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Extended Instruction in Business Courses to Enhance Student Achievement in Math

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COLLEGE OF EDUCATION

This is to certify that the doctoral study by

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Abstract

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MS, Indiana University, 1989

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Doctoral Study Submitted in Partial Fulfillment

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Abstract

Poor achievement on standardized math tests negatively impacts high school graduation rates. The purpose of this quantitative study was to investigate if math instruction in business classes could improve student achievement in math. As supported by constructivist theory, the students in this study were encouraged to use prior knowledge and experiences to make new connections between math concepts and business applications. The key research question examined if there was a significant increase in the standardized mathematics test scores of students enrolled in business classes with extended mathematics instruction compared to the standardized test scores of students not enrolled in business classes with extended mathematics instruction. The 2-sample *t*-test was used to compare the scores of 42 students in the treatment group to the scores of 47 students in the control group. Based on the findings, there was not a significant difference in the scores of the treatment and control groups. Recommendations for future research included redesigning the treatment to involve additional areas of mathematics instruction as well as extending the number of weeks for the treatment. This study may effect social change by informing teachers and administrators at the local site of the need to examine the effects of incorporating math into other content areas and recommending continued research in this area. The additional exposure, practice, and learning opportunities in math may help high school students achieve in mathematics and ultimately improve graduation rates.

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Dedication

This work is dedicated to my parents, Rev. James and Doreather McNabb, who gave me life. You always believed in me and taught me to believe in myself. I am standing on your shoulders and the shoulders of those that came before you. This accomplishment belongs to you as much as it does to me.

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Section 1: Introduction to the Study

Introduction

Public schools are responsible for supporting student achievement as evidenced by improved standardized test scores. To balance the growing demands of accountability while maintaining high quality of instruction, school leaders are charged with determining which programs will best increase student achievement (Trudel, 2007). As prescribed in the No Child Left Behind Act (NCLB) of 2001, state schools are required to administer standardized tests such as the Georgia High School Graduation Test (GHSG), to all public school students in order to measure adequate yearly progress (AYP) which is based on individual academic achievement as well as schoolwide progress (Gamble-Risley, 2006; Jennings & Rentner, 2006). According to the Race to the Top Program, promoted by President Obama via the American Recovery and Reinvestment Act (2009), quality teaching and teamwork are needed and strongly encouraged to meet the challenges of improving student achievement. Schomoker (2006) contended that the continuous cultivation of quality teaching and advocating teamwork is effective and vital to improving student learning and achievement. Also, a myriad of professional development activities along with collegial interactions offer meaningful information and feedback to teachers to help improve student achievement (Schomoker, 2006). Mentoring, peer coaching, lesson studies, and collaborative planning all support quality instruction and result in higher academic success for students (Hammond-Darling, 2006; Schwille, 2008). In addition, self-reflective activities, such as journaling, self-evaluation, openly expressing frustrations, and observing and being observed by fellow practitioners,

are powerful tools that translate into improved teaching and learning (Petrides, 2006). Mowrer-Reynolds (2008) stated that effective teachers realize a purposeful and meaningful blend of professional skills that are key to making gains in student achievement. Moreover, teachers need a sense of common purpose that must be deeply woven into a school's culture, instructional mission, and daily practice (Crowther, 2009). Thus, the outcome of high-stakes tests represents a culmination of teamwork involving quality instruction rather than the efforts of one teacher or a small group of teachers (Kusnick, 2008).

Problem Statement

Many high school students, including those at a school that shall be identified as Main Street High School (MSHS), a suburban high school near Atlanta, Georgia, struggle to succeed in mathematics, which contributes to low student achievement in mathematics on standardized tests (American Recovery and Reinvestment Act, 2009; Elementary and Secondary Education Act, 2000; Gwinnett County Public Schools, 2009-2010; National Commission on Excellence in Education (NCEE), 1983; Sloane, 2008). Currently in the state of Georgia, four mathematics courses are required for students to meet graduation requirements, limiting the opportunity for students to explore interests in elective areas (i.e., business classes that can bridge mathematics concepts and business principles using real-world applications). Fewer students have the opportunity to learn how mathematics and business relate to everyday life, and this results in many students leaving high school without the functional mathematics skills, basic computer skills, and practical business knowledge that would prepare them to live in a financially driven world (Beswick, 2007;

Wang, Woo, & Zhao, 2009). After high school, students encounter real-life financial and consumer situations where fundamental knowledge of applications in mathematics and business is paramount. This impacts students at MSHS who do not succeed in mathematics courses, perform below passing on the GHSGT and are unable to comprehend the relationship between mathematical concepts, business principles, and computer skills by infusing them into real-life situations.

There are many possible factors contributing to this problem, among which are increasing pressures on public schools to meet the mandates of the NCLB Act (Schoen & Fusarelli, 2008), less local school autonomy to decide what courses to offer to students (Georgia DOE, 2007), and a lack of public awareness that the central tenets of a business curriculum are intertwined with components of business principles, mathematical concepts, and basic computer skills (Superfine, Kelso, & Beal, 2010).

Purpose of the Study

The purpose of this study was to examine if there was a difference between the standardized mathematics test scores of 11th grade first-time test takers enrolled in a business class that offered extended mathematics instruction and the standardized mathematics test scores of 11th grade first-time test takers not enrolled in a business class that offered extended mathematics instruction. The treatment was the extended math lessons received by 11th grade first-time test takers enrolled in a business class that offered extended mathematics instruction. Study participants were limited to 11th grade students who took the standardized mathematics test for the first-time during the second semester of the school year. The population in the study comprised approximately 400

students in the 11th grade who were first-time takers of the standardized mathematics test. An experimental group ranging from 15 to 40 students received the treatment of extended mathematics instruction during one semester from two business teachers, of whom I was one. The participants in the comparison group did not receive extended mathematics instruction in a business class at any time prior to taking the standardized mathematics test.

Nature of the Study

The standardized mathematics test scores of 11th grade test takers who were enrolled in a business class that offered extended mathematics instruction was compared to the standardized mathematics test scores of 11th grade first-time test takers who were not enrolled in a business class that offered extended mathematics instruction. The experimental group received a treatment comprising 10 to 12 lessons of extended mathematics instruction during one semester of the school year prior to taking a standardized mathematics test. Participants in the comparison group did not receive the treatment. The state department of education distributed test results to the school's curriculum office, located within the school, where I collected the data. I analyzed the data using Minitab software to compare the scores of the experimental and comparison groups using a stratified random sampling of the comparison group to provide proportional balance of the respondents in both groups.

Hypotheses and Research Questions

Research Question 1: Is there a significant increase in the standardized mathematics test scores of all 11th grade first-time test takers who are enrolled in specific

business classes with extended mathematics instruction compared to the standardized test scores of all 11th grade first-time test takers who are not enrolled in specific business classes with extended mathematics instruction?

***Null Hypothesis**:* There is no significant increase in the mean standardized mathematics test scores of all 11th grade first-time test takers who are enrolled in specific business classes with extended mathematics instruction and the standardized test scores of all 11th grade first-time test takers who are not enrolled in specific business classes with extended mathematics instruction.

***Alternative Hypothesis**:* There is a significant increase in the standardized mathematics test scores of all 11th grade first-time test takers who are enrolled in specific business classes with extended mathematics instruction and the standardized test scores of all 11th grade first-time test takers who are not enrolled in specific business class with extended mathematics instruction.

***Research Question 2**:* What is the extent of the improvement in scores of the students receiving extended mathematics instruction in business classes over the students not enrolled in these classes?

***Method**:* The improvement in scores (if any) will be estimated by finding the difference in the two sample mean scores.

Theoretical Base for Quantitative Study

This study was framed in constructivist learning theory (Meyer, 2009). Learners use prior knowledge and experiences to give meaning to new learning and understanding within the constructivist framework. There is strong support for teaching math

applications in business courses by using the prior knowledge of the learner to enhance math skills while also teaching business principles and improving computer skills. Constructivist teaching practice is also conducive to collaborative endeavors among teachers (Manganello, 2010). Wang, Woo, and Zhao (2009) asserted complex problems are best solved with people working together to build upon significant knowledge. Teaching across the curriculum, an approach rooted in constructivism, is an important aspect of enhancing student achievement that can influence classroom practice (Altun & Buyukduman, 2007). Business and math teachers joining forces to enhance achievement in math is an undertaking pursuant with constructivist teaching and learning that promotes a student-centered focus (White-Clark, DiCarlo, & Gilchriest , 2008).

Based in constructivist theory, this study compared standardized math test scores of an experimental group who received a treatment and a control group who did not. The comparison of these scores was to determine if the treatment impacted the outcome of student achievement in math (Creswell, 2009).

Definition of Terms

The list of defined terms for the study is as follows:

Academic achievement: student performance on a standardized test that is used to measure learning along with or in addition to the grade point average (Thurlow, 2008).

Extended instruction: programs constructed within or beyond the traditional school day to provide academic assistance, enrichment, and support to help students become successful (Van Roekel, 2008).

Standardized test*:* a uniformed test administered under controlled conditions that is used to measure visible results of student achievement and weaknesses (Camacho & Cook, 2007).

Assumptions, Limitations, Scope, and Delimitation

Assumptions

In this study, the instructors were volunteers and the students in the experimental group authentically engaged in all aspects of the treatment involving extended mathematics instruction. It was assumed that the business teachers administering the treatment possessed a competent level of mathematics knowledge and devoted equitable amounts of time to the treatment to all participants. Finally, it was assumed that all experimental group participants were similar to each other regarding ability levels, notwithstanding that they were enrolled in three different business courses. Since students are typically assigned to their classes in a random manner, this assumption was valid.

Limitations

This study was limited to students were in the 11th grade who were first-time test takers of the standardized mathematics test, and who did not participate in tutorial or intervention programs sponsored by MSHS. The sampling of the study decreased the generalizability of the findings because the course curriculum in the three business courses from which the experimental group were selected may differ in content from state to state and the findings may not be relatable from school to school. Another

limitation to this study was that teachers taught in their own styles bringing different mixes of pedagogy and instructional methodology to the participants.

Scope and Delimitations

This study was conducted at a high school located within a suburban community near Atlanta with approximately 2,500 students. The source for gathering data was from the state department of education through the school's curriculum office and testing center. Test scores were forwarded to and distributed by guidance counselors to individual students. Participants who were chosen to receive treatment in the experimental group were selected on the basis of naturally formed classes in Accounting, Business Essentials, and Computer Applications at MSHS. These classes met the criteria established for the study by offering extended instruction in mathematics. The timeframe allocated for the treatment was during one semester of the school year within the regular class period. Twelve extended mathematics lessons were taught prior to the administration of the standardized mathematics test which was administered four times throughout the school year.

Significance of the Study

Throughout the decades, many educational initiatives have been implemented to improve the quality of public education in America (U.S. Department of Education, 2011). However, a new level of accountability and curriculum standards were introduced to improve public schools in 2001 with the NCLB Act, signed into law by President Bush (Sherman, 2008). No Child Left Behind holds school officials, administrators, and teachers legally responsible for academic achievement, which is measured from state-

mandated standardized test scores (Schoen & Fusarelli, 2008). President Bush identified mathematics as a critical area needing improvement in academic achievement through quality teaching in order for the nation to remain competitive in the world (Sloane, 2008). Thus, the results in this study provided insight into how the curriculum in specific business classes was employed to impact academic achievement on the standardized mathematics test at MSHS. As school accountability increases and more focus is placed on academic achievement through standardized tests, it was significant to see how the findings of this study might be an influence on teaching practices as well as standardized test preparation practices at MSHS for the future.

Social Change

There is a need to educate or improve student achievement in math, but there are federal, state, and local challenges to adequately equipping students for their future. Teaching math strictly as a discipline in secondary schools can be traced as far as the early 1800s. In the late 1800s and early 1900s, however, teaching math was designed to meet the needs and interests of the country (Willoughby, 1967). Teaching math to prepare all students for college became a priority in 1899. Researchers have indicated that many high school graduates do not have the math skills necessary for today's job market or for college entrance requirements (Stone, Alfeld, & Pearson, 2008). The No Child Left Behind Act of 2001 included math as one of the content areas for student achievement.

The implications for positive social change in this study included providing information to teachers, administrators, officials, and educational leaders about the

impact of extended math instruction on student achievement. Practice prepares students for standardized tests, college coursework, the work place, and equips individuals to make life decisions that are computer-, business-, or math-related. The knowledge and skills that students take away from high school will impact society as they will become workers, consumers, and employers.

In a 2003 study, the Gallup Organization found that essential employment skills for the 21st century included critical thinking/conceptual, computers, and math, among others (Eisner, 2010). Greenstone and Looney (2011) noted that strong math skills grant individuals more marketability in the work place. Thus, schools should align learning and training with labor market needs which ensures long term job success for workers (Greenstone & Looney, 2011).

The implication of positive social change for this study also provided meaningful information to the general public about the benefits of linking course knowledge to real-life skills. Understanding the relationship between course knowledge and real-life skills garners public support and can improve public sentiment for effective school programs. Acquiring stronger math skills in school has a positive influence on educational, career, and economic choices for individuals, families, communities, business, and society as a whole.

Summary and Transition

Section 1 included an introduction of the examination of the problem of low academic achievement on standardized mathematics tests at MSHS. Data from this study provided guidance for practitioners across the curriculum to help students improve their

basic mathematics skills, gain knowledge in business, and learn computer skills. The findings had the potential to influence policy and practices for teaching mathematics in business classes, and provide new insight on strategies for standardized test preparation opportunities. The following sections of this doctoral study provide discussions on literature review in the field; the research method; the results of the study; and the summary, conclusion, recommendations for actions, and whether there is a need for further study.

Section 2: Literature Review

Introduction

Understanding mathematics makes it easier to understand how the world operates (Drickey, 2006). Many life decisions are math oriented and revolve around economic data, basic measurements, numerical inferences, critical thinking, deduction, and proof (Schornick, 2010). Math and business applications are also linked in practical situations, such as purchasing a home, balancing a checkbook, preparing tax returns, making wise investments (e.g., calculating interest rates, sales tax, and discounts), or saving for retirement. Because students must demonstrate levels of competence in math on high stakes tests, schools must motivate and prepare students through quality teaching to ensure learning is reflected in student performance (Ryan, Ryan, Arbuthnot, & Samuels, 2007). Within the context of accountability, the NCLB Act of 2001 was designed to foster student achievement goals, values for learning, academic self concept, and self efficacy regarding their ability to improve in math (Groen, 2012). Although waning skills in mathematics are not new in America's schools, current educational and global economic conditions transmit a sense of urgency for students to be high achievers in a knowledge society where information is constantly changing (Duffy, 2008). As a result of rapidly changing information, schools are driven to continuously improve as they educate students (Hargreaves, 2003). With continuous improvement in mind, schools institute learning activities that will help students develop strong critical thinking skills. Critical thinking, as stated by Mason (2007), is the ability to apply healthy skepticism and sensible reasoning to diverse viewpoints. These skills are imperative to survival in a

world that is significantly stimulated by technological, economic, and global factors in a growing digital environment (Lytras et al., 2008).

Consequently, current conditions leave students faced with multiple challenges to learn to apply critical thinking to real-world problem-solving skills (Levine et al., 2008; Schoen & Fusarelli, 2008). Neubert (2010) based his belief on Dewey's (1955) view of the relationship between democracy and education, as the only way that our globalized society can address and resolve complex problems. Dewey (1955) was against a class system that enabled a few to rule the masses and suggested that such conditions motivated the worst in human behavior. He contended that equal educational and political opportunities made for a more stable society (Samoukovic, 2013). Preparing students to be world citizens who can live successfully in a changing economy is contingent upon quality education designed to improve student learning (Lovat & Clement, 2008).

Implementing programs that benefit and better prepare students for the future calls for teachers to cultivate their knowledge about innovative processes of teaching and learning (Darling-Hammond, 2006; Dunn et al., 2009). An important component of this effort involves restructuring mathematics learning experiences through interdisciplinary teaching and learning activities (DuFour, 2011; Hamos et al., 2009; Schoen & Fusarelli, 2008). Approaches to restructuring are fostered through participating in professional development that drives vigorous engagement in teaching and learning (Christie, 2009). Spirited participation also has been linked to improved student performance (Hornik & Thornburg, 2010). Along these lines, programs such as RTTT, a reform introduced by

President Obama in 2009, further supports interdisciplinary instruction in critical needs areas that include science, technology, engineering, and mathematics (American Recovery and Reinvestment Act, 2009). Similarly, the NCLB Act of 2001 was put into practice to groom students for twenty-first century job skills in a rapidly changing and global economy.

While adhering to reform guidelines, many schools encourage educators to explore new processes to improve student achievement and prepare students for the future. As asserted by Dewey (1955), citizens must actively participate in learning in order to meet the needs of a growing society. Thus, every public school seeks to enhance each student's capacity to examine, understand, compare, contrast, create, support, and value different viewpoints to solve real-life problems in order to survive in the knowledge society (Sahlberg, 2010).

Information for this section was gathered through a review of current literature. Sources were online library databases including Academic Search Premiere, Chronicle of Higher Education, ebrary, Educational Research Complete, ERIC, ProQuest dissertations, Psyc INFO, SAGE Journals online, Teacher Reference Center, Internet searches through Google Scholar, peer-reviewed journals, periodicals, and textbooks. The following key words and phrases were used in the search: *academic achievement, business, business education, career technology, collaboration, collegial interaction, constructivism, constructivist learning, constructivist learning theory, constructivist principles, constructivist teaching, constructivist theory, constructivist theory of instruction, history of mathematics education, interdisciplinary instruction, learning, math achievement,*

math education, mathematics, mathematics achievement, mathematics education, professional development, professional learning community, quality teaching, student achievement, teacher collaboration, teacher development, teacher leadership, teaching, teaching across the curriculum, and *technology education.*

Approximately 200 articles, books, or other resources were reviewed for this study. Resources were selected on the basis of relevance and timeliness to the study. Literature from Ausubel (2000), Bransford, Brown and Cocking (1999), Brooks and Brooks (2000), Bruner (1960), (1985), Dewey (1929), (1955), (1956), Duckworth (1987), Gallagher (1969), Piaget (1980), Phillips (1995), Schank (1983), (1991), von Glasserfeld (1989), and Vygotsky (1978) was reviewed to authenticate constructivism as the theoretical framework for the study. Similarly, literature from Brooks (1876), Colburn (1825), and Davies (1850) was reviewed to illustrate how curriculum, teaching strategies, and reforms in mathematics education have evolved from the early days of public education to public education today. These works provided a chronological view of different philosophies and recommendations for improvement in mathematics education. In addition, notable committees and reports from various periods were reviewed to substantiate the well-established relationship between mathematics education and the needs of America to succeed and thrive as a nation.

Historical View of Mathematics in Public Schools

Arithmetic in the nation's public schools has evolved since its infancy in the 1800s to its current status as mathematics today (Saracho & Spodek, 2009). Bidwell and Clason (1970) stated that around 1821, the rule method was applied to teach arithmetic to

boys over the age of 12 as a strict mental discipline that required drills and memorization. At that juncture, teachers taught arithmetic skills needed for every day life, and it was considered too difficult for young children and girls (Bidwell & Clason, 1970). A few years later, Colburn (1825) expanded and formalized the mental displine as *new mathematics* which introduced practical problems that involved manipulation with objects, the concept of numbers, operations, abstract characters, and patterns. By midcentury, Davies (1850) believed that arithmetic should be studied using a logical system that included definitions, principles, and theorems. Moving forward about 25 years, Brooks (1876) taught arithmetic as a process of reasoning for making a range of comparisons.

As the last decade in the ninetenth century rapidly approached and the new century was forthcoming, major educational reform was created through organized groups of experts in various disciplines in education (Willoughby, 1967). One such group was the American Mathematics Society (AMS) which was formed in New York in 1888. The AMS organized and activated a national voice that sought to assess the mathematics needs and interests of the country, as well as to improve how mathematics was taught in secondary schools. In 1899, a detailed report produced by the AMS recommended that secondary schools teach mathematics to all students to prepare them for college. In 1900, the College Entrance Examination Board (CEEB) was established to develop a universal method to verify that students were properly equipped for college-level coursework. In 1920, *The Problem of Mathematics in Secondary Education* report proposed that mathematics should be taught as a useful tool rather than as a logical

sequence. The most important reform of its kind, *The 1923 Report* was far reaching in its influence of public school mathematics curricula and recorded teacher training in foreign countries. In addition, the report advocated for all educated individuals to be taught mathematics and addressed concerns that secondary school mathematics placed too much emphasis on drills and manipulation (National Committee on Mathematical Requirements, 1923).

During the mid-1940s and following World War II, large numbers of soldiers during the war struggled with inadequate mathematics skills (Klein, 2003). This helped to pave the way for mathematics educators and proponents to make significant curricular progress in secondary mathematics classrooms. Moreover, the government was convinced that increased mathematics competency was essential to the national defense. In order to advance national security, emerging technological advances required a better prepared workforce to meet the needs of the work place, which demanded a greater knowledge of mathematics.

The launch of Sputnik by the Soviet Union in the 1950s ushered yet another era of major reform in mathematics. Congruent to the American public's dismay was the global reality that the Soviets had successfully produced more scientists and engineers than the United States (Johanningmeier, 2010). As a result, intellectuals from various academic settings were called upon to modify and improve the national curriculum. Educators continued for several years to respond to an increasingly diverse population of young people by preparing some of them for college and others for new challenges and responsibilities in a developing industrialized workplace (Kafka, 2008).

In 1983, a report entitled *A Nation at Risk*, propelled public education to the forefront of the country's conscientiousness with a comprehensive report which contended that the core of our nation's foundation was threatened due to the weakness of our educational system and the low academic performance of students (NCEE, 1983). The report pinpointed knowledge, learning, and intelligence as essential resources for America to maintain its competitive edge in the world (NCEE, 1983). Additionally, the report became a precursor for modern day reforms such as No Child Left Behind (2001) and Race to the Top (2009).

Most widely known for its unparalleled and controversial accountability component in modern day educational reform is the No Child Left Behind Act of 2001, which has revolutionized education by exacting extreme attention to achievement gaps (Sherman, 2008). Although the legislation is perceived by educational advocates to be well intended, critics insist that the constant spotlight on failures serves more as political clamor than as effective policy for improving student academic achievement (Forte, 2010). The most recent reform in education is the RTTT program, signed into law by President Obama, which seeks to improve student achievement, close achievement gaps, increase high school graduation rates, and guarantee postsecondary success (American Recovery and Reinvestment Act, 2009) by boosting student achievement in science, technology, engineering, and mathematics, often referred to as STEM (Hershberg & Robertson-Kraft, 2010). Throughout the decades, mathematics has been an integral part of the curriculum in America's schools that has been taught applying educational practices largely established in constructivist principles (Hachey, 2013).

Constructivism and Educational Practices in Mathematics and Business

Although there are various perspectives on the constructivist learning theory, the fundamental principle is that learners use prior knowledge to build, create, or construct meaning to their personal experiences to gain understanding or develop a new outlook (Ausubel, 2000; Bransford et al., 1999; Brooks & Brooks, 2000; Bruner, 1960, 1985; Dewey, 1929; Duckworth, 1987; Gallagher, 1969; Loyens, Rikers, & Schmidt, 2007; Meyer, 2009; Piaget, 1952; Phillips, 1995; Schank, 1983, 1991; von Glasersfeld, 1989; Vygotsky, 1978). The constructivist theory underpins the process of teaching and boosting the mathematics skills of learners in business courses where prior mathematics knowledge is utilized in embedded, real-life business concepts (Kirschner, Sweller, & Clark, 2006). Schwartz, Lindgren, and Lewis (2009) stated that the constructivist teaching theory strongly supports using current learning to lay a foundation for future learning. Manganello (2010) supported the premise that the framework of constructivist teaching is conducive to collaborative conversation. Collaborative conversation between mathematics and business teachers is important, as this conversation bridges practical business applications requiring a working knowledge of mathematics to fundamental concepts learned in mathematics courses. According to Wang et al., 2009, complex problems are best solved with people working together in an effort to build upon significant knowledge. Not only is support for teaching across the curriculum rooted in the constructivist paradigm, but teachers' thoughts about this approach influences their classroom practice (Altun & Buyukduman, 2007; Beswick, 2006; Dunn et al., 2009; Harkness, 2008).

White-Clark, DiCarlo, and Gilchriest (2008), argued that the student-centered nature of constructivism, as opposed to teacher-centered teaching approaches, yields more success in mathematics classrooms. After surveying and observing 49 preservice math teachers and college math professors, the researchers found that the preservice teachers' beliefs affected their teaching style. The study's findings denoted that 100% of the preservice teachers stated that their math professors used lectures more than other teaching approaches, while textbook lessons were also commonly used. When the preservice teachers were observed in the field as student teachers, they in turn, employed lectures 80% of the time and used independent practice 67% of the time with their students. The researchers concluded that, although constructivist approaches provide students with the best ways to learn math, there is a disconnect between what should be taking place in math classrooms and what actually takes place in math classrooms, both on the secondary level and on the college level. To help teachers embrace and implement constructivist principles in their classrooms, White-Clark, DiCarlo, and Gilchriest suggested hands-on activities, technology, and manipulatives as alternatives to the lecture approach. Business teachers have an abundance of opportunities to take advantage of these suggestions as math concepts are intrinsically blended into substantial segments of the business curriculum. In addition, business classes are commonly scheduled in computer labs fully equipped with hardware and software rendering alternative teaching and learning approaches.

The purpose of a study conducted by Beswick (2006) was designed to assess secondary mathematics teachers' beliefs and possible connections to their classroom

practice. This study consisted of a sample of 25 mathematics teachers from six secondary schools with similar geographical locations and demographics. Beswick used classroom observations, teacher and students surveys, and interviews to determine how the beliefs of the teachers impacted their ability to create a classroom climate conducive to employing constructivist principles. Nine critical beliefs emerged that conveyed how constructivist principles influenced the teachers' classroom environments. The teachers believed that mathematics is fun, unpredictable, and should make sense for connecting ideas. The teachers also believed that mathematics can be learned by all students and that teachers should be lifelong learners. Lastly, teachers believed that they are the authority figures in the classroom who are responsible for the classroom tone, instruction, learning, and exposure to new ways of thinking. Based on these findings, Beswick concluded that teachers who operate as facilitators and whose pedagody and classroom activities reflect constructivist principles, are more likely to inspire students rather than simply instruct them. These constructivist principles adapt to business classrooms in that most courses are taught in computer labs where teachers frequently serve as facilitators. Technology makes it feasible for instruction to incorporate multimedia presentations and for individual or all computers to be captured and or monitored for instructional purposes. Subsequently, through technology it is not only possible for the teacher to demonstrate or model, but to institute thought-provoking activities and experiences to enhance learning. Beswick also concluded that constructivist principles do not limit teachers to one teaching style (Beswick, 2006; Breyfogle & Van Zoest, 1998; Cobb, Wood, &Yackelm, 1990; Gouch, 1998; Pirie & Kieren, 1992), as different mathematics classrooms were

observed where teachers used different pedagogic strategies. Finally, Beswick's concluded that the constructivist theory was operational in classrooms when teachers believed in their roles as facilitators and performed in that capacity.

Teo, Chai, Hung, and Lee (2008) concluded that teachers' beliefs about pedagogy had an impact on how technology was used in their classrooms. Teachers with traditional views of teaching were inclined to incorporate technology through drills, practices, or tutorials; whereas, teachers with constructivist views of teaching were inclined to incorporate technology through collaborative activities, group projects, or simulations. The objective of this study was to examine if there was a relationship between teachers' beliefs about teaching and the use of technology and to also examine if the use of technology was predicted by beliefs about pedagogy, gender, and age. The researchers targeted 582 preservice teachers who were enrolled in a training institute in Singapore. Of the 582 participants, the average age was 27.31 years with 354 females and 228 males. Data for the study were drawn from an online survey questionnaire. Teo, Chai, Hung, and Lee reported that it is unlikely for traditional teachers to use technology in a constructivist way and that constructivist use of technology is a significant predictor of constructivist teaching as well as a predictor of age. The researchers also reported that with both uses of technology, constructivist teaching and age are significant predictors; and both uses of technology are not significantly predicted by traditional teaching and gender.

Matzen and Edmunds (2007) also purported that the way teachers implement technology in their classrooms is related to their instructional beliefs. In a case study that

involved 148 elementary teachers in a one-year pilot program, pre, post, and follow-up surveys were completed. The survey measured the participants' self-monitored computer use practices, technical skills, and their awareness of educational theories. Survey questions were grouped into two categories: general instructional practices and instructional use of computers. Using the Pearson correlation test, the findings indicated that instructional practices were associated with increased use of technology for higher order applications. Qualitative data were also collected, analyzed from teachers in two separate case studies using surveys, interviews, and observations. One case study involved two schools located in the same region with similar demographics. During the study, participants completed surveys, structured interviews at the end of the study, and were observed prior to, during, and at the end of the study. Data were coded from rising themes related to instructional practices and use of technology connected with traditional or constructivist practices. The results found that technology is a start for making changes with instructional practices, but inconsistencies surface between technology use and instructional practice with many teachers. The second case study involved a single teacher at a school. Data were collected from an in-depth structured interview and five full days of classroom observations. The findings suggested that the teacher did increase the use of technology using constructivist strategies, despite adhering to traditional instructional practices prior to the study. Matzen and Edmunds concluded that there is a relationship between technology and constructist classroom practies, and the use of technology can promote constructivist instruction. They

purported that more research is needed to examine long term effects of technology and its impact on classroom practices.

In a study that examined teacher and student beliefs about instruction, Buyukduman (2007) reported that constructivist teaching principles enable students to focus on building upon prior knowledge to increase their ability to solve real-life problems. This was accomplished on a case-by-case basis rather than a systematic format. The study consisted of 26 students and one teacher who evaluated the effects of a constructivist instructional design. The results indicated that the constructivist design had a positive effect on the students when the class environment: accommodated sharing ideas, supported group participation to understand content and complete assignments, and imposed levels of accountability. Students enjoyed positive learning experiences from interactions with classmates and teachers that led to more exchanges of ideas, discussions, and questions about the course content. Business courses are largely project-based with student evaluation expectations requiring the creation and production of original products, while frequently working in collaboration with fellow classmates. Often, final products are publicly viewed by adults serving as judges in competitions and by parents or other adults in public meetings or forums involving the community

The experiences shared by teachers and students in a college mathemathics class were examined by Harkness (2009) to determine what implications belief rather than doubt had on the teachers' and students' thinking about mathematics. The study began at the beginning of one semester with the teacher assigning the students performance goals which led to competition and comparisons among students as well as a focus on grades.

In addition, the performance goals which were teacher centered, generated self doubt in the students' abilities to be successful in mathemetics. In a later semester with a different group of students, the teacher assigned learning goals rather than performance goals. Learning goals were considered student-centered and swayed the focus toward mastery of tasks for the sake of learning. Because the learning goals led to student involvement through cooperation, collaboration, and conversations, students believed in their ability to learn mathematics concepts. Likewise, the teacher was motivated by the students' belief in themselves and thus, was more reflective in her own mathematical thinking and practice. Data for the study were drawn from videotaped interviews, transcripts, mathematical autobiographies, end-of-the-semester reflections, and formal evaluations. The researcher used triangulated data and analysis from which themes emerged which led to the conclusion that social constructivist teaching practices encouraged active participation in learning affording students a deeper understanding of mathematics than would have been experienced using a different teaching approach.

Gholson and Craig (2006) presented two main ideas in a discussion of how computer-based instruction supports constructivist learning activities.. First, they suggested that instruction in a computer-based environment is ideal for *vicarious learning*. Vicarious learning, defined by the researchers, happens when the learner does not physically interact with the content they seek to master. Rather, learning occurs through deep-level knowledge constructed by the learner using a self-pacing process, often via multimedia presentations. Gholson and Craig also introduced *schema theory* and *cognitive constructivism* as learning mechanisms for learners with low-level

knowledge bases to recognize and respond to patterns. Schema theory also distributes memory that verifies how prior knowledge is organized by new material making it easier to retain new content knowledge. Because many low-performing mathematics students enroll in business courses, these students can modify mathematics knowledge structures to retain new business content with implanted mathematics concepts.

The learning process is internal; therefore, only the individual learner can interpret, reason, and reflect to construct knowledge. Hence, the root of cognitive constructivism, argued Gholson and Craig (2006), is that the learner interprets knowledge to make sense of it. With this argument in mind, teachers and technology are regarded as secondary factors motivating learners to think and acquire knowledge. This argument does not imply, however, that all meaning is equal given that incorrect meanings can be constructed.

To avert incorrect meanings and enhance shared meaning to support the validity of the learners' constructed knowledge in a learning community, the language, customs, problems, and tools should be made known to students and teachers (Greene, 2009). Conducting strategic instruction enables embedded mathematics concepts to be taught in business courses which provide students opportunities for additional practice, encouragement, and increased learning (McPherson, 2009). Accordingly, computer-based instruction should be presented in a way that makes it easy for students to organize the subject matter (Nugent, et al., 2008). In a learning community where the focus is on strategic instruction, students can embrace learning as they are provided opportunities for

cognitive scaffolding which evokes them to ask questions, utilize auditory and visual processing simultaneously, eliminates splitting the learner's attention between necessary and unnecessary information, and to engage in self-explanation. Scaffolding was also discussed by Staples (2007) in a study that involved collaborative practices as an instructional strategy in a secondary mathematics class. Based on Staples's study, collaborative inquiry was used to guide high-level task implementation by positioning students as mathematics thinkers. When students experienced difficulty in collaborative situations, the teacher provided opportunities for them to construct as well as contribute ideas to the learning environment. This activity helped students to participate and improve their understanding of math in a community of learners. The implementation of academic skills and knowledge in a variety of business courses is coordinated to support student learning collaboratively by helping students organize new knowledge based on these principles. **The Relevance and Role of Mathematics and Business**

Many research studies have focused on high school mathematics course content, teacher knowledge, instructional practices, classroom activities, learning processes, student achievement, and the high school to college transition in math (Baumert et al., 2010; Boaler, 2008; Flores & Roberts, 2008; Goldspink, 2007; Le, Lockwood, Stecher, Hamilton, & Martinez, 2009; Lobato, 2008). Few studies, according to Schornick (2010), have concentrated on enhancing achievement in math based on the experiences, opinions, and views of the students. Therefore, Schornick sought to ascertain whether students could provide valuable insight into why math achievement in America's schools ranks behind many schools around the world. Her study encompassed six high school

graduates enrolled in college developmental math courses at four different institutions. With the utilization of in-depth interviews, the researcher probed to gain insight into the students' perceptions about previous and current math experiences. Responses were recorded on a matrix where emerging themes were established. New themes were uncovered that had not previously been addressed in other studies. For example, students tolerate math only to finish and they do not find the courses rigorous or relevant. In addition, students perceive their teachers as not valuing the teaching and learning of math. Finally,students find the use of technology as a means to complete assignments on the computer rather than a support tool to refine skills and knowledge in math courses.

Career and technical education (CTE) courses, frequently referred to as business courses, serve a diverse population of students and integrates high-level academics and technology (Elliott, 2007). Business and CTE programs offer students non-traditional learning opportunities such as work-based learning, mentoring, job shadowing, internships, and participation in student organizations (Association for Career and Technical Education, 2009). In a survey conducted by Manpower (2010), employers reported a "high need" for workers who possess critical thinking and problem solving skills, ethics, professionalism, creativity, and the ability to be lifelong learners. CTE courses can enhance critical thinking and problem solving skills although the general public often has the misconception that students who enroll in such programs are slow learners, not college bound, or are likely to become high school dropouts (Association for Career and Technical Education, 2010). According to Kuenzi (2008), students at all

educational levels should be prepared and encouraged to pursue coursework in the areas of science, technology, engineering, and mathematics.

A study conducted by Elliott (2007) involved 2,500 high school students from five different school districts located in three geographical locations. The participants were divided into CTE and non-CTE groups. The groups' test scores from the Arizona Instrument to Measure Standards were compared for a five-year period. Another instrument implemented to all participants in the study was a learning styles assessment. Other data for the study was gathered from the Arizona department of education. These data included curriculum choice; CTE or non-CTE concentration; gender; race/ethnicity; disabilities, English proficiency, economically disadvantaged, academically disadvantaged, single parent home; individual vocational education plans; and visual, auditory and kinesthetic learning styles. These variables were examined in the study as factors that may affect standardized test scores. The results from the study revealed that students with individual vocational education plans scored higher than students who did not have this plan. Test scores of students with CTE concentrator showed no significant difference with higher or lower test scores. Test scores of CTE students with handicaps, limited English proficiency, and who were also economically disadvantaged, academically disadvantaged and lived in a single parent home, showed significantly lower test scores. CTE visual and auditory learners had significantly higher test scores, while kinesthetic learner scores were significantly lower than non-CTE. Black, Hispanic or other males, as well as Hispanic female CTE students had lower test scores. The researcher concluded that: CTE students underperformed on standardized tests compared

to non-CTE students because learning styles and other characteristics of CTE students preclude scoring well on standardized tests; when learning styles are considered and other factors that impact standardized test scores are addressed, there is no significant difference between CTE and non-CTE student performance on standardized tests; and CTE and non-CTE students are different; therefore, comparing raw scores is inappropriate.

Ma and Singer-Gabella (2011) discussed the role of math from the perspectives of two worlds. Traditional pedagogy was described as the "nonfigured world" while reform pedagogy was described as the "figured world" of teaching and learning. Closely tied to each world are the identities of the people or actors within them. Students identified themselves as reproducers of knowledge through problem solving in the traditional nonfigured world. Subsequently, the role of math in the traditional nonfigured world was to routinely train students to practice procedures and model example problems. Mathematics learners and doers, on the other hand, were proned to be in the reform figured world. The role of math in the tradition nonfigured world was to prepare students to discuss their thinking, design their own learning strategies, and use reasoning skills to facilitate meaningful understandings of math. Likewise, teachers have identities in each world. Teachers in the traditional nonfigured world identified themselves as ones to maintain the rituals of teaching. Conversely, the reformed figured world teachers identified themselves as resources for learning. The researchers concluded that worlds of mathematics with models of identify has implications for how math is constructed for

teachers and students. Hence, a role of math is to help students and teachers negotiate new constructions in order to establish new understandings of math.

Based on the contention of Schoenfeld (2006), the role of mathematics has never been a simple composition as it has evolved over the past century. Mathematics has served as a conduit of economic crises, reform movements, and counter reform movements. Whereas mathematical literacy in the 1980s demanded a literate citizenship prepared for the labor force or more advanced levels of mathmematics, contemporary convention entails having a solid knowledge base, an understanding of mathematical ideas, and the ability to solve problems using effective reasoning. Agreement on the role of mathematics is not without controversy as is evidenced by the need for the What Works Clearninghouse (WWC). This organization, established by the U.S. Department of Education, scans, evaluates, and rates research literature that provides scientific evidence of the effects of educational practices.

The role of mathematics, argued Nasir, Hand, and Taylor (2008), can be germane to closing the achievement gap by viewing mathematics through the lenses of culture and knowledge. The researchers described cultural knowledge as knowledge attained in an environment outside of school while domain knowledge was defined as knowledge prescribed by math educators and mathematicians from within the school. Conceived within these definitions, as noted by the researchers, is that communities of practice levy the power of knowledge; therefore, boundaries between mathematical knowledge and cultural knowledge must be acknowledged. In addition, identity concerns must be reconciled when gaining insight into cultural and domain knowledge. In a prior study by

Nasir (2000) on thinking and learning, middle and high school basketball players were requested to solve a percentage and average problems in two ways: within the context of basketball and within a traditional school format. The study affirmed that players were better able to solve the problem from a familiar framework than they were for the traditional school perspective. Using the basketball background, players made assumptions, used intuitive knowledge, evoked reasoning, and invented strategies to solve the problem. With the traditional format, students misapplied formulas, did not manipulate numbers, and did not rely on collective knowledge to solve the problem. From this experience, Nasir, Hand, and Taylor argued that students' sense of themselves is often illustrated in cultural knowledge about mathematics. This sense may be absent in the domain knowledge realm of mathematics. Although the differences in solutions may not have solely been related to the presence or absence of symbolic represenatation, the researchers believed that the findings spoke to sociocultural characteristics between the boundaries of cultural and domain knowledge in mathematics. Many ethnic groups within schools underperform on math achievement tests (Ketterlin-Geller, Chard, & Fien, 2008; Stinson, 2006; Strayhorn, 2010; Woodward & Brown, 2006) as well as in authentic learning environments. Notwithstanding that best teaching practices and professional development help diminish achievement gaps, cultural and domain knowledge in mathematics is relevant to the conversation on teaching and learning mathematics (Diversity in Mathematics Education, 2007).

Stone, Alfeld, and Pearson (2008) conducted a study to determine if Career and Technical Education (CTE) courses provide rigor and relevance in math by teaching

explicit math concepts within specific labor-market preparation (SLMP) areas.

The study comprised approximately 236 CTE teachers from sites around the country with business and marketing, auto technology, health, information technology, and agriculture program areas represented. The research team, funded by the National Research Center for Career and Technical Education, mailed recruitment letter to teachers from lists of professional organizations. Interested teachers submitted an application identifying their SLMP, a prospective math teacher partner, and written permission from a principal. Participating teachers recruited students by sending letters to parents to sign and return opt out forms only. Funding provided teachers with cash stipends and professional development opportunities, while students were given gift certificates for participating in the study. Prior to starting the year-long study, teachers in each SLMP were divided into experimental or control groups. Experimental teachers received extensive training through professional development as well as assistance from their math teacher partners to enhance their ability to identify occupational math in their individual courses. Lesson plans were prepared and guided by seven elements of the instructional model designed for the study. Teachers in the controlled group taught CTE courses using the traditional approach. The research team argued that this process of teaching and learning math enabled students to transfer knowledge from situational applications to abstract concepts in math. The study began using the TerraNova Comprehensive Test of Basic Skills (CTBS) Survey as a pretest. Data were collected for one academic school year. At the end of the year-long treatment, randomly selected students from each experimental and control classroom were administered one of three standardized math tests which were the

TerraNova CTBS Basic Battery test, the ACUPLACER Elementary Algebra test, and the WorkKeys Appled Mathematics Assessment. The results showed that the pretest and treatment had a positive effect on the TerraNova CTBS posttest scores. The pretest and treatment had significant positive effects on ACCUPLACER posttest scores. The pretest scores significantly affected posttest scores on theWorkKeys test, however, the treatment did not. Stone, Alfeld, and Pearson concluded that the math-in-CTE model was an effective demonstration of rigor for teachers and students by transforming implicit occupational contexts into explicit connections, making it possible for students to transfer their knowledge to abstract mathematical concepts. The research team also concluded that math was relevant because students engaged in curriculum that was applicable to real-life situations. Math is a critical subject for the future workforce because of the increased competition and rapidly changing economies around the world (Wynarczyk, 2009). Business workers make up a large portion of the labor force, therefore, it is important that students gain an understanding of how to relate math to business problems and decisions (Green & Emerson, 2008).

Teacher Learning: Requisite for Student Achievement

Based on international discourse, many scholars espouse that teacher knowledge is imperative to student achievement, despite cultural and societal differences (Akiba, LeTendre, & Scribner, 2007; Angrist & Guryan, 2007; Ball, Thames, & Phelps, 2008; Blomeke & Paine, 2008; Van Zoest, Moore, & Stockero, 2008). In a study conducted by Kim, Ham, and Paine (2011), the goals and structures of secondary mathematics teacher preparation programs and student achievement were analyzed and compared in the

different national contexts of South Korea and the United States. Of the 49 nationally accredited institutions that were examined, 28 were in the United States and 21 were in South Korea. The universities in both countries were located in varied geographical settings. Researchers presumed that all programs were officially recognized by professional associations of established by each government's guidelines.

The similarities and differences in programs were examined through handbooks or comparable information from official websites. First, researchers examined routes to certification in both countries. South Korea had a more centralized system that involved entrance to a university, then passing the national teacher employment test administered annually by the Korea Institute for Curriculum and Evaluation (Kang & Hong, 2008). Routes to certification in the United States varied considerably among states (Hess & Petrilli, 2006) in large part due to teacher shortages (Feistritzer, 2008). Nonetheless, the Accreditation of Teacher Education regulates minimum certification standards to ensure that teachers possess basic skills and knowledge for teaching (National Center for Education Statistics, 2009).

Relying on the expertise of two of the three researchers who were proficient in English and Korean, embedded ideas related to the aims and curricular structure of the secondary math teachers programs were identified. While being careful to not translate data and decontextualize meanings, the program courses were categorized into five types of teacher knowledge: content knowledge, pedagogical content knowledge, pedagogical knowledge, general knowledge, and field experiences. With respect to aims of teacher preparation programs, researchers determined that in both countries, teacher knowledge

and instructional methods were considered equally important. The demand for deep content of knowledge, however, was three times higher in South Korea than in the United States. In contrast, more than three-fifths of the programs in the United States, as opposed to less than one quarter of the programs in South Korea mentioned that situated learning experiences were beneficial to math teachers. In regard to student diversity, half of the programs in the United States mentioned it as an official aim, whereas only one program in Korean provided data on student diversity with it as a program aim.

Regarding curricular structures for teacher preparation programs, similarities and differences existed between the two countries. Differences in the programs included details in curricular content, and similarities included the ratio of general and non-pedagogical coursework requirements. The findings in the study showed that secondary math teacher programs in the United States and Korea both supported content knowledge, general knowledge, pedagogical content knowledge, pedagogical knowledge and field experiences. South Korean programs, however, focused more on mathematical content knowledge while programs in the United States focused more on general knowledge. Exposure to a wide range of disciplines was more heavily concentrated on in programs in the United States with teacher knowledge with academic expertise in math more heavily concentrated on in programs in South Korea.

The study found that program aims and curricular structures in both countries were impacted by cultural and societal expectations. The researchers asserted that the historical view of teaching in the United States reflected low knowledge expectations, with the most important teacher quality being student discipline. Further researchers'

findings indicated that many individuals in the United States who majored in math were likely to seek positions outside of teaching. On the other hand, researchers discovered that teachers in Korean society were revered, appreciated, and society had high knowledge expectations for teachers. Researchers purported that education in Korea had a long history as a top priority and that teachers were considered among the most intelligent members of society. The researchers concluded that mathematics teacher preparation programs, as well as student achievement in the United States and Korea were influenced by cultural beliefs, historical contexts, and social traditions. The research team determined that, while curricular requirements in both countries were aligned with international educational policies, South Korean programs produced substantive excellence in teacher knowledge and in student achievement. Lastly, the researchers maintained that differences and similarities in mathematics teacher preparation programs in Korea and the United States were beneficial to educational research and policy, and will be able to improve teacher education and student achievement in both countries (Kim, Ham, & Paine, 2011),.

Wood (2007) argued that the challenges of increased accountability to improve student achievement can best be met through quality instruction. Professional development equips teachers with the tools to generate valuable and engaging learning activities that are needed to deliver quality instruction. From this evidence, it has been suggested that students learn best when teachers themselves understand the processes of learning (Darling-Hammond, 2006). Therefore, professional development should not be constrained to its traditional context, nor should it be limited in scope to mandated

training sessions (Hill, 2009). Because teachers serve as the agents to effect classroom change and are expected to deliver quality instruction that produces measurable results, school officials have a responsibility to provide or support high quality professional learning programs for teachers. It is within this forum that teachers can frequently share ideas and information and participate in a variety of meaningful collegial activities that will benefit students (Bezzina, 2006).

Hamos et al. (2009) reasoned that no longer can teachers take comfort remaining isolated in their individual classrooms to focus solely on their subject content. Prior research (Bullough, 2008) found evidence to support a similar argument, namely, that every member of a faculty ought to embrace the common purpose of academic achievement. Based on findings from Crowther (2009), common purpose and influence must be deeply woven into a school's culture, instructional mission, and daily practices to enhance academic achievement. Facilitating this approach to improve schools requires that teachers actively and willingly pursue excellence in teaching in order to transform theory into practice (Levine, 2007).

With common purpose in mind, officials are sensible to institute school wide strategic plans for successful student achievement. Moreover, the outcome of high stakes tests, the measure for student achievement, reflects the efforts of a team and not one teacher or a small portion of a faculty (Kusnick, 2008). It was suggested by Darling-Hammond (2006) that teachers manage classroom functions; prepare lesson plans; collect, analyze, and interpret data; assess students; and prepare students for high stakes

tests. Thus, the directive for continuous growth through professional development should simply reinforce what teachers already execute on a daily basis.

Collaboration provides outstanding opportunities for teacher learning and increased student achievement (Bezzina, 2006; Mullen, 2008). Through collaboration, teachers build trust, gain a source of strength by means of reflective practice that energizes them, and are enabled to support each other's endeavors (Fichtman Dana, 2009; Lenski, 2009). Accordingly, teachers grow from experiencing opportunities to observe, examine, analyze, refine, and think (Bogner, 2008). Collaboration, as espoused by Mowrer-Reynolds (2008), engenders a purposeful and meaningful blend of professional skills and personal characteristics. This kind of continuous cultivation of the art and science of teaching is important in making a difference in student learning and achievement (Schmoker, 2006).

Based on this evidence, it is teacher leadership, as opposed to administrative decree, that plays the greater role in collaboration. Teacher leadership, purported Harris, Lower-Moore, and Farrow (2008), has been recognized as a significant component in improved pedagogy which is an effective practice of leading schools. True leadership, argued Donaldson (2006), is a when participants collectively give and receive encouragement. According to Hirsch and Killion (2009), school leaders do well to nurture an atmosphere of trust where teachers can come together to share their thoughts, communicate with colleagues, experiment, and take risks. The review of literature supported and compared various successful models of collegial interactions, teacher collaborations, and teacher leadership that improved teaching and learning and increased

student achievement. Included were professional learning communities (Bezzina, 2006; Collinson, Cook, & Conley, 2006; Doolittle, Sudeck, & Rattigan, 2008; Hackmann, Walker, & Wanat, 2006), mentoring programs (Kerssen-Griep, Trees, & Hess, 2008; Mullen, 2011; Schwille, 2008; Varney, 2009; Washburn-Moses, 2010), study teams (DuFour, 2011; Lester & Evans, 2009; Meirink, Imants, Meijer, & Verloop, 2010; Mullen, 2008), lesson studies (Bogner, 2008; Kusnick, 2008; Lenski, Caskey, & Anfara, 2009; Lewis, 2009), and peer coaching (Huston & Weaver, 2008; Latz, Neumeister, Adams, & Pierce, 2009; Lieberman & Mace, 2009).

Literature Related to Methodology

Several studies have been conducted that related to the topic in my study, however, many of them were qualitative rather than quantitative. The qualitative variables included teacher beliefs about best practices in math, perceptions about the effectiveness of teacher training programs, perceptions of how constructivist principles influenced teaching styles, beliefs of how the use of technology enhanced learning and bridged in math and connected business and math concepts and affected teaching and learning in math classrooms, and how their beliefs ultimately impacted student achievement. The qualitative variables also concentrated on student perceptions about learning math and the role of math and simple ways to learn math. In addition, students' reflections on whether technology enhanced their learning in math were assessed

The study conducted by Buyukduman (2007) utilized quantitative data collection techniques that entailed a teacher delivering non-predetermined course content to 26 learners using constructivist principles. Using a process of self-evaluation, students set

individual goals during three sessions with the teacher. To help students achieve their goals, the teacher developed each student an individual plan taking into consideration their needs based on prior knowledge, availability of materials used, cooperative learning opportunities, and collaborative instruction. The independent variable for the study was individual learning goals set by each student. The dependent variable was the implementation of an instructional plan designed by the teacher to help students reach their goals. Findings determined that a constructivist teaching design had a positive impact on students reaching their goals as well as their teacher. Both variables in this study relate to the variables in my study with respect to the implementation of constructivist principles enhancing student achievement.

In their study, Stone, Alfeld, and Pearson (2008) used quantitative data collection procedures to measure the ability of CTE students to recognize and transfer math concepts from contextual understanding to abstract application. The independent variable was enhanced math learning within specific labor-market preparation areas in CTE classrooms. The dependent variable was math scores on traditional, applied, and college placement tests. Test scores of the experimental and control groups, all who are CTE students, were compared. The results found that the number of lessons taught and the extent to which they were taught positively impacted test scores on traditional and college placement tests. Scores on the applied test showed neither a positive nor negative impact on student scores.

Summary

The review of literature presented studies combining constructivist theory and educational practices in math and business classes and illustrated how teachers' beliefs impacted their classroom practices. Several studies focused on the affect that schools and teachers have on student achievement. Extensive research on schools, teachers, and student achievement linked the need for continued professional development, collegial interaction, and on-going self-reflective activities for teachers to better position themselves to meet growing demands for higher levels of student achievement. Little research existed that assessed the attitudes of students toward math; however, a few factors were discussed that either constrained or strengthened student achievement. Using technology in math classrooms was introduced as a blended framework with varied results. The role and relevance of math throughout the history of public education was discussed as an ever evolving trend designed to meet the needs of society by promoting critical thinking, practical problem solving, citizen preparation for the workforce, and helping learners build new meanings to gain a greater understanding of the world. The literature also provided supporting information that the government and national political climate impacted the course content in math and technology classes. Programs such as STEM recommended that students take advanced courses in math and technology to enhance student achievement, which in turn will prepare students for success in a technological and digital world.

Section 3: Research Method

Introduction

This quantitative study investigated whether or not there was a difference between the standardized mathematics test scores of 11th grade first-time test takers who were enrolled in specific business classes that provided extended mathematics instruction and the standardized test scores of 11th grade first-time test takers who were not enrolled in specific business classes that provided extended mathematics instruction. A post-test was administered (Creswell, 2009). Participants in the experimental group received a treatment and students in the comparison group did not receive a treatment. The treatment of mathematics lessons is included in the appendix of this study. After the treatment period, both groups took the same standardized mathematics test. The data collected from the standardized mathematics test was analyzed to answer the research questions.

Research Questions

1. Is there a significant increase in the standardized mathematics test scores of all 11th grade first-time test takers who are enrolled in specific business classes with extended mathematics instruction compared to the standardized test scores of all 11th grade first-time test takers who are not enrolled in specific business classes with extended mathematics instruction?
2. What is the extent of the improvement in scores of the students receiving extended mathematics instruction in business classes over the students not enrolled in these classes?

This section provided a description of the research design and approach, followed by information on the setting and sample for the study. A clear, detailed description of the treatment was provided. Specific information on instrumentation and materials was included. Then, details of the data collection and analysis procedure were presented. Lastly, measures to protect the rights of participants were summarized.

Research Design and Approach

This experimental design involved a post-test given to equivalent groups (Creswell, 2009). This strategy tested the effect of a treatment when one group of participants received it and one group did not. Whether or not the treatment influenced the outcome was then determined. In my research study, extended math lessons in business classes were employed as the treatment. The standardized math test served as the post-test. Following the treatment and post-test, a determination of whether or not the extended math lessons influenced standardized test scores in math was made.

Further support for choosing a quantitative design rested with the fact that no qualitative approach was consistent with the purpose of this study. This study was not suited to the narrative approach which explored deeper meaning. A phenomenological study focuses on the essence of an experience which did not align with this study. An ethnographical framework focuses on one cultural group, and this study was not limited to one cultural group. This study was not a grounded theory study which examines differences or changes over time. Lastly, this study was not a case study which observes one or more person, event, or activity.

Setting and Sample

The study took place in a Georgia high school located in suburban Atlanta with a population of approximately 2,400 students. The student body at the school was about 1% American Indian, 2% Asian, 57% African American, 11% Hispanic, 10% Multiracial, and 19% White students (Gwinnett County Public Schools, 2010). The participants in the study were students from the 11th grade population of approximately 400 students who had completed a maximum of two basic math courses. Participants were divided into two equivalent groups of 11th graders who were first-time test takers of the standardized math test. First, the experimental group was made up of approximately 40 participants who were available to the researcher and a colleague through Accounting, Business Essentials, and Computer Applications classes formed for the school year by the administration. The general population of the school did not take business courses. Thus, only business students were involved in the experimental group and received treatment in this study. The control group was assembled with similar student demographics by race, gender, grade level, and first-time test taker status who were not enrolled in Accounting, Business Essentials, or Computer Applications. The control group was randomly selected from the 11th grade roster to meet similar demographics of the experimental group. Approximately 40 students were placed in the control group in order to match the size of the experimental group. Access to the control group was made available to the researcher with written permission from the principal.

Treatment

The treatment comprised 20-minute math lessons called "Math Minutes" three times per week over a four week period prior to the administration of the standardized math test. "Math Minutes" was presented near the beginning of the class period to reinforce math concepts and applications that students needed to know for the standardized math test that was administered during the school year to first-time 11th graders.

Each lesson contained one to six problems developed by the researcher. These 12 lessons served as the treatment and were designed to review and measure the participants' understanding of basic competencies based on a maximum of two math courses taken as mandated by the state. The treatment was administered four weeks before the state test in Accounting, Business Essentials, and Computer Applications classes. Each of these classes contains embedded math applications that align with the computation segment of the state test. These lessons ended the week before the standardized test was administered. Numbers and computations similar to competencies on the standardized test, including computing sales tax, gross and net pay, calculating averages, and working with percentages, were covered in the treatment. These competencies corresponded with embedded applications illustrated in the business courses named above. These competencies also represented a "needs improvement" subject content area on the school's report card issued by the state department of education. Input from the school's principal and math department administrator were sought to help cultivate an effective approach to teach across the curriculum which was

supported by the instructional framework and the local school plan of improvement to enhance student learning. The extended lessons enabled students to demonstrate their math knowledge and skills, as well as strengthen areas of weakness by working individually with the teacher and collaboratively with classmates.

Instrumentation and Materials

Creswell (2009) described reliability for quantitative studies as consistency in test administration, scoring, and results from past uses of the instrument. In this study, the high school graduation math test had an established history of reliability through the state board of education and teachers administering the test were trained in consistent delivery through the school's assessment office under strict guidelines from the state department of education. The high school graduation test served as the posttest in this study. As prescribed by the No Child Left Behind Act of 2001, test scores from the three-hour instrument were calculated and used by the state department of education to measure student learning, also called student achievement, in math. Scores were sent to the school from the state department to the school's assessment office and distributed to individual students through the counseling department. Individual student data was made available to teachers electronically via the district's computerized teacher portal, the school's accountability report, and the state department's website.

Validity, maintained Creswell (2009), is the precision with which an instrument measures what it is supposed to measure. The standardized math test was designed to measure student achievement in concepts and skills based on state performance standards.

Data Collection and Analysis

Data collection took place in a Georgia high school located in suburban Atlanta. The process involved obtaining posttest data from the standardized math test and for the control and experimental groups. Students received parent consent letters one week prior to the administration of the standardized math test stating the purpose of the study.

Students in both the experimental and control groups were administered the state-mandated standardized math test through the school's assessment office the week following the conclusion of the extended lessons. The scores from both groups were compared to determine if the experimental group that received the treatment performed differently than the control group. To maintain consistent delivery, certified teachers were trained as proctors by the school's assessment office to administer the standardized test.

The students that were invited to participate in the study met the following criteria: 11th graders, first-time test takers of the standardized math test, nonparticipants in school-wide test interventions, and were enrolled in Accounting, Computer Applications, or Business Essentials classes. The Accounting and Computer Applications students were assigned to the researcher as a certified business teacher by the administration. The Business Essentials students were assigned to another certified business teacher by the administration. Weekly curriculum meetings were conducted with the researcher and colleague to ensure comparable time allocation, use of materials, and presentation of course content for the extended math instruction. The courses that

offered extended instruction were chosen because of the embedded business and mathematical applications that were present in the curriculum.

Providing extended math instruction was sanctioned by the school's administration as a legitimate teaching and learning strategy that was aligned with the local school plan of improvement (LSPI). The focus of this study was consistent with the goals of the LSPI which advanced school-wide, results-based instructional activities that cultivated teaching and learning for the benefit of enhancing student achievement.

The purpose of the study was to answer the research questions:

Research Question 1*:* Is there a significant increase in the standardized mathematics test scores of all 11th grade first-time test takers who are enrolled in specific business classes with extended mathematics instruction compared to the standardized test scores of all 11th grade first-time test takers who are not enrolled in specific business classes with extended mathematics instruction?

H_0*:* There is no significant increase in the mean standardized mathematics test scores of all 11th grade first-time test takers who are enrolled in specific business classes with extended mathematics instruction and the standardized test scores of all 11th grade first-time test takers who are not enrolled in specific business classes with extended mathematics instruction.

H_1*:* There is a significant increase in the mean standardized mathematics test scores of all 11th grade first-time test takers who are enrolled in specific business classes with extended mathematics instruction and the standardized test scores of all 11th grade

first-time test takers who are not enrolled in specific business class with extended mathematics instruction.

The purpose of the *t*-test was to determine if the treatment had an effect on the experimental group (Gravetter & Wallnau, 2008). To answer this research question, a 2 sample *t*-test was conducted to determine if there was a positive difference in the standardized mathematics test scores of the 11th grade first-time test takers who received the treatment of extended math lessons in business classes over the standardized mathematics test scores of students who did not receive the treatment. A two sample, *t* test was used to determine if the difference in the two means was statistically significant. The *p*-value that corresponded to the calculated *t* statistic would be determined to be statistically significant if it was less than 0.05 (the alpha level for this test). The individual student scores for the standardized high school math test were used to calculate the mean for each group. Improvement in scores was estimated by finding the difference in the two sample mean scores. The test scores could range from 100 to 400 and a zero score was only used if cheating was involved.

Research Question 2*:* What is the extent of the improvement in scores of the students receiving extended mathematics instruction in business classes over the students not enrolled in these classes.

Method*:* There is no relationship between extended mathematics instruction in business classes and student achievement on standardized mathematics tests.

Data for the study were available to the researcher, who was also a classroom teacher, through district authorized software, the school's assessment office, and public records on the website of the state department of education.

Measures for Ethical Protection

The researcher was a certified business teacher with more than 20 years of high school teaching experience and had taught at the school in this study for 4 years. The researcher's relationship to participants was that of teacher. A colleague of the researcher, also a certified business teacher with similar credentials, participated in the study as a teacher of the participants in the experimental group. The roles of researcher and teachers in the study did not affect the data collection process because all teachers had access to student data using software that was provided by the district office. The treatment was within the normal realm of the curriculum because it bridged the math and business curriculum which was supported by the local school plan of improvement. The high school graduation test, which served as the posttest in the study, was a normal part of schooling in the district. Test preparation activities were also supported by the local school plan of improvement and by the district.

All facets of the study were conducted in an ethical, professional, and confidential manner set forth by the standards and requirements of the Walden University Institutional Review Board (IRB). In addition, the guidelines of the National Institutes of Health (NIH) were also followed to ensure participants' rights. Documentation included in the appendix includes written approval from the university, and written approval from the principal of the school to conduct research and report the findings. The data analysis

process preserved the anonymity of the participants by assigning each person a number disclosed only to the researcher. Upon completion of the study, and prior to the publication of the findings, all information pertaining to individual participants was destroyed.

Section 4: Data Analysis

Introduction

The data analysis of this study involved the two-sample *t*-test to address the research questions by comparing the population means of treatment and control groups. The research questions were: (1) Is there a statistically significant increase in the standardized mathematics test scores of all 11th grade first-time test takers who are enrolled in specific business classes with extended mathematics instruction compared to the standardized test scores of all 11th grade first-time test takers who are not enrolled in specific business classes with extended mathematics instruction? (2) If there is improvement in the scores of the students receiving extended mathematics instruction in business classes compared to the students not enrolled in these classes, what is the extent of that improvement?

To preserve the fidelity of the treatment, there was frequent collaboration between both teachers of the experimental group. There was agreement on teaching strategies, which days of the week to present, and the appropriate time for each of the lessons. Collaboration ensured that the treatment was consistently delivered to the experimental group notwithstanding that two teachers participated and that lessons were presented throughout the school day in different class periods.

Research Tools

Summary statistics for the two-sample *t*-test and confidence interval are shown in Table 1. The table shows that the control group tested higher than the experimental

group. This outcome may have been the result of a control group that contained more high-level, college bound students who did not need as much additional math instruction.

Table 1

Two-Sample t-test and Confidence Interval Summary Statistics

Group	*N*	*M*	*SD*	*SE*
Treatment	42	239.6	48.1	7.4
Control	47	250.4	24.9	3.6

The experimental group, on the other hand, contained fewer high-level students, more technology students who were not necessarily college bound, and students who needed additional math instruction. A state-mandated increase in the number of math courses required for graduation reduced the number of students eligible to take elective courses. Providing extended math lessons through the business curriculum was designed in part to support improving student achievement in math across the curriculum.

The data collected were the standardized math test scores of the students in the treatment and control groups. Test scores were made available to every teacher in the district for each of their students through the teacher portal a few weeks after the test was administered. The portal was used to collect scores for the experimental group in this study. With permission from Walden University and Main Street High School's principal, a query report of aggregated test scores was run by the school's technology coordinator to collect scores for all other students who were tested. The students' scores in the control group were randomly selected from the query report. Individual test scores of the two groups were entered into Minitab software in order to calculate the descriptive and inferential statistics which included the two-sample *t*-test statistics and p-values. The actual treatment and control groups test scores are shown in Table 2 and Table 3. The scores in the tables are listed in the order that they appeared in the query report. There is no significance to rows or columns.

Table 2

Standardized Test Scores for Treatment Group

Students 1 - 11	Students 12 – 22	Students 23 - 32	Students 33 - 42
206	218	206	255
203	206	222	225
212	215	235	242
242	225	242	255
259	285	255	222
242	250	250	270
270	158	162	270
222	215	259	300
246	239	188	215
242	276	259	209
215	478		

Table 3

Standardized Test Scores for Control Group

Students 1 - 12	Students 13 - 24	Students 25 - 36	Students 37 - 47
264	228	218	300
246	276	255	218
194	188	235	270
242	285	242	285
239	276	290	255
228	250	264	250
239	246	276	246
242	231	239	242
259	276	235	290
255	290	218	264
239	225	255	239
285	239	239	

The sample sizes were greater than 30, which is supported by Peck, Olsen, and Devore (2010) as appropriate. The treatment group contained 42 students ($n = 42$) who were enrolled in Accounting, Business Essentials, or Computer Applications business classes, and the control group contained 47 students ($n = 47$) who were not enrolled in these classes. Students in both groups were 11th graders and first-time test takers of the standardized math test, also known as the High School Graduation Test. Additionally,

the probability plot of the treatment data is roughly linear (except for an outlier at 478) and the probability plot of the control data is also roughly linear. This linearity indicates that both sets of data are approximately normally distributed. The treatment and control probability plots are shown in Figure 1 and Figure 2.

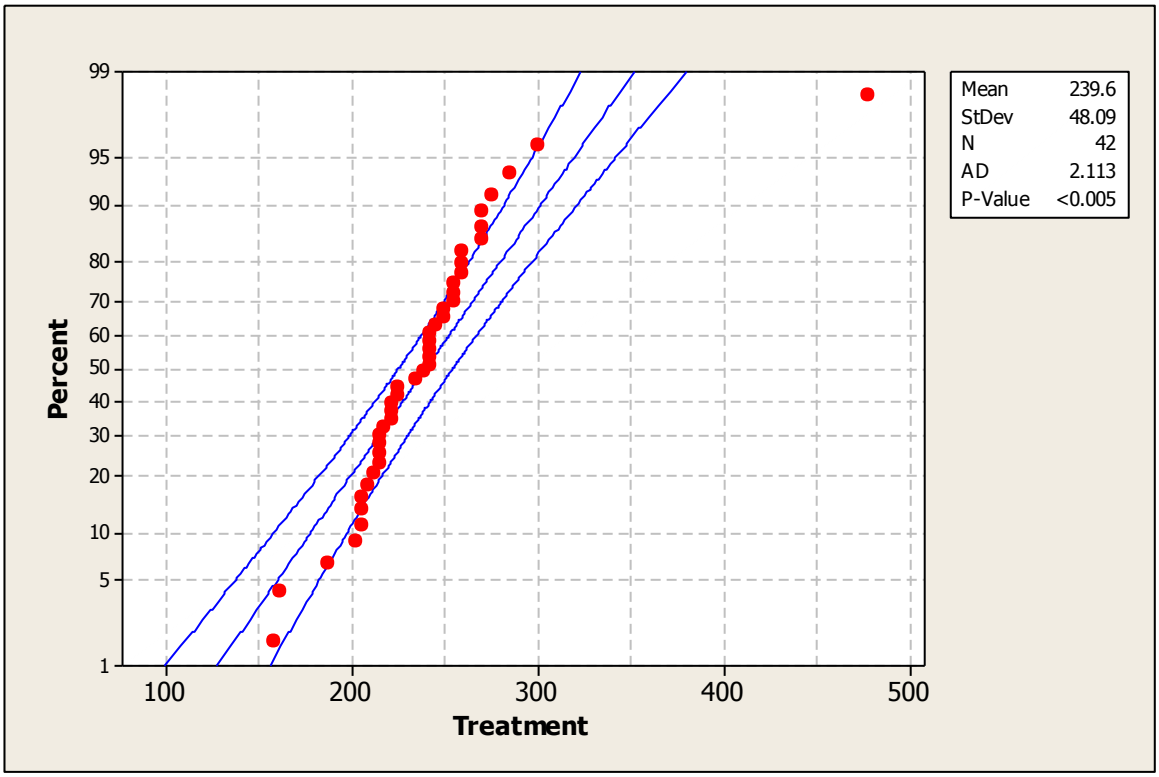

Figure 1. Individual test scores of treatment group.

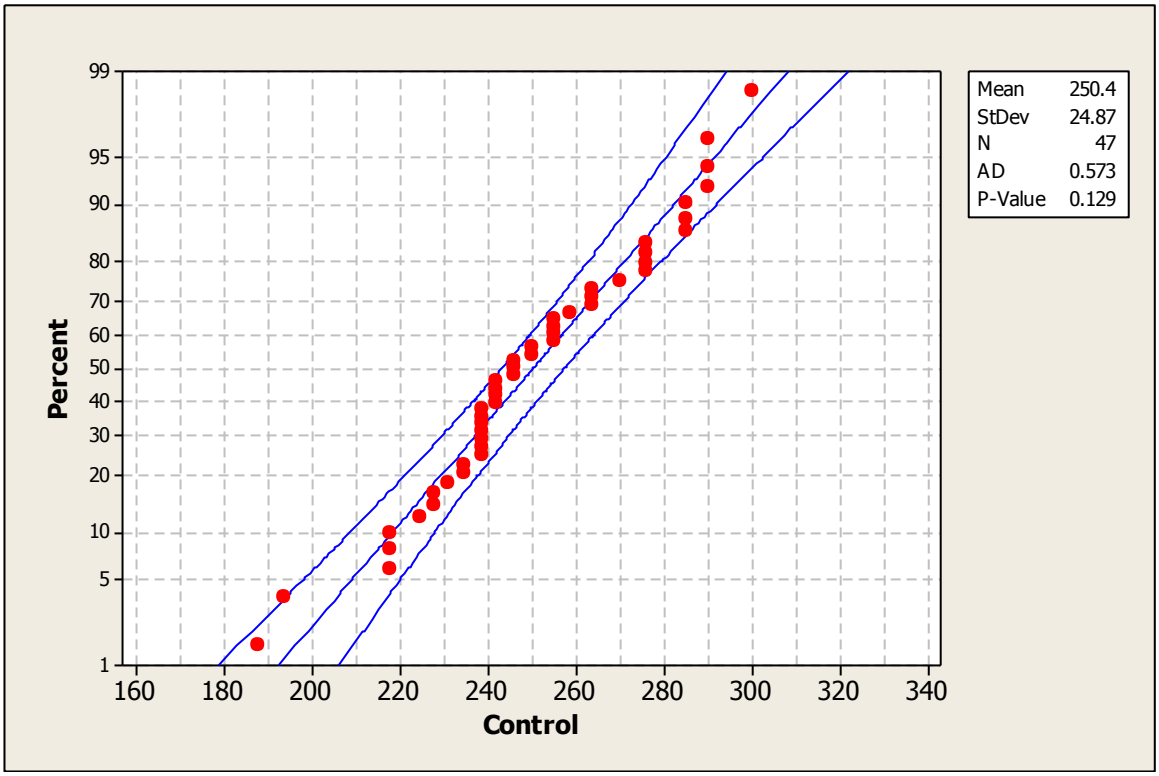

Figure 2. Individual test scores of control group.

Histograms of the data further support the normality of the data sets. The difference in the spread of the scores of the two groups did not affect the shape of the distribution. Therefore, it was reasonable to proceed with the two-sample *t* test. Histograms are shown in Figure 3 and Figure 4.

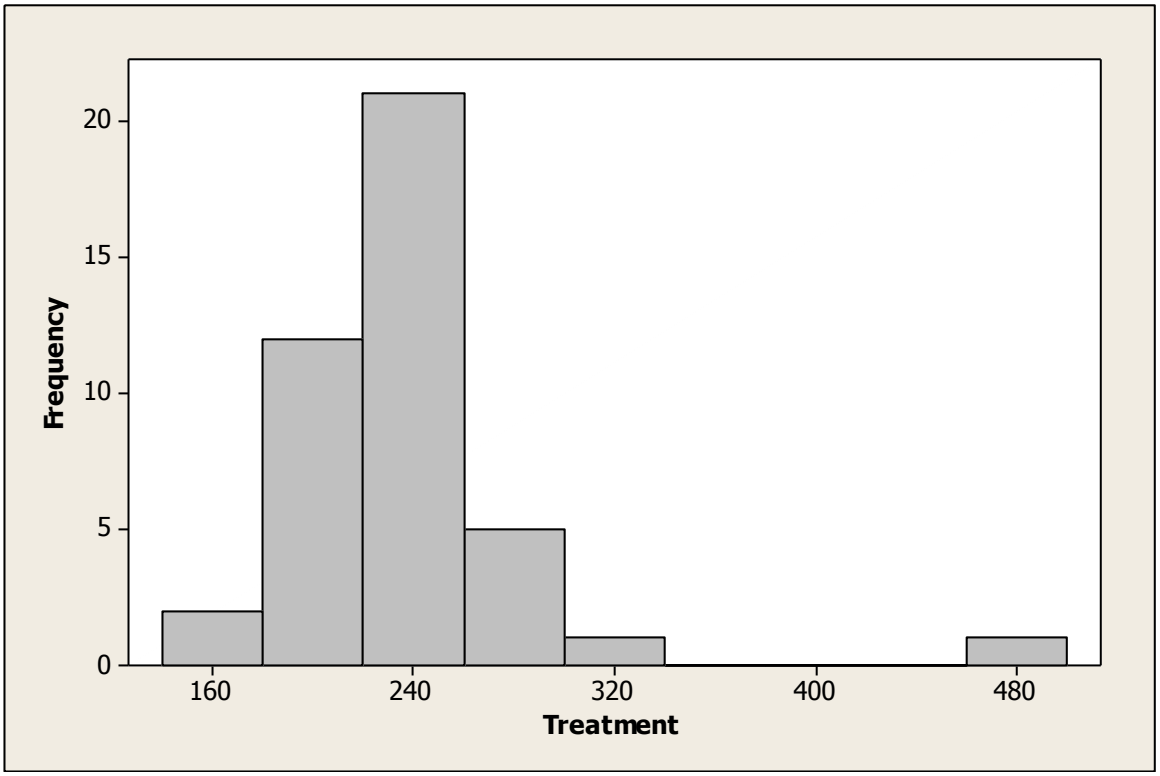

Figure 3. Ranges of test scores of treatment group.

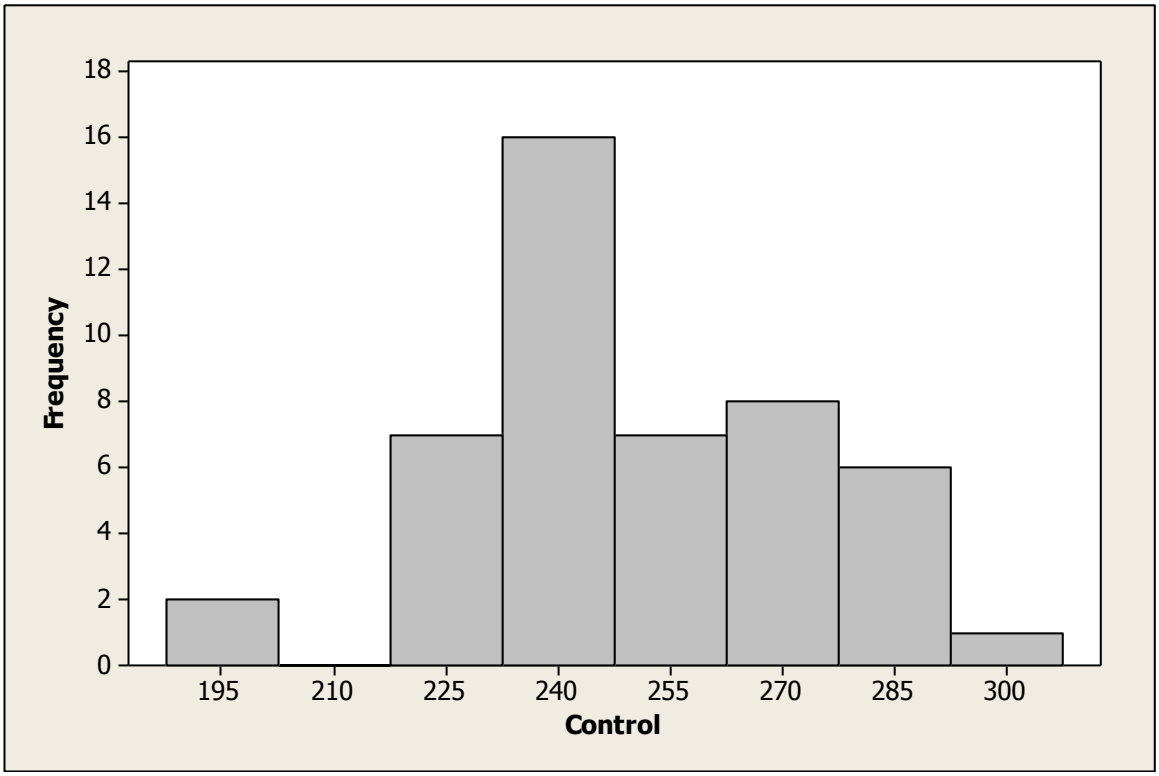

Figure 4. Ranges of test scores of control group.

The null hypothesis is: $\mu_{treatment} = \mu_{control}$. The alternative hypothesis is: $\mu_{treatment} \neq \mu_{control}$. Once the experiment was completed, I failed to reject the null hypothesis. The estimate for the mean difference in the scores between the two groups was -10.72. The *t*-test statistic and the *p*-value for the 2-sample *t*-test for the difference in the means of these data are 1.31 and 0.196, respectively. This *p*-value is not statistically significant at the $\alpha = 0.05$ level of significance. Additionally, the 95% confidence interval for the difference (-27.25, 5.81) contains zero which adds further credibility to the conclusion that the difference in the test scores is not statistically significant.

Summary

This chapter focused on the analysis of the data collected. The two sample *t*-test was used to address the research questions. The data indicated no statistically significant difference between the standardized math test scores of students who received treatment and students who did not. The data did not indicate that students that received the treatment performed above or below the level of the students that did not receive the treatment. The results of the two sample *t*-test required no further action to answer research question 2. Chapter 5 concludes the study by reporting the findings, providing implications for social change, and recommendations for action and further study.

Section 5: Discussion, Conclusions, and Recommendations

Introduction

Various studies have addressed poor student performance and the lack of student achievement in math. Low achievement in math has raised concerns of educators, business leaders, and political leaders about our nation's competitive edge in the world (Williams, 2011). To be successful in the 21st century, students need an understanding of math and how it helps the world operate in local, national, and global markets. Programs of relevance and rigor should provide advanced training to students in math and business through real-world situations that allow students to leave school with stronger skills and be better equipped for a constantly changing world (Street et al., 2012). Leaders expect that cross curricular endeavors will support efforts to improve math skills so that the nation will enjoy an increase in the number and quality of future mathematicians, as well as scientists and engineers (Williams, 2011). A report from the U. S. Department of labor stated that workers with higher math skills earn higher wages than workers with lower math skills. Thus, educators seek and welcome diverse measures that help students to strengthen math skills and become technologically literate to meet the challenge of higher workplace expectations.

The purpose of this study was to determine: (a) Is there a significant increase in the standardized mathematics test scores of all 11th grade first-time test takers who are enrolled in specific business classes with extended mathematics instruction compared to the standardized test scores of all 11th grade first-time test takers who are not enrolled in specific business classes with extended mathematics instruction? (b) Is there an

improvement in the scores of the students receiving extended mathematics instruction in business classes compared to the students not enrolled in these classes, and if so, what is the extent of that improvement?

Employing the two-sample *t*-test, test scores of an experimental and a control group were compared. Forty-two students in the experimental group were enrolled in Accounting, Business Essentials, and Computer Applications and received 12 extended math lessons as a treatment. The control group consisted of 47 students who were not enrolled in these classes and did not receive the treatment. As stated earlier, the findings indicated that the *t*-test statistic and the *p*-value for the 2-sample *t*-test for the difference in the means of these data are 1.31 and 0.196, respectively. This *p*-value is not statistically significant at the $\alpha = 0.05$ level of significance.

Interpretation of Findings

The interpretation of findings for this study was based on the two research questions. The null hypothesis for Research Question 1 stated that there was no significant increase in the mean standardized mathematics test scores of all 11th grade first-time test takers who were enrolled in specific business classes with extended mathematics instruction and the standardized test scores of all 11th grade first-time test takers who were not enrolled in specific business classes with extended mathematics instruction. Data analysis conducted with the two-sample *t*-test showed no significant difference between the test scores of students enrolled in specific business classes and the students who were not. Therefore, it was concluded that the treatment of 12 math lessons did not impact math test scores of students in the experimental group. The mean and

standard deviation of this group were 239.6 and 48.1, respectively. It was also concluded that the treatment did not lower the test scores of the experimental group compared to the scores of the control group. The highest test score for the treatment group was 478 and the lowest score was 158. The highest test score for the control group was 300 and the lowest score was 180. There is the possibility that the spread of the scores is purely coincidental; or the composition of the groups may have swayed the results. A change in the graduation requirement decreased the enrollment of gifted, honors, and advanced placement students in Accounting, Business Essentials, and Computer Applications. This decrease could be a factor in the differences in scores between the control and experimental groups. The results in this study are not consistent with the findings of other researchers who fused math, business, and technology content to improve student achievement in math (Asunda, 2012; Clark & Ernst, 2008; Kelly, 2010; Maloney, 2007; Parr, Edwards, & Leising, 2008; Stone, Alfeld, & Pearson, 2008). The comparison of the results of this study with similar studies found that some of the studies agreed with this one and some of them did not. These incongruities may be accredited to college-aged participants as opposed to high school students with this study. College students may see more relevance in improved math skills because of the connection of math skills to job opportunities in their near future. Also, other studies engaged outside research teams and provided incentives for staff and participants. This study involved two business teachers who also served as the researchers. The sole incentive was to support the school's intiative to improve student achievement in math. Student participants received additional instruction in math but did not receive treats,

grade incentives, monetary gifts, or any other incentives. The overarching evidence from STEM research indicated that, through subject integration by educators, students can build upon prior knowledge and apply their own experiences to construct new math knowledge (Kelly, 2010). The results in this study compared standardized test scores between the experimental and control groups which showed no significant difference; however, the results do not indicate that students were harmed or whether or not students demonstrated a greater level of excitement or understanding of math concepts in their business classes. The treatment in the study was aligned with the number and computation portion of the standardized test. These concepts and skills align perfectly with the standardized test. An overview of the standardized test process standards include building new math knowledge through solving problems and by using technology, reasoning and evaluating math arguments, communicating mathematical ideas, connecting math making with other disciplines, analyzing and evaluating strategies, and representing math in multiple contexts. A redesigned treatment could include other math weaknesses such as reasoning, logic, problem solving, and fractions. The study could also be extended to other courses under the business and technology umbrella that have embedded math. Such courses include programming, digital technology, and engineering, By using prior knowledge from algebra, geometry, calculus, and trigonometry classes, students can build on that foundation with additional math instruction received in computer programming and engineering classes. Application from the knowledge students acquire may enrich practical skills which could include calculating room dimensions or designing and constructing a deck.

Implications for Social Change

The shift in workplace patterns in today's knowledge-based society dictate that workers be competent in math, as well as informed about business practices and technology. Recognition of this fact leaves educators, politicians, and business leaders driven to devise an educational agenda that aligns student learning with cutting-edge workplace demands. Skilled workers must be able to frame, compute and problem solve, read competently, write proficiently, research and utilize pertinent information, demonstrate critical thinking competence, and be technologically savvy. Possessing proficient math skills gives an individual the power to manage his or her life effectively, be a more valuable worker, and become an empowered citizen. The goal of this study was to examine if standardized math test scores would improve by teaching math in specific business classes at a suburban high school of diversified learners. Although the results of this study did not show a significant difference in test scores of students who were taught math in business classes as opposed to students who were not, students were exposed to extensive math and business applications to which they otherwise would not have been. Despite no significant difference was shown in test scores for students receiving math treatment, the additional lessons incorporating math concepts and business applications through technology were received. It is implied that students who received treatment are more exposed individuals entering college, the work force, or society. Thus, the treatment renders the individual student more exposed, the community more enriched, organizations improved, and institutions enhanced.

Recommendations for Action

Student achievement in math continues to be at the forefront of the conversation in education today. Educators believe that students can achieve success though best practices which includes teaching across the curriculum and implementing real-life activities within their classrooms. Despite the fact that these statistical results were not significant, the following recommendations are offered as a way to translate this research into positive action:

1. Present this study to the Career and Technical Education teachers through Staff Development opportunities to encourage the use of teaching embedded math in business and technology courses.
2. Present this study in cross curricular collaborative meetings to prompt faculty members to plan, prepare, and participate in teaching activities to improve student achievement. To better understand math, it is helpful for high school students to connect real-life applications in various subject areas. Opportunities for students to learn through additional meaningful activities can be constructed through technology, business, science, and with other subjects using the students own experiences. The cross curricular collaboration in this study only involved business and math.
3. Submit the highlights of this study as an article for publication in the Business Education Forum, the official publication of the National Business Education Association. The Forum is an academic journal that is written by, edited by, and geared toward business educators and others concerned with improving

learning for students, for making teaching more effective, and for advancing business education.

Recommendations for Further Study

Inasmuch as the results of this study did not show a significant difference in test scores between students who received math lessons in business classes and students who did not receive the treatment, the study was appropriate for this population. The study contributes to the body of knowledge by marketing how the hidden curriculum in business courses can be integrated into an academic content area that needs to improve student achievement. Recommendations for further study include:

1. This study was conducted within Accounting, Business Essentials, and Computer Applications courses; another study might include a different class or classes or a different format for the class or classes. Future research could include: Conducting the study in a Programming class which might yield different results. The results might be different in a team-taught class. The results might be different in a Business/Math collaborative class.
2. This study implemented 12 math lessons in specific business courses beginning one month prior to students taking the standardized math test; another study might offer more math lessons over a longer period of time prior to the test.
3. This study was conducted using a quantitative design; a qualitative approach could explore with open-ended questions whether or not the

students believed the treatment was beneficial to them. What factors do the students attribute to this benefit? In what ways do the students think the treatment could be improved?

4. This study involved the collaboration and best practices of two business teachers who taught math in specific courses. A program evaluation approach could involve extracting from the knowledge of more business teachers in order to evaluate how the business curriculum, best practices, as well as teaching strategies, can be assessed to support student achievement in math.

Conclusion

It is well documented through various research studies and standardized test scores that high school students need to strengthen their math skills to meet the demands of a changing world. Improving student achievement in math is a team endeavor that requires innovative processes needing support from district officials, building administrators, and classroom teachers who are willing to cross their normal content boundaries. Despite that academic data from this study provided evidence that achievement in math did not significantly change as a result of students receiving math instruction in business courses, the evidence did not indicate that the instruction was not beneficial to the students in ways not always revealed on a standardized test. Student achievement in math will continue to be a concern as schools strive to meet local, state, and federal standards. With the support of official, administrators, and the community,

teachers should continue to investigate ways to improve student achievement in math to help them leave school prepared to succeed in our fast-paced, information-based society.

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Appendix A: Math Minute Lessons

Lesson 1

1. Jim wants to buy a DVD that costs $16.00 plus 6% sales tax. How much is the sales tax?
    a. $6.00
    b. $0.61
    c. $1.00
    d. $0.96
2. How can 3^4 be expressed as a number without exponents?
    a. 12
    b. 81
    c. 18
    d. 64
3. Jessica got a job at Taco King. The job pays her $5.85 per hour. Jessica worked 30 hours the first week. Which operation below should she use to find out how much she earned? How much did she earn? _____
    a. Addition
    b. Subtraction
    c. Multiplication
    d. Division
4. If Steven earned $958.45 this month and must make a monthly payment on his car for $245.00 this week, which operation below should he use to find out how much

money he has left after the payment is made? How much money is left after the payment? _____

a. Addition
b. Subtraction
c. Multiplication
d. Division

5. Which scenario below would require the use of division? Explain your answer
    a. Purchasing several items at the mall
    b. Splitting $500 equally with 3 of your friends and yourself
    c. Withdrawing money from your checking account
    d. Depositing 3 of your paychecks into your savings account

Lesson 2

1. Three friends, Jim, Kelly, and Josh ordered pizza. The bill for pizza came to $34.30. If they want to share the bill evenly, what operation below should they use to determine how much each person owes? How much does each person owe? _____
    a. Addition
    b. Subtraction
    c. Multiplication
    d. Division
2. Jessica used the ATM machine twice today. Her balance at the start of the day was $42.00. She made a deposit of $65.00 on her first visit. On her second visit

she made a withdrawal of $37.00. Help Jessica figure out how much she has left in her back account. The balance is _____

a. $60.00

b. $70.00

c. $80.00

d. $90.00

3. Kevin is the principal of a school and is investigating the size of each class. 12% of the students are Freshmen; 28% are Sophomores, 25% are Juniors, and 35% are Seniors. Circle the graph type that would best compare the different classesto the entire student body. If the total number of students at the school is 1,123 circle the number of Seniors at the school. There are _____ number of students in the smallest class. (Record your answer on the blank line).

a. Line graph	335 Seniors
b. Pictograph	365 Seniors
c. Bar graph	388 Seniors
d. Circle or pie graph	393 Seniors

4. If 4 people worked one day, they could build 60 computers. If only 3 people worked one day, how many computers could they be expected to build?

a. 20

b. 40

c. 45

d. 80

5. The distance from Folkston, GA to Snellville, GA is 306 miles. Sarah drove round trip 2 times last month. How many miles did Sarah drive?
    a. 1200 miles
    b. 600 miles
    c. 1800
    d. 1500

Lesson 3

1. Tricia wants to buy a digital camera that normally sells for $210.00. This weekend it is on sale for 40% off. How much could Tricia save if she bought the camera this weekend?
    a. $126.00
    b. $52.50
    c. $40.00
    d. $84.00
2. How much will Tricia pay for the camera?
    a. $126.00
    b. $52.50
    c. $40.00
    d. $84.00
3. If the APR on your Visa credit card is 18%, what is the monthly rate?
    a. 1%
    b. 1.25%

c. 1.5%

d. 1.75%

4. You have an interest bearing account that pays 5%. Your beginning balance is $100. How much is your ending balance once the account has earned interest?

   a. $150.00

   b. $135.00

   c. $115.00

   d. $105.00

5. If your checking account has $25.00 in it and you deposit $50.00, how much is your new balance?

   a. $25.00

   b. $50.00

   c. $75.00

   d. $100.00

Lesson 4

Devon is preparing a simple budget. He earns $125.00 every two weeks from his part time. His parents give him $100.00 per month for completing chores and for lunch money. The first week in every month, Devon completes miscellaneous jobs for his neighbors, Mr. and Mrs. Dawson. The jobs range from cleaning the garage, cleaning the gutters, mowing the lawn, replacing mulch, raking leaves, trimming bushes, painting, washing windows, and washing the car. Mr. and Mrs. Dawson pay Devon $12.50 an hour for 4 hours of work. Devon spends $80.00

per month for entertainment (movies, bowling, sporting events, eating out). On Tuesdays and Thursdays, Devon skips lunch and plays basketball in the gymnasium. He pays to each lunch 12 times during each month at a cost of $1.50 per lunch.

1. How much is Devon's income each month?
    a. $200.00
    b. $300.00
    c. $400.00
    d. $500.00
2. How much money does Devon save every month by only purchasing 12 lunches as opposed to 20 lunches?
    a. $8.00
    b. $10.00
    c. $12.00
    d. $15.00
3. How much are Devon's total monthly expenses?
    a. $78.00
    b. $88.00
    c. $98.00
    d. $108.00
4. What is the maximum amount Devon could put into a savings account each month?

a. $184.00

b. $294.00

c. $312.00

d. $344.00

Lesson 5

1. Which number below represents 87%?

   a. .87

   b. 8.7

   c. 87.0

   d. 870.

2. Which number below also represents 64?

   a. 8^2

   b. 3^4

   c. 6^4

   d. 6.4×10^2

3. Which answer below represents 5 and three quarters?

   a. $5\frac{1}{2}$

   b. $5\frac{5}{8}$

   c. $5\frac{3}{4}$

   d. $6\frac{1}{4}$

4. Angelica read to her brother for $\frac{1}{4}$ of an hour. How many minutes did she read?

    a. 4

    b. 15

    c. 24

    d. 40

Lesson 6

1. As you are driving along I-20 East, you see a sign stating that Augusta is 30 miles away. How long will it take you to get to Augusta if you drive 55 miles per hour?

    _____

2. Brendan makes $12 an hour doing yard work during the 10 weeks of summer vacation. If Brendan averages 30 hours per week, what is a reasonable estimate of what Brendan will earn during the summer?

    a. $120.00

    b. $360.00

    c. $660.00

    d. $3600.00

3. If shoes which originally cost $24.00 are selling at a 25% discount, what is the amount of the discount?

    a. $6.00

    b. $8.00

    c. $12.00

d. $18.00

4. If Juanita borrows $6,000 to buy a car at a fixed interest rate of 13% per year, how much interest must she pay if she pays the loan in full at the end of one year?

    a. $78

    b. $565

    c. $780

    d. $6013

Lesson 7

1. If Michael is a full-time employee that works a 40-hour work week (regular hours), how many overtime hours did he work on Tuesday if his time card shows that he worked from 8:00 am until 7:00 pm? He takes an unpaid hour for lunch.

    a. 1 hour

    b. 2 hours

    c. 3 hours

    d. 4 hours

2. If Michael makes $12.25 per hour and time and a half for over-time pay, how much is his overtime pay rate per hour?

    a. $15.00

    b. $15.75

    c. $18.38

    d. $20.50

3. How much was Michael's regular pay on Tuesday?

a. $98.00

b. $108.00

c. $118.00

d. $128.00

Lesson 8

1. Roger's regular pay is $498.00 and his overtime pay is $136.76. How much is his gross pay?

    a. $634.76

    b. $744.76

    c. $854.76

    d. $1250.76

2. How much federal income tax will be deducted from Roger's paycheck based on his gross pay if the federal tax rate is 30%?

    a. $100.43

    b. $170.43

    c. $180.43

    d. $190.43

3. How much FICA (social security tax) would be deducted from Michael's paycheck if the rate is 8.4%?

    a. $23.32

    b. $33.32

    c. $43.32

    d. $53.32

4. How much Medicare would be deducted from Roger's paycheck if the rate is 3.45%?
    a. $21.90
    b. $32.83
    c. $43.86
    d. $10.00
5. What are the total tax deductions from Michael's paycheck?
    a. $150.00
    b. $230.18
    c. $265.65
    d. $275.81

Lesson 9

1. Jamison purchased the following items at the mall: Jeans - $55.00 (30% off); sneakers - $139.99 (25% off); T-shirt - $26.00. Sales tax was 6%. How much was the discount on the jeans?
    a. $10.50
    b. $12.50
    c. $15.50
    d. $16.50
2. How much was Jamison's total bill before sales tax? _____
3. How much sales tax did Jamison pay? _____
4. How much was Jamison's bill including the sales tax? _____

Lesson 10

1. Yesterday Sean spent $179.66 at the mall. He originally had $200.00. How much money does he have left?
    a. $10.25
    b. $15.87
    c. $20.34
    d. $22.81
2. Does Sean have enough money to purchase a DVD for 16.99 with a sales tax rate of 6.5%? (Prove your answer)
    a. Yes _____
    b. No _____
3. What is the cost of the DVD plus tax?
    a. $17.09
    b. $18.09
    c. $19.09
    d. $20.09
4. Sean picked up his paycheck on the way home from the mall. Last weekend he worked 8 hours on Saturday and 8 hours on Sunday. Both days were included on this paycheck. He makes $7.25 per hour. How much will his gross pay be?
    a. $98.00
    b. $108.00
    c. $116.00

d. $125.00

5. What will Sean's net pay be if he pays 8% federal income tax, 3.2% FICA, 4.1% Medicare, and 3% state income tax?

    a. $85.37

    b. $94.77

    c. $104.52

    d. $120.00

Lesson 11

1. Paula opened a new checking account two weeks ago with $50.00. Today she deposited $300.00. What is her new balance?

    a. $50.00

    b. $300.00

    c. $350.00

    d. $370.00

2. Paula wrote check #1 for a $25.00 gift card at WalMart. She wrote check #2 to Allstate Insurance for $75.00. How much money remains in her account?

    a. $150.00

    b. $200.00

    c. $250.00

    d. $300.00

3. The bank service charge at the end of the month came to $5.50. This amount should be _____ to determine her new balance:

a. Added

b. Subtracted

c. Multiplied

d. Divided

4. An outstanding check for $17.00 should be

    a. Subtracted from the account balance by the bank

    b. Subtracted from the account balance by Paula in her checkbook register

    c. Added to the account balance by the bank

    d. Added to the account balance by Paula in her checkbook register

5. After processing the bank service charge and the outstanding check, what is the correct balance in Paula's account? _____

Lesson 12

Consuela works for Holmstead Computer Corporation as a computer sales representative. She sells large volumes of desktop computers designed for business use that cost in the range of $900 to $1,100. Connie is paid a salary of $32,700 per year plus a commission rate of 12% of sales from $5,000 - $9,000 and 15% for sales over $10,000.

1. How much salary did Connie earn for March?

    a. $1725

    b. $2725

    c. $3725

    d. $4725

2. In March, Connie sold 4 computers @ $995.00 and 2 computers at $1,095.00. How much were Connie's total sales for the month of March?
    a. $3170.00
    b. $4170.00
    c. $5170.00
    d. $6170.00
3. How much commission did Connie earn for the month of March?
    a. $540.40
    b. $640.40
    c. $740.40
    d. $840.00
4. What were Connie's total earnings during the month of March?
    a. $2465.40
    b. $3465.40
    c. $3765.40
    d. $3881.20

Math Lesson Keys

Lesson 1

1. D
2. B
3. C
4. B

Lesson 2

1. D
2. B
3. D; 393 Seniors; 134 Freshmen (smallest class)
4. C
5. A

Lesson 3

1. D
2. C
3. D
4. C

Lesson 4

1. C
2. C
3. B
4. C

Lesson 5

1. A
2. A
3. C
4. B

Lesson 6

1. 33 minutes
2. B
3. A
4. C

Lesson 7

1. B
2. C
3. A

Lesson 8

1. A
2. D
3. D
4. A
5. C

Lesson 9

1. D
2. $169.49
3. $10.17
4. $179.66

Lesson 10

1. C
2. A

3. B
4. C
5. B

Lesson 11

1. C
2. C
3. B
4. B

Lesson 12

1. B
2. D
3. C
4. B

Curriculum Vitae

Lessie M. Houseworth

lmhouseworth@yahoo.com

Education

2015	Doctor of Education
	Teacher Leadership
	Walden University
	Baltimore, MD
2010	Educational Specialist
	Teacher Leadership
	Walden University
	Baltimore, MD
1989	Master of Education
	Secondary Education
	Indiana University, NW
	Gary, Indiana
1976	Bachelor of Education
	Business Education
	Indiana University
	Bloomington, Indiana

Professional Experience

2005 – Present	Teacher, Gwinnett County Public Schools

2004 – 2005	Teacher, DeKalb County School System
2003 – 2004	Teacher, Rocky Hill Public Schools
1992 – 2003	Teacher, Gwinnett County Public School
1990 – 1992	Teacher, Massey Business College
1986 – 1990	Teacher, Hammond Public Schools
1982 – 1986	Teacher, Indiana Vocational Technical College
1977 – 1979	International Business College

Courses Taught

Introduction to Business & Technology	Computer Applications
Financial Literacy	Multimedia
Accounting I & II	Business Procedures
Business Law	Business Essentials
Banking Systems	Desktop Publishing

Professional Activities

Department Chairperson	Curriculum Development
New Teacher Mentor	Student Teacher Supervisor
Staff Development Planner	Job Shadow Coordinator
Media Committee Representative	SACS State Team Member
High Schools that Work Coordinator	Advisory Board Member

Professional Affiliations

Golden Key International Honor Society

Association for Career and Technical Education

National Education Association

National Business Education Association

Georgia Business Education Association

Georgia Association of Educators

Professional Association of Georgia Educators