Dwyer, Russell, & Bebell, 2004a). Market Data Retrieval (2005) accentuated this trend in that, despite continually declining budgets, 70% of school districts across the nation anticipated technology spending to increase or remain
unchanged in the 2006 fiscal year. The extensive expenditures on technology in schools have been accompanied by claims that technology’s impact on education is significant (Software & Information Industry Association, 2000). This report notably commissioned by the software industry and significantly questioned by critics as to its intent due to a potential conflict of interest also found positive correlations in technology affecting student achievement, motivation, and self-concept. Critics have often questioned such claims when made by insiders of the hardware and software industries (Weiner, 2000).

The emergence of modern technologies pushes educators to understanding and leveraging these technologies for classroom use; at the same time, the on-the-ground implementation of these technologies in the classroom can and does directly impact how these technologies continue to take shape (Klopfer, Osterweil, Groff, & Haas, 2009). Educators need to adopt and familiarize themselves with the new and recent technologies to effectively implement them into their classroom (Lawless & Pellegrino, 2007). Computer assisted instruction impacts student development.

With the growth of technology, educators and researchers need to keep up with the progression of technology and try to find the right method for the help their students succeed. Professors are finding more ways to integrate these technologies into the classroom to increase student engagement and achievement (U.S. Department of Education, Use of Technology in Teaching and Learning, 2009). According to eLearn Magazine, the introduction of technologies in the secondary education classroom has been increasing for the past twenty-five years (Burns, 2010).

Technology can help in increasing knowledge of core curriculum to college students. Technology can equip students to independently organize their learning process. So, instead of
being passive recipients of information, students using technology become active users (Moeller & Reitzes, 2011). There are many ways in which a college professor can integrate technology into the classroom; hence, computer assisted instruction with computer software is the method used in this study. Presently, integrating technology is important since technological advances are more frequently used. This literature review will provide overview from previous pedagogical research on how students learn, and overview of learning theories and the different technology approaches that are available for measuring the success of incorporating technology into the curriculum.

**How to Measure the Effectiveness of Technology Integration**

Evaluating the appropriateness and effectiveness of educational technology is an important aspect of integrating current technologies into the classroom curriculum. Assessing teaching and learning without the use of technology can be difficult at times. So, it is critical that researchers be able to assess the use of technology in the classroom. Some teachers think that incorporating technology into their teaching is very time consuming and questions their ability to teach. Teachers should evaluate before, during, and after instruction to find out whether a certain instructional technology is effective or not. Teachers to measure the effectiveness of any technology used in the classroom can use the following:

- Measure student performance
- Reliable assessment
- Traditional assessment
  - Testing
- Alternative assessment
  - Authentic assessment (performance-based assessment)
• Observe motivation and observe how long students work on an objective

**Computer assisted instruction with Computer Software**

The most prominent computer assisted instruction used inside classrooms to impact student performance appears to be computer software. The following studies examine computer software generally. In the (Schmid, Miodrag, & Francesco, 2008) study, researchers were looking for a clearer understanding of how a computer program could support tutoring instruction. The study was an evaluation research with a grounded theory analysis. In their study, the researchers analyzed the complex interactions that had taken place between the tutor and student using a computer during the tutoring sessions. The literacy software, a beta version was designed to guide the tutors while working one-on-one with the students that fall into the lower 30% of reading achievement. The participants in this study included eight, five-year-old daycare students. The participants were grouped by gender: four girls and four boys. Each group had both pre and early readers. Participants participated in 20-minute tutoring sessions each day for the duration of two weeks. The data for this study included parent surveys on demographics, age, gender and language use at home, as well as, observational notes and observational anecdotal notes the tutor composed. One limitation of this study was the abbreviated period during which the study took place. Two weeks is not a long enough to obtain reliable outcomes. Another
limitation was the small pool of participants used for the study. For this reason, the
generalizability of the results may be unreliable. However, the findings of this study do show
that the interactive computer software used by the students motivated and supported student
learning and that “participants become active participants rather than passive observers in the
process”. Also, this study focused on young children in grade school, whereas this intended
research will focus on post-secondary students at HBCUs.

A similar study that relates to kindergarten students was conducted by (Mitchell & Fox, 2001). In this quantitative study, the researchers examined two computer programs that were
designed to increase phonological awareness in kindergarten students. The purpose of the study
was to “investigate the effects of computer-administered instruction and teacher delivered
instruction on the phonological awareness of at-risk kindergarten and first grade students” (p. 316). The researchers guided the study by asking three research questions, “Can phonological
awareness be enhanced through computer-administered instruction? How effective is computer-
administered phonological awareness instruction as compared with teacher-delivered
instruction?” and “Is the effectiveness of these instructional methods of influenced by children’s
grade level?” (p. 316). There were 36 kindergarten students and 36 first grade students from six
different classrooms; the elementary school was in the southeastern part of the North Carolina.
The students consisted of 40 males and 32 females. The student participants ranged in age from
five years old to eight years old. Each was classified as “at-risk” based on teacher observations
and the results of the Peabody Picture Vocabulary Test-Third Edition (PPVT-III), and Literacy
Initiative for Everyone (LIFE) assessment. The students were given pre- and post-tests that
included the LIFE assessment and Phonological Awareness Test (PAT). The students were
randomly assigned and divided into three different treatment groups; each group contained 24
students with an equal number of kindergarteners and first graders. The groups were called Group A, B, and C and each received different instruction. Group A received computer-administered instruction in phonological awareness, Group B received teacher-delivered instruction in phonological awareness, and Group C explored mathematics and drawing software. Throughout the four-week study, the students were given practice time following 20 minutes of instruction. The results of this study indicated that there were “no significant differences between age, PPVT-III score, and pre-treatment measures” (p. 334). (Mitchell & Fox, 2001), determined that “phonological awareness of at-risk kindergarten and first grade children can be enhanced by using computer-administered instruction, as well as by using teacher-delivered instruction” (p. 336). Although most of the studies focused on students in elementary grades, the findings can be useful to this body of work. It is also noted that most of the scholarly literature is focused on elementary and secondary grade levels, and not much on the infusion of technology into post-secondary education.

Another study using kindergarten students as participants was conducted by (Coyne, Pisha, Dalton, Zeph, & Smith, 2012). This study was conducted to determine a concrete approach to teaching students with significant intellectual disabilities. The researchers hoped to demonstrate how a research-based, balanced literacy approach, with the integration of the Universal Design and technology-based computer software, could create more supportive and accessible learning environments for students with disabilities. This quantitative study examined nine teachers of kindergarten through second grade and their students. Each classroom included students with significant intellectual disabilities in both inclusive classrooms and “substantially separate classrooms” (p. 164). A total of 23 students were selected from the observed classrooms using two criteria: the participants were “reported to have shown significantly below average
intellectual functioning and deficits in two or more areas, and they received reading instruction in one of the identified classrooms” (p. 164). The researchers administered the Woodcock-Johnson Test of Achievement III which is used to determine reading growth through Listening Comprehension and Basic Reading Assessments. There are many limitations with this study because some observations were not recorded during the study. However, findings from this study indicate that the students involved showed “significantly greater gains in the Woodcock-Johnson Test of Achievement III passage comprehension subtest” (p. 162) because of being taught with the Universal Design and technology software approach to literacy instruction.

**Computer Assisted Instruction**

(Computer-assisted instruction. Research on school effectiveness project: Topic summary report) said that because of the technological advances, computer assisted instruction has gained popularity since computers have become less expensive and more powerful, which allows students more access to computers at home and at school. (Trochim, 2006) said that computer-assisted instruction makes it easier for instructors to develop courses that incorporate mastery learning or personalized instruction which may potentially increase passing and retention rates.

Often professors use computer-assisted technology to supplement their traditional teaching style of teaching concepts, whereas in other cases professors rely solid on the software to for instruction. I most cases the computer-assisted instruction can be customize to the software training to the lessons based on student’s individual needs. The possibilities of computer assisted technology are endless because there are so many benefits of having a software that can be customized to a student’s specific needs Not to mention, that most of customized assisted technology can be set with specific deadlines or it can be set up for self-paced instruction, which will allow the student to move at his own pace. This technology is ideal for developmental
courses and any other courses that may require students to have prior knowledge of a skill, like Calculus I. The ability of this software to assign material that can be set to self-paced and immediate feedback is wonderful for students.

**MyMathLab**

MML is computer software where students have access to features such as interactive tutorial exercises, instant feedback, multimedia, homework, quizzes, tests, videos, e-books and tutorial center. Instructors can assign, and monitor students’ progress based on homework, quizzes, and tests. A detailed description of some of these features follows below.

**Interactive Tutorial Exercise**

Homework and practice exercises are the same as the exercises found in the accompanying textbook. The exercises are generated by built-in algorithms to give students unlimited attempts for practice and mastery in a self-paced mode. Exercises come with a step by step guided solution, and when students enter the wrong answer, instant feedback is provided. After the third attempt, a new window with a guided solution appears and a new problem is generated for the student to try again. Students also have access to quizzes and tests. This allows for frequent testing which can be monitored by the instructor. Depending on the instructor, these quizzes and tests can be used as part of students’ grade or for students to practice newly learned material. Based on students’ performance on these quizzes and tests, instructors can create and recommend specific plans of action for each student.

**E-Book and Multimedia**

When students log in to MML, they have access to the same book used in class. In addition to having access to the e-book, students have access to a section called “Tools for Success”. In it they find studying and learning techniques, recommendations on how
to deal with math anxiety, and how to use graphing calculators. The multimedia sections of MML offers a collection of video clips and animations on every section covered in the book. Students can play videos on sections covered by the instructor in class to reinforce learning at a self-paced mode.

The Tutor Center

Students have access to the Pearson Tutor Center 24 hours a day, 7 days a week.

Once registered, students have one free session of up to 30 minutes of one-on-one tutoring for the duration of the course; students can purchase additional hours. They can contact the Tutor Center by phone, fax or email. Assistance is provided in English and Spanish.

Summary

In Chapter 2, the researcher examined previously reviewed literature that assisted in understanding prior pedagogical strategies and learning theories that have been done to explain the way students learn. Yet the bases of this study focus on two theories cognitive multimedia learning theory, and the theory of mastery learning. Both are highly respected theories that explain the most effective way of teaching and learning. The researcher intends to focus on the combination of these theories with the assistance of computer software also known as computer assisted instruction, MyMathLab.

In the reviewed literature, there was evidence that computer assisted instruction is most effective when it is used as an accompany lecturing, which is known as the traditional method of instruction. Some literature proved that computer assisted instruction is an excellent tool to use when teaching using mastery level since it allows individualized to have elf-paced learning.
where instant feedback is given to the student. The instant feedback serves as motivation to the student and in some cases, the student is encouraging to continue the learning process.

Based on the reviewed literature, cognitive multimedia learning along and mastery learning delivered through computer assisted instruction are both excellent instructional strategies and learning tools since both seem to meet the needs of adult learners better than lecturing, the traditional method of instruction commonly used in many institutions across the world. which was the purpose of this study. In other words, the researcher looks at teaching for mastery learning along with the use of computer-assisted instruction, MyMathLab, as the recipe of a highly effective instructor. MyMathLab allows students to work at their own pace and complete all assigned lessons that the professor has available at his or her own pace and time. Regardless of the student’s schedule, he or she can complete all assigned work if it is completed prior to the due date. The students are also allowed to watch tutorials and videos as many times as needed to assist in the learning process. Having the ability to watch tutorials and videos, helps students to fill a sense of security with completing assignments. Ultimately, MyMathLab is designed for students to meet course learning objectives with the use of computer-assisted technology that is customized to each individual user. It should be noted that there is a large amount of literature on elementary and secondary education courses that have incorporated MyMathLab technology into math courses, yet there is not a large amount of published literature on post-secondary institutions using this software to increase student success in Calculus I classes.

In the next chapter, the research describes the methodology of this study and restates the research problem. Chapter 3 details the purpose of this study, which is to investigate the differences in the final course grade of Calculus I students that were taught with two different instructional methods. The participants in this study were placed into two groups to complete this
investigation 1.) one group was taught using traditional lecturing for mastery learning with what was delivered though the use of MyMathLab, computer assisted instruction, 2.) the second group was taught using traditional lecturing for mastery learning without the assistance of a computer software. The next chapter will give a detailed explanation of how this research study was conducted.
Chapter 3: Methodology

Research in this study investigated the differences in the final course grades of Calculus I students that used the computer assisted instructional tool, MyMathLab and students who did not use the MyMathLab or any assisted instructional tool. For the purposes of this study, passage rate was defined by students letter grades. If a student received a letter grade of A, B, C, or D the student was considered to have passed the course. A grade of F was defined as a student did not pass the course. However, one must keep in mind that in most cases a student is required to earn a grade of D or better if the student wishes to pursue a STEM degree. The investigation included an evaluation of the effectiveness MyMathLab when used to assist in the delivery of Calculus I concepts as opposed to when the Calculus I concepts were delivered using the traditional method of lecturing with no assisted instructional tool such as MyMathLab. Students who were taught with the use of MyMathLab were defined as the treatment group. Students who were taught using the traditional lecturing methods were defined as the control group. Students enrolled in Calculus I classes were selected as participants because this course is a required course for all STEM disciplines at most universities. Because Calculus is also one of the gateway courses to a STEM degree, research in this study is timely and significant. A quasi-experimental design was used to test two hypotheses. Chapter three provides detail of the research methodology used. The chapter begins with a restatement of the hypothesis and research questions. The chapter then provides a description of the sample population and concludes with a discussion of the methodology and research design.
Hypotheses

The study aims to investigate if there is a difference in the Math 264 passage rate with the use of computer assisted instruction, MyMathLab, and the lecturing, traditional teaching method. Questions:

1. Do students who were taught Math 264 using mastery learning along with MyMathLab have a higher passage rate, than those students taught Math 264 with mastery leaning without the use of MyMathLab?

2. Do students that previously took Math 264 where MyMathLab was used believe that the computer assisted technology assisted them in advanced math courses?

Null Hypothesis:

There is no difference in the passage rate of Math 265 Calculus I students based on MyMathLab usage along with traditional lecturing at an institution in the southwestern region of the United States.

Sampling Population Environment

The Research Site

Research in this study takes place at a masters’ large programs institution in the southeastern region of the United States. The research was conducted on a sample of the population due to limitations, including constraints on access, funding resources, and time. For anonymity, the institution in this study will be identified as University of Duplechain.

University of Duplechain is a comprehensive institution, fully accredited by the Southern Association of Colleges and Schools Commission on Colleges offering graduate, professional, and doctorate degree programs. UD has a total undergraduate enrollment of 5,347, its setting is urban. It utilizes a semester-based academic calendar. UD offers a total of nine bachelor’s degree
programs in STEM: biology, chemistry, computer science, physics, electronic engineering technology, civil engineering, electrical engineering, mechanical engineering, and mathematics. This institution has a 62% retention rate of full-time students pursuing a bachelor’s degree. So over half of the incoming first-time, full-time degree seeking freshman are returning to the University of Duplechain to continue their sophomore year of college.

The overall graduation rate for full-time, first-time degree seeking students at the research site is 29%. The graduation rate below includes students that transferred from other institutions prior to graduating from college. These students are included in the success of the institution. The alarmingly low graduation rate can potently be increased as result of this research study. These facts may help the researcher understand this institution and its student population a little better.

The Course

To graduate with one of the nine Bachelor of Science, BS, degrees from the research site with a degree in one of the STEM disciplines approved by Louisiana Board of Regents⁵; students must complete the coursework in the school’s catalog specific to the discipline with a grade of C or better and maintain a grade point average of 2.5 or better on all attempted coursework. One course that is required for all STEM disciplines is Math 264-Calculus I, which is a 4-hour credit course. It is designed to be the first math course of the calculus sequence of three courses. Topics include revisit to some basic functions, the derivative at a point, the derivative function, higher derivatives, product and quotient rule of differentiation, chain rule of differentiation, and

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⁵ The Louisiana Constitution of 1974 gave the Board of Regents the responsibility to approve, disapprove, or modify all existing and proposed degree programs and administrative units of Louisiana’s public colleges and universities. These responsibilities have been delegated to the Academic and Student Affairs Committee, which is advised by its staff.https://regents.la.gov/divisions/planning-research-and-academic-affairs/academic-affairs/
applications of derivatives. Prerequisites: A grades of 'C' or better in Math 134 and 140, or consent of the department.

The Instructor

The table below shows the number of faculty and graduate assistance at the research site as of Fall 2016. This study reviewed data from seven semesters. Each semester there were three to four sections of Math 264 taught. Two of the professors that taught Calculus I at the research site understood the benefit of computer assisted instruction and committed to teaching sections with the assistance of MyMathLab. All sections were taught by a qualified mathematics professor.

Table 3.1. Faculty and Graduate Assistants by Primary Function Fall 2016

<table>
<thead>
<tr>
<th>Faculty and Graduate Assistants by Primary Function Fall 2016</th>
<th>Full Time</th>
<th>Part Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total faculty</td>
<td>405</td>
<td>104</td>
</tr>
<tr>
<td>Instructional</td>
<td>325</td>
<td>103</td>
</tr>
<tr>
<td>Research and public service</td>
<td>80</td>
<td>1</td>
</tr>
<tr>
<td>Total graduate assistants</td>
<td>109</td>
<td></td>
</tr>
<tr>
<td>Instructional</td>
<td></td>
<td>72</td>
</tr>
<tr>
<td>Research</td>
<td></td>
<td>37</td>
</tr>
</tbody>
</table>

Source: National Center for Education Statistics College Navigator

Description of Subjects

The subjects of this study are students that were enrolled in Math 264 Calculus I classes taught by a professor at an institution in southeast area of the United States. This institution is one of four campuses within the same HBCU System, which is in Louisiana. The subjects in this study are a sample of the population due to limitations, including constraints on access, funding resources, and time. These students, who self-enrolled, were enrolled in Calculus I between Fall 2014 to Spring 2017 semesters. This institution has specific admissions requirements, yet there are several different provisions for a student to gain admission to this institution. Students interested in enrolling at this school must have the following: high school diploma, high school grade point average (GPA) of 2.0 or better, a certain score on one of the following exams the
American College Testing (ACT) or Scholastic Aptitude Test (SAT) exam to be admitted into the institution. Now, there are several previsions that will allow a student to be admitted into the institution. There are provisions that will allow students to be accepted into the institution. For example, students that have an ACT math score of 18 or below can have the option of a placement exam to test into math courses. Students are placed into mathematics courses based on their entrance exam score or placement score. Students that meet the standardized exam ACT (19 or better) or SAT (math score of 460), score can enroll in college level algebra or in some cases the student will be placed directly in calculus I the very first semester. Those students that do not meet the ACT required score at admittance, are required to take a computerized placement exam to assess skill level and to be placed. Depending on the placement test score, students may be placed in developmental math courses initially depending on their math proficiency.

So, there are three specific ways that a student can enroll in Math 264 Calculus I:

1. Courses the student took in high school (students who have had Algebra I, II, Geometry and Advanced Mathematics, or Trigonometry)
2. ACT/SAT score
3. Pass Math 135 and Math 140, developmental math courses that teach basic grade school algebra, with a final grade of C or better.

**Research Methodology**

Research in this study was conducted by a quantitative study quasi-experiment design with one independent variable and one dependent variable. The researcher attempted to determine if there was a causal relationship between the instructional method of teaching Calculus I with the assistance of a computer assisted technology, MyMathLab (independent variable) and the dependent variable, final course grade. Because of time constraints and the fact that the test
groups already existed, there was no random assignment given to the subjects in this study. The researcher was aware that there are some disadvantages of using a quasi-experimental design; hence, the researcher felt that this was the best design for the type of study being done. It is also a possibility that the participant groups are independent of one another. There was not enough evidence to confirm this notion, so the researcher proceeded as though the groups were equal.

During the late 19th century and throughout the 20th, strategies of inquiry associated with quantitative research were those that invoked the post positivist perspectives. These include the true experiments and the less rigorous experiments called quasi-experiments and correlational studies and specific single-subject experiments (Campbell & Stanley, 1963). More recently, quantitative strategies involved complex experiments with many variables and treatments, factorial designs and repeated measure designs (Creswell, 2003). The two strategies that were used in this study were experiment and survey. An experiment, such as this study, desires to establish causality.

The quasi-experimental design shares similarities as the traditional experimental design, but it specifically lacks the elements of random assignment to the treatment or control group. Ordinarily, an experiment includes random assignment of subjects to reduce bias. Since the random selection was not possible, efforts were made to select groups that have as many similarities as possible. The research elected to do a Wilcoxon signed-rank test to test the first research question.

Some may question the use of the Wilcoxon signed rank test when there is a possibility that the groups were independent and not dependent. It is noted that in education and psychology, the most commonly used two sample test for shift is, of course the Student t-test. A major reason for its popularity lies in the fact that is said to be (a) robust to deviations of populations from
normality, and (b) more powerful than nonparametric counterparts that might be used in this stead (Boneu, 1962). Researchers who face the task of analyzing data that have been drawn from populations whose shapes are abnormal, are assured that the t-test is still the most appropriate procedure. Yet for the purpose of this study, the research conducted this study with the understanding that all participants in Group A and Group B were equals.

The second instrument that the researcher used to conduct this research study was a survey. It was the researcher’s intent to make a generalization from the sample response rate of the population that was surveyed. The researcher created a two-part survey in Qualtrics that was available online for participants. The survey contained 39 survey items arranged into groups on perception.

The concept of response rate refers to the percentage of individuals that respond to the survey divided by the total number of individuals in the sample. The literature on survey research, however indicates that more variables can be involved in calculating response rates than simply the number of responses divided by the number of individuals approached with the survey. In 1990, a group of professional organizations and research groups began to develop and disseminate standardized guidelines for defining and calculating response rate (Lynn, Beerten, Laiho, & Martin, 2001). In the United States, the American Association for Public Opinion Research (AAPRO) has developed a series of guidelines that appear to have become generally accepted among many survey research experts in the United States. For the purpose of this dissertation, all references to “response rate” refer to the simple calculation of number of responses divided by number of individuals approached to the survey.

One may ask what the standard response rate should be. According to (Fowler, 2002), “There is no agreed-upon standard for a minimum acceptable response rate.” For example, the American
Educational Research Association (AERA), a major scholarly association and journal publisher focusing on education research, has published extensive guidelines for reporting of education-related social science research (American Educational Research Association, 2006). The details of guidelines are spelled out but, they do not mention a minimum or nominally acceptable response rate for survey research. Fowlers stated that “The Office of Management and Budget of the United States federal government, which reviews surveys done under contract to the government, generally asks that procedures be likely to yield a response rate in excess of 75%” (p. 42). The research in this study defines a healthy response rate of at least 60%.

Study participants were students that were enrolled currently in advanced mathematics courses, courses that proceed Math 264. These criteria were established in the email that was sent to all students in group (Appendix 1) provided by the researcher. Before participants could begin the survey, they had to answer the following screening questions (1) Did these students took Math 264 at UD (2) Did the professor use MyMathLab in Calculus (3) If MyMathLab was used, what perception does the student have of the software now that he or she is in an advanced course?

Participants accessed the online instrument via a unique hyperlink that was included in the body of the email that was sent by the researcher. In the body of the email that was sent out, the researcher explained the importance of the study, and proceeded to tell students what needed to be done to participate. The email also stated that participation in this study was voluntary and that students that chose not to participate were not going to be penalized in any way.

**Research Design**

In this study, a quantitative research approach was taken to examine if there was a relationship between instructional method of teaching Calculus I with the use of MyMathLab
and student passage rates in the course. In addition, a second quantitative method was incorporated to view the MyMathLab perceptions from former Calculus I students.

A quantitative approach is one in which the investigator primarily uses post positivist claims for developing knowledge (i.e., cause and effect thinking, reduction to specific variables and hypotheses and questions, use of measurement and observation, and the test of theories), employs strategies of inquiry such as experiments and surveys, and collects data on predetermined instruments that yield statistical data. In Qualitative Inquiry & Research Design, Creswell argues mixed method is stronger than completing qualitative or quantitative research in isolation (2007). Yes, the research in this study is confident that the quantitative analysis done on the data collected will give strong results for other researchers to follow.

During data collection, the researcher collected seven semesters of final course grades from students that were once enrolled in Math 264 between Fall 2014 to Fall 2017. Students that were enrolled in sections that used MyMathLab along with traditional teaching for mastery learning will be placed in the experimental group. Whereas, students that were enrolled in sections of Calculus I that were taught the traditional way for mastery learning and did not use MyMathLab will be placed into the control group. Below is a chart summarizing the total number of participants that were enrolled in Calculus I between Fall 2014 and Fall 2017 at the research institution.

Table 3.2. Total Number of Students Participants

<table>
<thead>
<tr>
<th>Semester</th>
<th>Total Number of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall 2014</td>
<td>121</td>
</tr>
<tr>
<td>Spring 2015</td>
<td>73</td>
</tr>
<tr>
<td>Fall 2015</td>
<td>107</td>
</tr>
<tr>
<td>Spring 2016</td>
<td>72</td>
</tr>
<tr>
<td>Fall 2016</td>
<td>102</td>
</tr>
<tr>
<td>Spring 2017</td>
<td>70</td>
</tr>
<tr>
<td>Fall 2017</td>
<td>81</td>
</tr>
<tr>
<td>Grand Total</td>
<td>626</td>
</tr>
</tbody>
</table>
A research paradigm is shown in the figure below. It shows the variables studied and the processes involved in the quantitative aspects of the study.

Figure 3.5. Research Paradigm

**Quantitative Design**

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Dependent Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of MyMathLab videos, tutorials, assignments and quizzes</td>
<td>Final Course Grade</td>
</tr>
</tbody>
</table>

In this study, there were four sections each semester of Math 264, starting in fall 2014 to fall 2017 that were included in this study. Eight sections using the MyMathLab technology, whereas eight sections were taught using the traditional method without the assistance of MyMathLab. The researcher chose to look at four years of historical Calculus I course data because the number of students enrolled in each section was very small. The total of 626 students over the course of the four-year period were included in this study. Each student that participated in this study self-enrolled in Math 264 during the respective semester. The researcher did not have anything to do with the assignment of students in the classes. There was no random selection for this study. Two professors from the College of Science and Engineering that teach Calculus I at UD agreed to assist me with my research. The researcher was also able to get cooperation from the Director of Institutional Research. Once the researcher met with the faculty members and explained the relevant design for this study, both were willing to assist. Prior to getting access to the data, the researcher was given a list of Math 264 sections that would be included in the study and which faculty member taught the section and if the sections used MyMathLab.
The students in this study were taught using two slightly different methods of instruction, so students were divided into two groups, A and B. Group A, was taught using the traditional method of instruction for mastery learning, lecturing, along with the use of MyMathLab. Group B was taught using the traditional method of instructions for mastery without the assistance of computer assisted technology, MyMathLab. There were two professors at the site that used MyMathLab to teach Math 264 Calculus I each semester. The other faculty members used the traditional method of instruction without the assistance of software. In this study, students were assessed based on their final course grade in Math 264 (pass or fail). Final course grades are letter grades, ranging A through F. Final grades for students with a letter grade of C or higher were converted to “pass”, whereas final grades of D or lower were converted to “fail”. To ensure confidentiality, anonymity and to protect participants’ privacy, all interview questions will be unmarked at the end of the interview. The researcher will also remove student names from final grades list and replace the name with a unique identifier. The results of this study will only be reported in aggregate form making it impossible to identify any one student’s data.

Table 3.3 on the next page below shows the treatment that was administered to each of the two groups.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Group A(treatment)</th>
<th>Group B(control)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional instruction for mastery learning</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Use of MyMathLab</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>MyMathLab videos, instant feedback on homework assignments, e-book and chat-rooms</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
The calculus course used the curriculum designed by Person, the textbook company. The textbook will have a corresponding software, MyMathLab, which will consist of the same lessons as the textbook. MyMathLab is currently being used at institutions in southwest United States. So, the researcher would be evaluating a math course, multiple sections of the course, along with the computer assisted instruction being used.

As indicated earlier, this research involved a total of approximately six hundred twenty-six students that were enrolled in the Math 264 Calculus I course at the research site. The students will enroll themselves in the course and section. If the student does not meet the Calculus prerequisite that the university identifies, the student will not be allowed to enroll. The researcher will not have anything to do with the assignment of students in the classes.

The calculus course used the curriculum designed by Person, the textbook company. The textbook had a corresponding software, MyMathLab, which consisted of the same lessons as the textbook. MyMathLab is currently being used at institutions in Louisiana. So the researcher is evaluating a Math 264 Calculus I section at University of Duplechain in Louisiana.

The researcher intended for the faculty member teaching Calculus I, which was a sixteen-week course, to cover the first sixteen chapters of the text. The assigned Experimental Group was taught the same sixteen chapters from the same textbook, yet this group was required to use MyMathLab throughout the semester. The Control Group will have consisted of approximately one hundred thirty students. All course sections in this study were taught calculus using the same textbook and have the same professor yet did not use MyMathLab. The rationale for the design is to (1) improve on validity and (2) to ensure that the educational intervention be evaluated with the sample population.
This study involved four years of mathematics courses taught by the various faculty at University of Duplechain. The professor follows the same syllabus and exam dates for both sections. The institution hired faculty in the study followed the same syllabus to teach the course. The researcher selected calculus professor that currently use the software and were willing to be a part of a research study. The researcher used the ASSURE model as a guide for her research design since the ASSURE model deals with integrating technology in the classroom. The ASSURE model provides a systematic way to plan lessons that effectively integrate the use of technology and media to enhance student learning. This model uses a step-by-step process for planning a lesson and the technology and media that will strengthen it. Each of the six letters in the ASSURE acronym map correspond to a step in the process.

A is for "Analyze Learners"
S is for "State Standards and Objectives"
S is for "Select Strategies, Technology, Media, and Materials"
U is for "Utilize Technology, Media, and Materials"
R is for "Require Learner Participation"
E is for "Evaluate and Revise"

Using the ASSURE model as a guide in the implementation of the computer assisted instruction or in this case, MyMathLab, in teaching Calculus, the following steps or procedures will be done by the researcher. All sections of Calculus I used in this study met face-to-face, yet the experimental group had a MyMathLab course designed online. The calculus course had the curriculum designed by Person, the textbook company. The text book had a corresponding software, MyMathLab, which consisted of the same lessons as the textbook. The professor required that some of the assignments be completed outside of the classroom. The professor also monitored the number of hours each student is logging into the MyMathLab site to complete assignments. The control group was assigned homework outside of the classroom, but this group
was not responsible for purchasing the software, nor completing any assignments outside of what was assigned from the textbook. Once the classes were set up, the professor had access to MyMathLab to see what the students were doing, which allowed the professor to monitor students’ performance like, doing their practice exercises, are they watching the assigned videos and how much time did they spend on each video and time devoted to doing the practice exercises. All the other data was collected in the mathematics classrooms during the regular class period. At the end of the semester, after using MyMathLab, the professors turned in final grades to the mathematics department. The researcher compared the final course grades of the treatment group to the control group to find out if there is a significant difference in student performance. The researcher also conducted a survey that explores former Calculus I student’s perceptions of the use of MyMathLab videos and practice exercises in their Calculus classes.

**Data Collection and Research Instrument**

The quantitative data of this study came from two measures. The first quantitative strategy used was an experiment. An experiment was conducted to test the relationship between the treatment and the control group. The data results of the students’ final course grade and a survey were used. All course sections in this study followed the same course syllabus and textbook. So, each student was assigned the exact same course material and took the same departmental exams. The survey instrument that was utilized in this study was adopted from the survey questionnaire used by SRI International. SRI is an independent, nonprofit research center that works with clients to take the most advanced R&D from the laboratory to the marketplace. No validation is required since it has already been validated by SRI when they did the research on the use of Khan Academy in the classrooms in California. Khan Academy is an open source, free software used for the same intent as MyMathLab, which is to enhance learning.
Data Collection and Analysis

The goal of the study was to determine the effectiveness of MyMathLab as an enrichment tool in the teaching college students’ Calculus I. Since I choose to use historical data, the data collection method was relatively easy. A data request was sent to the UD Math Department of all Math 264 sections from Fall 2014 to Fall 2017. The research also requested student final letter grade and the professor teaching the section. There were two specific professors that consistently required that MyMathLab be used throughout the course. All course sections followed the same standard syllabus and exam.

The second quantitative approach used to investigate the second research question was a survey. Students that were in advanced mathematics courses were asked to complete the survey. The survey was intended to help understand the impact this educational technology, MyMathLab, had on students in advanced courses. Students took a survey questionnaire to explore their perceptions on the use of MyMathLab and its effectiveness. The survey questionnaire which was adopted from the survey used by SRI International was administered toward the end of the semester to all mathematics and engineering junior and senior level students after they were exposed to MyMathLab in Calculus I. No further validation of the research instrument is needed since SRI International has already validated similar courseware. The survey results were recorded and presented in both textual and tabular form.

The table below shows the summary of the research methodology. For each of the research questions, the table shows the research instrument and the statistical method/s that will be used in this study to answer each question as well as the research variables that are important in this study.
Research Questions | Research Variables | Research Instrument | Methodology/Statistical Treatment
---|---|---|---
1. Do students who were taught Math 264 using mastery learning along with MyMathLab have a higher passage rate, than those students taught Math 264 with mastery leaning without the use of MyMathLab? | Use of MyMathLab videos and assignments | Final Course Grade | Quantitative Wilcoxon signed-rank test

Do students that previously took Math 264 where MyMathLab was used believe that the computer assisted technology assisted them in advanced math courses? | | Research Survey Instrument | Quantitative Descriptive Statistics

Figure 3.6. Summary of Research Methodology

**Summary**

The proposed study aims to measure the effectiveness of the computer assisted instruction as an enhancement tool in the teaching of college level calculus classes. It seeks to determine if the students’ final course grade in Calculus I are significantly higher when using MyMathLab videos and exercises. It also aims to explore the students’ perceptions of MyMathLab videos and exercises.

Studies on the use of MyMathLab in the classrooms are limited, which may result in limitation as the researcher conducts this study.
This study hopes to present students’ perceptions of MyMathLab videos and exercises based on their experience in the classroom. By analyzing student grades, it also attempts to determine the effectiveness of MyMathLab as an enrichment tool in the teaching of Calculus. It is hoped that results of the study will contribute in helping college level mathematics professors improve their teaching, thus, making the students learn more effectively.

The researcher is aware that there may be limitations such as negative perception of courseware from professors and students. In 2017, the researcher must be aware that there are college professors that do not want to incorporate anything new into their current curriculum and that if negative perception exists, students may not buy into the redesigned course. Another limitation may be cost of courseware. Students in the courses selected to participate in this study will be required to purchase the specific courseware. The additional cost may pose a problem for some. Most importantly, the researcher must be mindful that there is always a possibility that it may be difficult to get participants. College professors and students may not be the easiest group of individuals that are willing to participate in such a study. So, the researcher must prepare of all challenges that may occur.

In the next chapter, the results of this study will be presented. The researcher had two research questions that were analyzed using a quantitative approach. In the next chapter, the researcher will explain that different approaches had to be used to analyze the two questions.
Chapter 4: Data Analysis and Findings

Chapter 4 is the results of the study. The study aimed to measure the effectiveness of the MyMathLab as an enhancement tool in the teaching of Math 264 Calculus I classes at University of Duplechain. The researcher sought to investigate if there was a significant difference in mathematics performance as measured by students’ final course grade of students taught with traditional lecturing for mastery learning along with incorporating computer assisted instruction, MyMathLab. The second research question yields a second quantitative approach, which was a survey to evaluate students’ perception on the use of MyMathLab after completion of Math 264 Calculus I.

Research Question 1: Do students who were taught Math 264 using mastery learning delivered through MyMathLab have a higher passage rate, than those students taught Math 264 for mastery leaning without the use of MyMathLab?

The data gathered for research question number 1 was analyzed using a quasi-experimental design. The question aimed to determine if students taught with the same instructional method along with the use of technology would have a higher passage rate than students taught without the use of computer software.

The researcher used seven semesters of historical data to investigate research question 1. Participants that participated in this study were placed into groups based on the instructional method taught. Students that withdrew from the course were omitted from this study. To keep anonymity of the participants and the instructors, all names have been changed. Students in Group A were taught using traditional instruction, lecturing for mastery learning along with MyMathLab. Students in Group B were taught using traditional instruction, lecturing without the assistance of computer assisted instruction, MyMathLab. In this study, the independent variable was the method of instruction and the dependent variable was the student’s final course grade.
Table 4.1 below shows that there was a total of six hundred twenty-six undergraduate students in this study over the course of a seven-semester period.

Table 4.1: Total Number of Students Enrolled in Math264 by Group/Semester

<table>
<thead>
<tr>
<th>Semester</th>
<th>Group A</th>
<th>Group B</th>
<th>Grand Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall 2014</td>
<td>92</td>
<td>29</td>
<td>121</td>
</tr>
<tr>
<td>Fall 2015</td>
<td>26</td>
<td>81</td>
<td>107</td>
</tr>
<tr>
<td>Fall 2016</td>
<td>79</td>
<td>23</td>
<td>102</td>
</tr>
<tr>
<td>Fall 2017</td>
<td>0</td>
<td>81</td>
<td>81</td>
</tr>
<tr>
<td>Spring 2015</td>
<td>30</td>
<td>43</td>
<td>73</td>
</tr>
<tr>
<td>Spring 2016</td>
<td>27</td>
<td>45</td>
<td>72</td>
</tr>
<tr>
<td>Spring 2017</td>
<td>34</td>
<td>36</td>
<td>70</td>
</tr>
<tr>
<td>Grand Total</td>
<td>288</td>
<td>338</td>
<td>626</td>
</tr>
</tbody>
</table>

The table below shows the breakdown of participants by classification. Although the students were not randomly placed into the two groups, here one can get an idea of the students’ experiences. Only 11% of the participants were not STEM majors but enrolled in the Calculus I course.

Table 4.2: Total Number of Students Enrolled in Math264 by Classification/Semester

<table>
<thead>
<tr>
<th>Semester</th>
<th>Dual Enrollment</th>
<th>Freshman</th>
<th>Sophomore</th>
<th>Junior</th>
<th>Senior</th>
<th>Grand Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall 2014</td>
<td>43</td>
<td>49</td>
<td>19</td>
<td>10</td>
<td></td>
<td>121</td>
</tr>
<tr>
<td>Fall 2015</td>
<td>39</td>
<td>32</td>
<td>18</td>
<td>18</td>
<td></td>
<td>107</td>
</tr>
<tr>
<td>Fall 2016</td>
<td>8</td>
<td>51</td>
<td>22</td>
<td>21</td>
<td></td>
<td>102</td>
</tr>
<tr>
<td>Fall 2017</td>
<td>12</td>
<td>45</td>
<td>14</td>
<td>10</td>
<td></td>
<td>81</td>
</tr>
<tr>
<td>Spring 2015</td>
<td>10</td>
<td>31</td>
<td>23</td>
<td>9</td>
<td></td>
<td>73</td>
</tr>
<tr>
<td>Spring 2016</td>
<td>25</td>
<td>24</td>
<td>13</td>
<td>10</td>
<td></td>
<td>72</td>
</tr>
<tr>
<td>Spring 2017</td>
<td>1</td>
<td>5</td>
<td>32</td>
<td>18</td>
<td>14</td>
<td>70</td>
</tr>
<tr>
<td>Grand Total</td>
<td>1</td>
<td>142</td>
<td>264</td>
<td>127</td>
<td>92</td>
<td>626</td>
</tr>
</tbody>
</table>

There were professors that taught Calculus I at the University of Duplechain over the seven-semester period. There were two professors that agreed to teach the course with the use of MyMathLab. Those professors were Professor A and Professor C. So, there was a total of 288 students in Group A, and 338 students in Group B.
Table 4.3. Total Number of Students Enrolled in Math264 by Professor Name/Semester

<table>
<thead>
<tr>
<th>Semester</th>
<th>Professor A</th>
<th>Professor B</th>
<th>Professor C</th>
<th>Professor S</th>
<th>Professor J</th>
<th>Professor I</th>
<th>Grand Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall 2014</td>
<td>61</td>
<td>29</td>
<td>31</td>
<td></td>
<td></td>
<td></td>
<td>121</td>
</tr>
<tr>
<td>Fall 2015</td>
<td>26</td>
<td>53</td>
<td></td>
<td>28</td>
<td></td>
<td></td>
<td>107</td>
</tr>
<tr>
<td>Fall 2016</td>
<td>30</td>
<td>23</td>
<td>49</td>
<td></td>
<td></td>
<td></td>
<td>102</td>
</tr>
<tr>
<td>Fall 2017</td>
<td></td>
<td>23</td>
<td></td>
<td>34</td>
<td>24</td>
<td></td>
<td>81</td>
</tr>
<tr>
<td>Spring 2015</td>
<td>30</td>
<td>43</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>73</td>
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<tr>
<td>Spring 2016</td>
<td></td>
<td>45</td>
<td>27</td>
<td></td>
<td></td>
<td></td>
<td>72</td>
</tr>
<tr>
<td>Spring 2017</td>
<td></td>
<td>19</td>
<td>34</td>
<td>17</td>
<td></td>
<td></td>
<td>70</td>
</tr>
<tr>
<td>Grand Total</td>
<td>147</td>
<td>235</td>
<td>141</td>
<td>28</td>
<td>51</td>
<td>24</td>
<td>626</td>
</tr>
</tbody>
</table>

Data Analysis

The Wilcoxon rank-sum test was conducted using student’s final course grades. The Wilcoxon rank is a nonparametric alternative to the two-sample t-test, which is based solely on the order in which the observations from the two samples fall. This test was selected because the students’ final course grades were alphabets and were converted to “pass” or “fail”. Those student that earned a letter grade of C or higher were coded to “pass”, whereas students that earned letter grades of “D” or “F” were converted to “fail”. As mentioned before, students that withdrew from the course were omitted from this study. Pass and fail are considered categorical data, which is the reason why the researcher selected this statistical method. Table 4.5 below has a detailed breakdown of students enrolled in Math 264 Calculus I with pass-fail percentages.
Table 4.4. Total Percentage of Pass and Fail by Experimental and Control Groups

<table>
<thead>
<tr>
<th>Semester</th>
<th>MyMathLab</th>
<th>Percentage that failed</th>
<th>Percentage that Passed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall 2014</td>
<td>Group A</td>
<td>26%</td>
<td>74%</td>
</tr>
<tr>
<td></td>
<td>Group B</td>
<td>52%</td>
<td>48%</td>
</tr>
<tr>
<td>Spring 2015</td>
<td>Group A</td>
<td>20%</td>
<td>80%</td>
</tr>
<tr>
<td></td>
<td>Group B</td>
<td>60%</td>
<td>40%</td>
</tr>
<tr>
<td>Fall 2015</td>
<td>Group A</td>
<td>12%</td>
<td>88%</td>
</tr>
<tr>
<td></td>
<td>Group B</td>
<td>63%</td>
<td>37%</td>
</tr>
<tr>
<td>Spring 2016</td>
<td>Group A</td>
<td>59%</td>
<td>41%</td>
</tr>
<tr>
<td></td>
<td>Group B</td>
<td>69%</td>
<td>31%</td>
</tr>
<tr>
<td>Fall 2016</td>
<td>Group A</td>
<td>44%</td>
<td>56%</td>
</tr>
<tr>
<td></td>
<td>Group B</td>
<td>74%</td>
<td>26%</td>
</tr>
<tr>
<td>Spring 2017</td>
<td>Group A</td>
<td>12%</td>
<td>88%</td>
</tr>
<tr>
<td></td>
<td>Group B</td>
<td>36%</td>
<td>64%</td>
</tr>
<tr>
<td>Fall 2017</td>
<td>Group A</td>
<td>48%</td>
<td>52%</td>
</tr>
<tr>
<td></td>
<td>Group B</td>
<td>48%</td>
<td>52%</td>
</tr>
<tr>
<td>Total</td>
<td>Group A</td>
<td>34%</td>
<td>66%</td>
</tr>
<tr>
<td></td>
<td>Group B</td>
<td>57%</td>
<td>43%</td>
</tr>
</tbody>
</table>

The chart above shows seven semesters of Calculus I data at UD. On average, there were four sections of Math 264 each semester. Students self-enrolled into the course section of their choosing. Each semester there were four professors teaching this course at UD. The professors had the right to use MyMathLab or not, so the groups were created based on if the professor chose to use MyMathLab to teach Math 264.

Above the chart shows that in Fall 2014 there were a total of 121 students that completed Math 264. Of the 121 students, 92 of them were in sections that used MyMathLab; in other words, 26% of the students that enrolled in Math 264 where MyMathLab was incorporated passed the class.
Table 4.5 below shows the results of the Wilcoxon analysis. The Wilcoxon two-sample test statistics equals 103,064, which is the sum of the Wilcoxon scores for the students who used the MyMathLab. The sum is greater than 90,288, which is the expected value under the null hypothesis of no difference between the two groups of students. The one-sided p-value is less than 0.0001, which shows the students who used MyMathLab are significantly more than those students who did not use the MyMathLab software.

**Table 4.5. Wilcoxon Rank Test**

<table>
<thead>
<tr>
<th>MYMATHLAB</th>
<th>N</th>
<th>Sum of Scores</th>
<th>Expected Under H0</th>
<th>Std Dev Under Ho</th>
<th>Mean Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>288</td>
<td>103064.0</td>
<td>90288.0</td>
<td>1942.23446</td>
<td>357.861111</td>
</tr>
<tr>
<td>NO</td>
<td>338</td>
<td>93187.0</td>
<td>105963.0</td>
<td>1942.23446</td>
<td>275.701183</td>
</tr>
</tbody>
</table>

Average scores were used.

Table 4.6 below shows the results of the median two-sample test. The test statistic is 180.92, and the standardized z value is 6.58. The one-sided p-value is Pr > Z, which is less than 0.0001.

Thus, the null hypothesis, that there is no difference in the passage rate of Calculus I students based on MyMathLab usage, is rejected. So, the results of the Wilcoxon Test proved that there is a significant difference between final course grades of students that were taught traditionally for mastery learning along with MyMathLab, versus those students that were just taught traditionally with mastery learning.
Table 4.6. Two-Sample Test

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Median Two-Sample Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statistic</td>
<td>180.9249</td>
</tr>
<tr>
<td>Z</td>
<td>6.5780</td>
</tr>
<tr>
<td>One-Sided Pr</td>
<td>&gt; Z &lt;.0001</td>
</tr>
<tr>
<td>Two-Sided Pr</td>
<td>&gt;</td>
</tr>
</tbody>
</table>

Colleges and universities pay close attention to professional experience when hiring faculty, yet they do not focus on the individuals teaching methodology or if the person has any teaching experience. Most people that apply for college professor positions have no teaching experience at all but have knowledge of content area, so these people are hired to teach students that pay an enormous amount of money to attend college. The knowledge of subject area is critical, but the delivery method is just as important or more important in a classroom. Professors often speak about being highly effective and things that can be done to make them more effective, but technology is usually something that is viewed as time consuming and costly. Content area technology is always available to educators, but most say that learning how to utilize the technology can be cumbersome. So, in turn, most professors make the decision not to incorporate technology into their curriculum before the technology is viewed. Although there are situations where faculty perception of technology is viewed negatively, the results of this study show that the use of technology along with lecturing for mastery learning yields better student performance in Calculus I.
Research Question 2: Do students who previously took Math 264 where MyMathLab was used believe that the computer technology assisted them in advanced math courses?

The second research question was investigated using a survey. The question aimed to determine if students who previously took Math 264 with the use of MyMathLab currently perceive that the software was helpful. It was the researcher’s intent to make a generalization from the sample of the population that was surveyed. The researcher created a two-part survey in Qualtrics that was available online for participants. The survey continued 39 survey items arranged into groups on perception.

Participants in this investigation were students that were enrolled currently in advanced mathematics courses in Spring 2018 semester, courses that proceed Math 264. This criterion was established in the email that was sent to all students in group (Appendix 1) provided by the researcher. Before participants could begin the survey, they had to answer the following screening questions (1) if these students took Math 264 at UD (2) did the professor use MyMathLab in to teach Calculus I (3) if MyMathLab was used, what perception does the student have of the software now that he or she is in an advanced course.

Participants accessed the online instrument via unique hyperlink that was included in the body of the email that was sent by the researcher. In the body of the email that was sent out, the researcher explained the importance of the study, and proceeded to tell students what needed to be done to participate. The email also stated that participation in this study was voluntary and that students that chose not to participate were not going to be penalized in any way.

All surveys were submitted anonymously. At the time data were complied, there was 46 responses, which was a 66% percent response (46 responses out of 70). There was a total of seventy students that were enrolled in in STEM courses in the Spring 2018 semester that were
contacted via email for this study. The table below shows the results of the two-part survey responses from students.

Table 4.7. Summary of Participants Survey Responses-Part I

<table>
<thead>
<tr>
<th>Survey Questions</th>
<th>Total Yes</th>
<th>Total No</th>
<th>Total N/A</th>
<th>Total Responses</th>
<th>% of Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before we begin, we would like to make sure you qualify for our study. Are you 18 years of age or older?</td>
<td>46</td>
<td>0</td>
<td>46</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>I have read the informed Consent document for the MyMathLab study. I understand the purpose and nature of the study as it is described.</td>
<td>38</td>
<td>8</td>
<td>46</td>
<td>83%</td>
<td></td>
</tr>
<tr>
<td>Did you take Math 264 Calculus I at University of Duplechain (UD)?</td>
<td>19</td>
<td>22</td>
<td>5</td>
<td>46</td>
<td>41%</td>
</tr>
<tr>
<td>Did your professor use MyMathLab in your Math 264 Calculus I course?</td>
<td>14</td>
<td>4</td>
<td>28</td>
<td>46</td>
<td>30%</td>
</tr>
<tr>
<td>Before taking this course, I was comfortable using a computer.</td>
<td>12</td>
<td>2</td>
<td>32</td>
<td>46</td>
<td>26%</td>
</tr>
<tr>
<td>In general, I found the MyMathLab software to be user-friendly.</td>
<td>13</td>
<td>1</td>
<td>32</td>
<td>46</td>
<td>28%</td>
</tr>
<tr>
<td>In general, I liked doing my homework on MyMathLab instead of doing paper and pencil homework.</td>
<td>11</td>
<td>3</td>
<td>32</td>
<td>46</td>
<td>24%</td>
</tr>
<tr>
<td>I understand math concepts better after using MyMathLab to complete my homework assignments.</td>
<td>11</td>
<td>3</td>
<td>32</td>
<td>46</td>
<td>24%</td>
</tr>
<tr>
<td>The time I spent on MyMathLab assignments was helpful to me.</td>
<td>12</td>
<td>2</td>
<td>32</td>
<td>46</td>
<td>26%</td>
</tr>
<tr>
<td>The MyMathLab assignments matched the classroom instruction for Math 264.</td>
<td>13</td>
<td>1</td>
<td>32</td>
<td>46</td>
<td>28%</td>
</tr>
<tr>
<td>I understand the math topics taught in Math 264 class better after completing the MyMathLab assignments.</td>
<td>12</td>
<td>2</td>
<td>32</td>
<td>46</td>
<td>26%</td>
</tr>
<tr>
<td>In general, I found it easy to enter my answers in MyMathLab.</td>
<td>11</td>
<td>2</td>
<td>32</td>
<td>45</td>
<td>24%</td>
</tr>
<tr>
<td>In general, I found it easy to use the various parts of the MyMathLab program.</td>
<td>12</td>
<td>2</td>
<td>32</td>
<td>46</td>
<td>26%</td>
</tr>
</tbody>
</table>

(table cont’d)
The survey results below show the results of the second part of the Qualtrics perception questions. Only 13% (six out of the 46 responses) of the responses said that MyMathLab was very helpful to them, now that they are no longer in the course. Yet, 71% (10 out of 14 responses) in Table 4.7 said the overall use of MyMathLab has helped them in current course.

<table>
<thead>
<tr>
<th>Survey Questions</th>
<th>Total Yes</th>
<th>Total No</th>
<th>Total N/A</th>
<th>Total Responses</th>
<th>% of Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>In general, I liked doing my homework with paper and pencil?</td>
<td>4</td>
<td></td>
<td></td>
<td>4</td>
<td>100%</td>
</tr>
<tr>
<td>The homework assignments matched the classroom instruction for Math 264 Calculus</td>
<td>4</td>
<td></td>
<td></td>
<td>4</td>
<td>100%</td>
</tr>
<tr>
<td>I understand the math topics taught in Math 264 class better after completing</td>
<td>4</td>
<td></td>
<td></td>
<td>4</td>
<td>100%</td>
</tr>
<tr>
<td>the course assignments.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall, the use of MyMathLab has helped me in my current course?</td>
<td>10</td>
<td>4</td>
<td></td>
<td>14</td>
<td>71%</td>
</tr>
<tr>
<td>Overall, I think the use of MyMathLab succeed in mathematics courses?</td>
<td>12</td>
<td>2</td>
<td></td>
<td>14</td>
<td>86%</td>
</tr>
</tbody>
</table>

Table 4.8. Summary of Participants Survey Responses-Part 2

<table>
<thead>
<tr>
<th>Survey Questions</th>
<th>Very Helpful</th>
<th>Some what Helpful</th>
<th>Not Very Helpful</th>
<th>N/A</th>
<th>Total Responses</th>
<th>% of Very Helpful</th>
</tr>
</thead>
<tbody>
<tr>
<td>Please rate each aspect of MyMathLab program based on how helpful it has been to</td>
<td>8</td>
<td>3</td>
<td>1</td>
<td>34</td>
<td>46</td>
<td>17%</td>
</tr>
<tr>
<td>you: - Immediate feedback on my answer to a problem</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Please rate each aspect of MyMathLab program based on how helpful it has been</td>
<td>7</td>
<td>2</td>
<td>1</td>
<td>34</td>
<td>44</td>
<td>16%</td>
</tr>
<tr>
<td>to you: - Option to see the problem worked out step by step with Help Me Solve</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>This</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Please rate each aspect of MyMath Lab program based on how helpful it has been</td>
<td>6</td>
<td>5</td>
<td>0</td>
<td>34</td>
<td>45</td>
<td>13%</td>
</tr>
<tr>
<td>to you: - Option to see more problems like this one with View an Example</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(table cont’d)
<table>
<thead>
<tr>
<th>Survey Questions</th>
<th>Very Helpful</th>
<th>Somewhat Helpful</th>
<th>Not Very Helpful</th>
<th>N/A</th>
<th>Total Responses</th>
<th>% of Very Helpful</th>
</tr>
</thead>
<tbody>
<tr>
<td>Please rate each aspect of MyMathLab program based on how helpful it has been to you: - Ability to access the textbook online</td>
<td>7</td>
<td>1</td>
<td>4</td>
<td>33</td>
<td>45</td>
<td>16%</td>
</tr>
<tr>
<td>Please rate each aspect of MyMathLab program based on how helpful it has been to you: - Ability to review my homework assignment after I have completed it</td>
<td>6</td>
<td>4</td>
<td>35</td>
<td>45</td>
<td>13</td>
<td>13%</td>
</tr>
<tr>
<td>Please rate each aspect of MyMathLab program based on how helpful it has been to you: - Ability to see assigned homework and due dates</td>
<td>7</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>13</td>
<td>54%</td>
</tr>
<tr>
<td>Please rate each aspect of MyMathLab program based on how helpful it has been to you: - Ability to see my grades on each assignment</td>
<td>7</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>11</td>
<td>64%</td>
</tr>
<tr>
<td>Please rate each aspect of MyMathLab program based on how helpful it has been to you: - Ability to start an assignment, save it, and come back to finish it later</td>
<td>6</td>
<td>6</td>
<td>0</td>
<td>1</td>
<td>13</td>
<td>46%</td>
</tr>
<tr>
<td>Please rate each aspect of MyMathLab program based on how helpful it has been to you: - Ability to rework questions as many times as I need to</td>
<td>6</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>13</td>
<td>46%</td>
</tr>
<tr>
<td>Please rate each aspect of MyMathLab program based on how helpful it has been to you: - Option to view video instruction for each section of the textbook</td>
<td>6</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>13</td>
<td>46%</td>
</tr>
<tr>
<td>Please rate each aspect of MyMathLab program based on how helpful it has been to you: - Access to the free Person Tutor Center</td>
<td>6</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>13</td>
<td>46%</td>
</tr>
<tr>
<td>Please rate each aspect of MyMathLab program based on how helpful it has been to you: - Option to complete sample quizzes, chapter reviews, and chapter tests</td>
<td>6</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>13</td>
<td>0%</td>
</tr>
</tbody>
</table>

One may ask what the standard response rate should be. According to (Fowler, 2002), “There is no agreed-upon standard for a minimum acceptable response rate.” For example, the American Educational Research Association (AERA), a major scholarly association and journal
publisher focusing on education research, has published extensive guidelines for reporting of education-related social science research (American Educational Research Association, 2006). Interestingly enough, the details of guidelines are spelled out but, they do not mention a minimum or nominally acceptable response rate for survey research. Fowlers stated that “The Office of Management and Budget of the United States federal government, which reviews surveys done under contract to the government, generally asks that procedures be likely to yield a response rate in excess of 75%” (p. 42). The research in this study defines a healthy response rate of at least 60%.

**Summary**

The research aimed to address two research questions: 1.) Do students who were taught Math 264 using mastery learning along with MyMathLab have a higher passage rate, than those students taught Math 264 with mastery leaning without the use of MyMathLab? 2.) Do students that previously took Math 264 where MyMathLab was used believe that the computer assisted technology assisted them in advanced math courses?

The findings revealed that student’s that were taught Math 264 Calculus I for mastery learning with the assistance of MyMathLab had a significantly higher passage rate than those students taught the same course without the use of computer assisted instruction. However, the results of the survey did not reveal that students that previously took Math 264 with the use of MyMathLab perceived that the software had an impact on them in current courses.

The next chapter will summarize the research study and provide some discussion of the intentions of the study, its findings, conclusion, recommendations, and implications for future research.
Chapter 5: Conclusion

Chapter 5 presents a summary of the purpose and findings of the research study and discussion of its connection to previous research, limitations, and recommendations.

Research in this study investigated the differences in the final course grade of Calculus I students that used the computer assisted instructional tool, MyMathLab and students who did not use the MyMathLab or any assisted instructional tool. For the purposes of this study, passage rate was defined by student’s letter grade. If a student received a letter grade of A, B, C, or D the student was considered to have passed the course. A grade of F was defined as a student did not pass the course. However, one must keep in mind that in most cases a student is required to earn a grade of D or better if the student wishes to pursue a STEM degree. The investigation included an evaluation of the effectiveness MyMathLab when used to assist in the delivery of Calculus I concepts as opposed to when the Calculus I concepts were delivered using the traditional method of lecturing with no assisted instructional tool such as MyMathLab.

The failure rate of college level Calculus I is hindering the number of STEM graduates at many institutions. Improving developmental mathematics education in community colleges: A Prospectus and early progress report on the Statway Initiative said fewer than half of college students enrolled in a “credit-bearing” college mathematics course completes it successfully (2010). So, it is critical that institutions put practices in place to help students with their mathematical deficiencies. Faculty pedagogy, curriculum design, and student assessment practices are the dominant sources of problems for students who eventually switch from STEM to other majors (Tyne, 2016). However, Seymour, E; Hewitt, N (1997) says, an underlying reason is the conceptual difficulties that students have that are not adequately addressed over the course of their mathematics career. The conceptual difficulties are carried throughout the
students’ lives; which poses major problems at the collegiate level. Students that have conceptual differences typically score low on standardized exams but manage to progress through school. Once these students enter college with the intent to major in STEM, math challenges become prevalent. At times, these students are at a cross road and are forced to change majors because they cannot grasp the mathematic concepts required to pass Calculus I, which is normally the first required course for all STEM majors.

The quantitative results of this study provided information to address the primary research question that guided this study. Additionally, there was a second research question that also had quantitative results to provide information to the researcher.

**The Primary Research Question that guided this study was:**
1) Do students who were taught Math 264 using mastery learning along with MyMathLab have a higher passage rate, than those students taught Math 264 with mastery leaning without the use of MyMathLab?

**The Secondary Research Question that guided this study was:**
2) Do students that previously took Math 264 where MyMathLab was used believe that the computer assisted technology assisted them in advanced math courses.

**Conclusion of Research Question 1**

The researcher collected quantitative data to address research question 1. The quantitative data were collected by means of getting four years, seven semesters of historical course data with 626 total participants from the institutions administration. 288 participants (46%) were enrolled in Calculus I sections that used MyMathLab. There was a total of six instructors that taught the sections of Calculus I, but only two that agreed to in cooperate MyMathLab. The independent variable was the instructional method used to teach Calculus I to students. The
dependent variable was the final course grade. The variables that were factors in this study were:

1) S# (unique identifier)
2) Current Term
3) Student Classification
4) Total Credit Hours Enrolled
5) Major
6) Course Listing
7) Instructor Name
8) Final Course Grade

The Wilcoxon rank-sum test was conducted using student final course grades. The Wilcoxon rank is a nonparametric alternative to the two-sample t-test which is based solely on the order in which the observations from the two samples fall. This test was selected because the students’ final course grades were alphabets and were converted to “pass” or “fail”. Those students that earned a letter grade of C or higher were coded to “pass” whereas students that earned letter grades of “D” or “F” were converted to “fail”. As mentioned before, students that withdrew from the course were omitted from this study. Pass and fail are considered categorical data, which is the reason why the researcher selected this statistical method.

The observed results of the statistical test indicated that there is a significant difference between final course grades of students taught with the use of MyMathLab and those taught the traditional method without the use of computer assisted technology.
Conclusion of Research Question 2

The second research question, Do students that previously took Math 264 where MyMathLab was used believe that the computer assisted technology assisted them in advanced math courses?

Here, the researcher addressed Research Question 2 by analyzing survey, with descriptive statistics, results from the emailed survey that was sent out to 70 students at the research site that were enrolled in advanced mathematics courses. At data collection, there was a 66% response rate on the survey (46 participants out of 70). There was a total of seventy students that were enrolled in advanced mathematics courses in the Spring 2018 semester that were contacted via email for this study. The results also showed that 14 participants (30%) of the respondents said they used MyMathLab in their Math 264 Calculus I course. Yet, 71% (10 out of 14 responses) in Table 4.7 said the overall use of MyMathLab has helped them in current course.

It is recognized that the findings on student perception was influenced by the small sample in the study along with time constraints. The sample size is a critical factor in determining that the analysis would meet the significance level given the expected effect. However, due to the small sample size surveyed, the present study employed that the survey results contributed to the quantitative results for research question 1.

Connections to Research

Mayes (2001) believes that humans can only process a finite amount of information in a channel at a time, and they make sense of incoming information by actively creating mental representation. His CTML helped to explain multimedia design principles; for example, multimedia principles work because students experience meaningful learning when they select, organize, and integrate visual/pictorial and auditory information with their prior knowledge.
Some researchers have expressed reservation about generalizability of how multimedia design effects influence in student learning (Acha, 2009). There was an experiment done to investigate the multimedia effect with four models of Web-based problem solving self-instruction in learning mathematics (Kim & Kim, 2012). This study used algebra and geometric representations often employed in learning mathematics within two different screen sizes. It included 101 tenth grade students from four classes in a public middle school in South Korea. In sum, the exiled multimedia design principles in this experiment studied on vocabulary to teach mathematics found that nonverbal information (pictures) are not equally effective as verbal information for all learners in the study. Moreover, modern research studies show mastery learning to be particularly effective when applied to instruction focusing on higher level learning goals such as problem solving, drawing inferences, deductive reasoning, and creative expression (Guskey & lea, 2001).

The researcher also kept into account that Knowles (1984) claimed that adult learners are self-directed and take responsibility for their own actions. Furthermore, they are likely to engage in their learning process, and they are task motivated. In this study, MyMathLab made it easier for students and instructors to communicate through a discussion board; which fostered a one-on-one virtual working relationship between the student and the instructor. Other features that were available to students was the customized online course, where students received instant feedback, and had the ability to watch tutorials and videos.

In this study, the researcher took into consideration finds on experiments done using CTML and findings from Bloom’s Theory of Mastery Learning and felt that the best student performance would come from the theoretical framework of using an instructional method that included both Myers and Bloom’s theories with the use of MyMathLab to teach Math 264.
Calculus I at an HBCU. Based on the findings of Research Question 1, the instructional method that included both Myers and Bloom’s theories along with the use of MyMathLab yields significant different in student performance. Although there were no found studies on the use of MyMathLab in a Calculus I course, the findings were consistent with previous research conducted on the use of MyMathLab to teach developmental mathematics in secondary schools and in community colleges.

For research question 2, the researcher was unsuccessful in finding literature on survey research nor scholarly journals that have produced a universally agreed-upon figure to describe an ideal or even a minimally acceptable survey response rate. Yet, as the research stated it is imperative that researchers conducting survey research understand the response rates for which they should aim not only because larger response rates can strengthen their research but also because reviewers, and journal editors may include response rate as a criterion when they evaluate scholarly work.

**Limitations**

This research experienced limitations during the study. Limitations of the study included funding, population sample, access to the sample, access to student performance scores and reliability of self-reporting. The lack of funding for conducting this study limited the research to only examining a sample of the population. If funding had been available, the researcher would have liked to examine a larger more diverse population.

The participants in this study came from historical data voluntarily given to the researcher from the institution. The demographics of the sample do not proportionately represent the entire population. If there was more time and resources available, the researcher could have conducted random selection of current students to create the sample for this study.
Since the researcher was given historical data from the institution, there was no access to the participations during the study. The researcher relied on the school’s administrator to get accurate and reliable participant data. The researcher also relied on the administrators to get email addresses for students that were currently enrolled in advanced mathematics courses to conduct the survey. The researcher included several modes of contact (phone, mailing address, email) in the survey to students, but only a small number were interested in participating.

The last but most important limitation was reliability of self-reported data, which increased the potential for multiple resources of biases. The researcher had to rely on the participants that took the survey to recall how he or she felt about MyMathLab and hoped that each would give honest responses. The researcher assured participants that all data collected would be reported anonymously in the original email communication and in the survey.

**Recommendations for Future Study**

This study was conducted, in part, to contribute to the literature needed to inform education agencies, policymakers, and advocates of the impact instructional methods and technology had on student success in Calculus I in HBCU environments.

The researcher felt it was necessary to investigate the attitudes and perceptions of the sample to add to the current research, but it would also be beneficial to analyze how the use of specific mobile applications could be used in a classroom or could be used by student and faculty to promote learning. Although some studies have been done with the use of MyMathLab and mastery learning in grade schools and community colleges, new studies could focus specifically on this instructional method for college level Calculus I courses.
Second, future research should also further develop new instructional methods and current technology and best practices so that students can have better performance in college level courses that have high attrition rates.

Summary

Research in this study investigated the differences in the final course grade of Math 264 Calculus I students that used the computer assisted instructional tool, MyMathLab and students who did not use the MyMathLab or any assisted instructional tool. The study took place at a HBCU in the southeastern region of the United States. For the purposes of this study, passage rate was defined by student’s letter grade. Participants were broken up into one of two groups. There was one treatment group and one control group. The treatment group (Group A) were students taught Calculus I for mastery learning with the assistance of MyMathLab, whereas the control group (Group B) were students that were taught Calculus I for mastery learning without the use of MyMathLab. The Wilcoxon rank-sum test was conducted using student final course grades to find out if there was a significant difference between Group A and Group B. The test revealed that there is a significant difference between the passage rate of students in Group A and in Group B. Last, the researcher conducted a survey to get perceptions of students that had previously taken Calculus I with the use of MyMathLab. It was recognized that the findings on student perception was influenced by the small sample in the study along with time constraints.
References


Appendix A: Student Survey Instrument-Online

MyMathLab_Dissertation Study

Intro Sheila Duplechain DeRouen is inviting you to take part in a research study about the use of MyMathLab software. Sheila is a Adjunct Instructor at Southern University and A&M College. She is also a doctoral student at Louisiana State University, running this study with the help of Dr. Roland Mitchell. The purpose of this research is to explore student perceptions about their use of the MyMathLb program to complete assignments in Math 264 Calculus I. Your part in the study will be to complete a short online survey about your use of the MyMathLab software associated with my Math 264 course. The survey may be completed online at your convenience within a 7-day time frame. It will take you less than 5 minutes to participate in this study by completing the survey. Consent By beginning the survey you acknowledge that you are at least 18 years of age, have read this consent form, have understood the above information, and agree to voluntarily participate in this research. Four people will win a $25 Visa Gift Card by completing this survey and entering contact information for the drawing. The drawing will be done on May 3, 2018 so please leave contact information at the end of this survey!!!!!!!

Screen line Before we begin, we would like to make sure you qualify for our study. Are you 18 years of age or older?

☐ Yes (1)

☐ No (2)

Skip To: End of Survey If Before we begin, we would like to make sure you qualify for our study. Are you 18 years of age or... = No
I have read the informed Consent document for the MyMathLab study. I understand the purpose and nature of the study as it is described.

- I am willing to participate in the MyMathLab study. I understand my rights as a participant in the study. (If you select this choice, you will be sent to the next page to begin the survey.) (1)

- I am not willing to participate in the MyMathLab study. I understand that my decision not to participate will not affect my standing with my professor or the university. (2)

Q4 Did you take Math 264 Calculus I at Southern University and A&M College (SUBR)?

- Yes (1)

- No (2)

Q5 Did your professor use MyMathLab in your Math 264 Calculus I course?

- Yes (1)

- No (2)
Q6 What semester did you take Math 264 Calculus I at Southern University and A&M College?

- Fall 2017 (1)
- Summer 2017 (2)
- Spring 2017 (3)
- Fall 2016 (4)
- Summer 2016 (5)
- Spring 2016 (6)
- Fall 2015 (7)
- Other (8) ____________________________

Q7 Before taking this course I was comfortable using a computer.

- Strongly agree (1)
- Agree (2)
- Somewhat agree (3)
- Neither agree nor disagree (4)
- Somewhat disagree (5)
- Disagree (6)
- Strongly disagree (7)
Q8 In general, I found the MyMathLab software to be user-friendly.

- Strongly agree (1)
- Agree (2)
- Somewhat agree (3)
- Neither agree nor disagree (4)
- Somewhat disagree (5)
- Disagree (6)
- Strongly disagree (7)

Q9 In general, I liked doing my homework on MyMathLab instead of doing paper and pencil homework.

- Strongly agree (1)
- Agree (2)
- Somewhat agree (3)
- Neither agree nor disagree (4)
- Somewhat disagree (5)
- Disagree (6)
- Strongly disagree (7)
Q10 I understand math concepts better after using MyMathLab to complete my homework assignments.

- Strongly agree (1)
- Agree (2)
- Somewhat agree (3)
- Neither agree nor disagree (4)
- Somewhat disagree (5)
- Disagree (6)
- Strongly disagree (7)

Q11 The time I spent on MyMathLab assignments was helpful to me.

- Strongly agree (1)
- Agree (2)
- Somewhat agree (3)
- Neither agree nor disagree (4)
- Somewhat disagree (5)
- Disagree (6)
- Strongly disagree (7)
Q12 The MyMathLab assignments matched the classroom instruction for Math 264.

- Strongly agree (1)
- Agree (2)
- Somewhat agree (3)
- Neither agree nor disagree (4)
- Somewhat disagree (5)
- Disagree (6)
- Strongly disagree (7)

Q13 I understand the math topics taught in Math 264 class better after completing the MyMathLab assignments.

- Strongly agree (1)
- Agree (2)
- Somewhat agree (3)
- Neither agree nor disagree (4)
- Somewhat disagree (5)
- Disagree (6)
- Strongly disagree (7)
Q14 In general, I found it easy to enter my answers in MyMathLab.

- Strongly agree (1)
- Agree (2)
- Somewhat agree (3)
- Neither agree nor disagree (4)
- Somewhat disagree (5)
- Disagree (6)
- Strongly disagree (7)

Q15 In general, I found it easy to use the different parts of the MyMathLab program.

- Strongly agree (1)
- Agree (2)
- Somewhat agree (3)
- Neither agree nor disagree (4)
- Somewhat disagree (5)
- Disagree (6)
- Strongly disagree (7)
Q16 Please rate each aspect of MyMath Lab program based on how helpful it has been to you:

<table>
<thead>
<tr>
<th>Aspect</th>
<th>1 Not very helpful</th>
<th>2 Somewhat helpful</th>
<th>3 I did not use this</th>
<th>4 Somewhat helpful</th>
<th>5 Very helpful</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate feedback on my answer to a problem (1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Option to see the problem worked out step by step with Help Me Solve This (2)</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Option to see more problems like this one with View an Example (3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Ability to access the textbook online (4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ability to review my homework assignment after I have completed it (5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ability to see assigned homework and due dates (6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Ability to see my grades on each assignment  
(7) | o | o | o | o | o | o |
| Ability to start an assignment, save it, and come back to finish it later  
(8) | o | o | o | o | o | o |
| Ability to rework questions as many times as I need to (9) | o | o | o | o | o | o |
| Option to view video instruction for each section of the textbook (10) | o | o | o | o | o | o |
| Access to the free Person Tutor Center (11) | o | o | o | o | o | o |
| Option to complete sample quizzes, chapter reviews, and chapter tests (12) | o | o | o | o | o | o |
Q18 What semester did you take Math 264 Calculus I at SUBR?

- Fall 2017 (1)
- Summer 2017 (2)
- Spring 2017 (3)
- Fall 2016 (4)
- Summer 2016 (5)
- Spring 2016 (6)
- Fall 2015 (7)
- Other (8)

Q19 Before taking this course I was comfortable using a computer?

- Strongly agree (1)
- Agree (2)
- Somewhat agree (3)
- Neither agree nor disagree (4)
- Somewhat disagree (5)
- Disagree (6)
- Strongly disagree (7)
Q20 In general, I liked doing my homework with paper and pencil?

- Strongly agree (1)
- Agree (2)
- Somewhat agree (3)
- Neither agree nor disagree (4)
- Somewhat disagree (5)
- Disagree (6)
- Strongly disagree (7)

Q21 I understand Math concepts better after completing my homework assignments.

- Strongly agree (1)
- Agree (2)
- Somewhat agree (3)
- Neither agree nor disagree (4)
- Somewhat disagree (5)
- Disagree (6)
- Strongly disagree (7)
Q22 The time I spent during homework assignments was helpful to me.

- Strongly agree (1)
- Agree (2)
- Somewhat agree (3)
- Neither agree nor disagree (4)
- Somewhat disagree (5)
- Disagree (6)
- Strongly disagree (7)

Q23 The homework assignments matched the classroom instruction for Math 264 Calculus I.

- Strongly agree (1)
- Agree (2)
- Somewhat agree (3)
- Neither agree nor disagree (4)
- Somewhat disagree (5)
- Disagree (6)
- Strongly disagree (7)
Q24 I understand the math topics taught in Math 264 class better after completing the course assignments.

- Strongly agree (1)
- Agree (2)
- Somewhat agree (3)
- Neither agree nor disagree (4)
- Somewhat disagree (5)
- Disagree (6)
- Strongly disagree (7)

End of Block: No Software Use

Start of Block: Drawing

Q27 If you would like to be included in the drawing for a $25 Visa Gift Card, please type your contact information below.

- First Name (11) ______________________________
- Last Name (18) ______________________________
- Email Address (12) __________________________
- Telephone Number (19) _______________________

End of Block: Drawing
Appendix B: Study Consent Form

PARTICIPANT INFORMED CONSENT

(Please read this informed consent in its entirety prior to agreeing to participate in this study)

Dear Students,

Hello, my name is Sheila Duplechain DeRouen, I am a doctoral student in the Educational Leadership & Research program, with emphasis in higher education administration at Louisiana State University. My dissertation focus is on technology as an intervention to enhance student learning in colleges courses. I have come to believe that the use of technology to simulate students learning and to aid professors in meeting student deficiencies in courses that are considered challenging for most such as calculus. I also feel that the incorporation of technology in these courses will result in higher course passage rates. College professors are experts, but often they are overwhelmed with guaranteeing that students are meeting all student learning outcomes. You are receiving this consent form because you are a student enrolled in a calculus course this semester. I am interested in getting student perceptions on technology and reviewing course grades in an effort to assess if the use of technology has an impact on student performance.

If you give me permission, I would like to invite student participants in this research study to complete a survey on perception, which will take about 10 minutes of your time. I would also like permission to review course grades for all student participants. It is also my desire to observe your calculus class several times during the semester. If you except my invitation to participate in this study, please check the box below and return this letter to your calculus professor, who will contact me. I will make myself available at a time and place of your convenience if you would like to speak with me prior to approval.

There is no compensation for responding nor does this study involve greater than minimal risk. All information collected will be used for my research and will be kept confidential. No identifying information that might jeopardize confidentiality will be collected. In order to ensure confidentiality, anonymity and protect your privacy all interview questions and will be unmarked at the end of the interview.

This study is extremely important to me, so I would like to thank you for assisting me with my educational endeavors through your participation. Once the study is completed, I would be happy to share the results with you if you desire. In the meantime, should you have any other questions regarding this survey/questionnaire, you may contact the Principal Investigator, Sheila Duplechain DeRouen at e-mail address sdulec1@lsu.edu, or Co-Investigator Dr. Roland Mitchell, at rwmitch@lsu.edu.

This study has been approved by the LSU IRB. For any questions concerning participant rights, please contact the IRB Chair, Dr. Dennis Landin, 225-578-8692, or irb@lsu.edu.
Thank you,

Sheila Duplechain DeRouen, PhD Student, Principal Investigator
Educational Theory, Policy and Practice Department
Louisiana State University Researcher

Dr. Roland Mitchell, PhD, Co-Investigator
School of Education
Louisiana State University

___ Yes, I agree to be a participant in your study. I agree to share my course grades with the researcher along with completing a 10 minute survey.
___ No, I do not agree to be a participant in your study. I do not agree to share my course grades with the researcher nor do I agree to complete a 10 minute survey.
Hello All,

Sheila Duplechain DeRouen is inviting you to take part in a research study about the use of MyMathLab software. Sheila is a Adjunct Instructor at Southern University and A&M College. She is also a doctoral student at Louisiana State University, running this study with the help of Dr. Roland Mitchell. The purpose of this research is to explore student perceptions about their use of the MyMathLab software to complete assignments in Math 264 Calculus I. You are receiving this email because you are enrolled in an advance math course during the Spring 2017 semester.

Your part in the study will be to complete a short 5 minute online survey about your use of the MyMathLab software associated with Math 264 Calculus I course. The survey may be completed online at your convenience within a 7-day time frame.

Remember, your participation in the survey is completely voluntary and all of your responses will be kept confidential. No personally identifiable information will be associated with your responses to any reports of these data. Southern University and A&M College has approved this survey. Should you have any comments or questions, please feel free to contact me at sheila_duplechain@subr.edu.

Four people will win a $25 Visa Gift Card by completing this survey and entering contact information for the drawing. The drawing will be done on May 3, 2018 so please leave contact information at the end of this survey!!!!!!!

To begin the survey, please click on the link below:

Follow this link to the Survey:
Take the Survey

Or copy and paste the URL below into your internet browser:
http://lsu.qualtrics.com/jfe/preview/SV_8qSCDpgaOJOBVkh?Q_CHL=preview

Follow the link to opt out of future emails:
Click here to unsubscribe

Thank you very much for your time and cooperation.
Appendix D: Institutional Review Board Approval

ACTION ON EXEMPTION APPROVAL REQUEST

TO: Sheila DeRouen  
High Education Administration

FROM: Dennis Landin  
Chair, Institutional Review Board

DATE: December 18, 2017

RE: IRB# E10822  
TITLE: MyMathLab as an Educational Intervention to Enhance Student Learning Outcome of Calculus at Historically Black Colleges and Universities


Review Date: 12/18/2017

Approved X Disapproved

Approval Date: 12/18/2017  
Approval Expiration Date: 12/17/2020

Exemption Category/Paragraph: 2b

Signed Consent Waived?: No

Re-review frequency: (three years unless otherwise stated)

LSU Proposal Number (if applicable):

Protocol Matches Scope of Work in Grant proposal: (if applicable)

By: Dennis Landin, Chairman

PRINCIPAL INVESTIGATOR: PLEASE READ THE FOLLOWING
– Continuing approval is CONDITIONAL on:
  1. Adherence to the approved protocol, familiarity with, and adherence to the ethical standards of the Belmont Report, and LSU’s Assurance of Compliance with DHHS regulations for the protection of human subjects*  
  2.
  3.
4. Prior approval of a change in protocol, including revision of the consent documents or an increase in the number of subjects over that approved.
5. Obtaining renewed approval (or submittal of a termination report), prior to the approval expiration date, upon request by the IRB office (irrespective of when the project actually begins); notification of project termination.
6. Retention of documentation of informed consent and study records for at least 3 years after the study ends.
7. Continuing attention to the physical and psychological well-being and informed consent of the individual participants, including notification of new information that might affect consent.
8. A prompt report to the IRB of any adverse event affecting a participant potentially arising from the study.
10. SPECIAL NOTE: When emailing more than one recipient, make sure you use bcc. Approvals will automatically be closed by the IRB on the expiration date unless the PI requests a continuation.

* All investigators and support staff have access to copies of the Belmont Report, LSU’s Assurance with DHHS, DHHS (45 CFR 46) and FDA regulations governing use of human subjects, and other relevant documents in print in this office or on our World Wide Web site at http://www.lsu.edu/irb
Certificate of

The National Institutes of Health (NIH) Office of Sheila successfully completed the NIH Web-based "Protecting Human Research

Date of completion:
Certification Number:
Vita

Mrs. Duplechain DeRouen has 13 years of experience in education. She has served as a computer science instructor, programmer, program manager and information technology specialist, an institutional researcher, and Director of Title III. Sheila has coordinated several federal and state grants and has taught elementary, secondary, and higher education technology courses. In addition to her teaching responsibilities Mrs. Duplechain DeRouen has spent several years as an institutional researcher. Prior to Sheila’s return to LCTCS, she was the System Director of Institutional Research and Data Governance at Southern University System. Sheila has an excellent relationship with the state and federal agency having served as the liaison between many of these agencies. Mrs. Duplechain DeRouen is a member of the Association for Institutional Research (AIR), the Southern Association for Institutional Research (SAIR), newly elected Vice President of Louisiana Association of Institutional Researcher (LAIR) and Alpha Kappa Alpha Sorority. She holds a Bachelor’s of Science Degree in Computer Science and Masters in Computer Science from Southern University and A&M College.