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A Quantitative Quasi-Experimental Study of an Online High School Mathematics Remediation Program

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COLLEGE OF EDUCATION

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Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

The local problem that drove this study is that a high school in an upper middle class suburban city in Pennsylvania wants to improve its student scores on its end-of-course Algebra 1 Keystone Exam. The purpose of this study was to conduct a quantitative, quasi-experimental assessment of an online high school mathematics remediation program to determine if the remediation program was successful in its endeavor to remediate students. This research study, informed by the self-efficacy and the behaviorist learning theories, attempted to determine whether students who (a) scored below proficient on the May algebra exam and were placed in the Math Lab course improved statistically significantly compared with the students who (b) scored below proficient on the May algebra exam and who retook the exam in January but were not placed in the Math Lab course. Using a convenience sample, an independent samples *t* test was performed on the difference scores (original Keystone Exam and retest) of 408 students. The study determined that the online remediation program did not increase student scores for the students at the Pennsylvania high school compared with students who were not in the remediation program. The second literature review and white paper provide six research-based recommendations for the SEPSD to improve the Math Lab course. The recommendations include eliminating the course, purchasing a different remediation program, or modify elements of the current program. The students in the SEPHS would benefit from the research with a better remediation program. The research based suggestions, once implemented, should lead to the improvement of mathematics achievement.

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Section 1: The Problem

Introduction

The semi metropolitan region used for this evaluation lies in southeastern Pennsylvania and is made up of two counties, three cities, and numerous townships and boroughs. With approximately 600,000 residents, it is the third largest metro region in the state, behind only Pittsburgh and Philadelphia (District profile, 2013).

The Southeastern Pennsylvania school district (SEPSD) used for this study is located in a suburban setting. Popular local attractions include art museums and galleries, sporting arenas, historical sites, wineries, and zoos, in addition to several walking, hiking, and biking trails. An international airport, interstate highway, and the Pennsylvania Turnpike have attracted numerous industries and commercial businesses to the area. The three major employers in the SEPSD are two Fortune 500 companies (Krause & Kennedy, 2013), and a family amusement park. In addition, with six major institutions of higher learning, DeSales University, Cedar Crest College, Lafayette College, Lehigh University, Moravian College, and Muhlenberg College, the area maintains a strong commitment to educational excellence (District profile, 2013).

The 72 square miles of the SEPSD encompasses three townships and has a total population of approximately 50,000. The school district's wide socio-economic range is a result of bordering a large city on the southeast and extending to farmlands at the western and northern extremities of the district (District profile, 2013).

SEPSD ranks 20th in size of the 500 school districts in Pennsylvania and with nearly 3,200 students for the 2012 - 2013 school year, the district's lone high school (SEPHS) is one of

the largest high schools in the state of PA. With a plethora of resources, a vast array of course offerings and programs are available to students, parents, staff, and the community. The SEPSD superintendent stated, "With high expectations, the community faithfully supports all students with an abundance of resources" (Sniscak, 2015). Because of its size, resources, and community commitment to excellence, the community expectations are high for all disciplines of the high school. This includes interscholastic athletics and the performing arts, but especially the field of academics (District profile, 2013).

Definition of the Problem

In 1965, President Lyndon Baines Johnson signed into law the Elementary and Secondary Education Act (ESEA). The law provided grants to low-income students in elementary, secondary, and post-secondary schools (Every Student Succeeds Act, n.d.). The No Child Left Behind (NCLB) Act was passed in 2002 and introduced high stakes testing and standardized testing. With this act, accountability jumped to the forefront of public education in the United States (Dee, Jacob, Hoxby, & Ladd, 2010). NCLB established proficiency rates for schools to obtain through benchmark testing to remain in positive standing, achieve annual yearly progress (AYP), and avoid school and/ or district sanctions (Hanushek & Rivkin, 2010).

On December 10, 2015, President Barack Obama signed into law the Every Student Succeeds Act (ESSA). It reauthorized the ESEA to provide equal opportunities to all students (ESSA, n.d.). The law recognized that "NCLB's prescriptive requirements became increasingly unworkable for schools and educators" (ESSA, n.d., p. 2). The law provides "flexibility to states regarding specific requirements of NCLB in exchange for rigorous and comprehensive state-

developed plans designed to close achievement gaps, increase equity, improve the quality of instruction, and increase outcomes for all students" (ESSA, 2014, p. 5). ESSA "lessens the reliance of standardized tests, while maintaining the annual requirement to administer assessments in grades 3 through 8, and in high school" (Pennsylvania State Department of Education, n.d.). Despite the passing of the ESSA, at this time, the state of Pennsylvania has made no changes to its standardized testing with its Keystone Exams at the high school level. The SEPHS continues to plan for the Keystone Exam in May and January each year. The research for this study was conducted before the passing of the ESSA.

Prior to the passage of ESSA, for AYP purposes, the state of Pennsylvania defined many different subgroups, including white, African-American, Latino, Asian, male, female, and low socio-economic, among others. If a school has 40 or more students in a subgroup, the school is required to have a specific percentage of students in those subgroups demonstrate proficiency on the Pennsylvania System of School Assessments (PSSA). In 2009, students at SEPHS met all the standards set forth by the Pennsylvania Department of Education and achieved AYP on the state's standardized testing, the PSSA, by achieving a sufficient percentage of students demonstrating proficiency. The high school was proficient in all 25 tested subgroups.

In 2010, SEPHS did not make AYP. The high school achieved proficiency in 20 of the 21 tested subgroups. Data retrieved from the Pennsylvania Department of Education showed SEPHS did not make AYP due to low mathematics scores by students with Individual Education Plans (IEPs), which comprise the special education subgroup (Pennsylvania Department of Education, 2012a; Pennsylvania Department of Education, 2010).

Lang (2010) wrote that NCLB can help improve education because the law requires the collection of large amounts of test data, which schools can use to focus their future teaching for enhanced learning. District administrators, school administrators, and teachers began looking at the test data to determine the root cause(s) of why the high school did not make AYP. Rooney and Heuvel (2004) defined *root cause analysis* (RCA) as a method to identify the specific reason why an event happened. When the RCA determines why an event occurred, a workable plan can be implemented to correct for future events. Poor student performance on mathematics testing has been a concern for years for educators and parents (Salman, Esere, Omotosho, Abdullahi, & Oniyangi, 2011) and the performance pressure has increased with NCLB.

One possible reason discovered for the decline in test scores could be changing student demographics. Throughout the United States, school districts and schools are showing an increase in diversity in their students' languages, religions, ethnicities, and socioeconomic statuses (Chamberlain, 2003). SEPSD, currently with more than 9,200 students, has seen a steady increase in its economic diversity during the past 10 years. According to the 2002 District Strategic Plan, only 4% of the district's 8,000 students received federal free or reduced lunches. For the 2013-2014 school year, over 15% of the district students qualified for the free or reduced-price lunches (Lester & Sheehan, 2014). Because of changes in student demographics and family economics, school districts need to realize that their academic programs and curriculum that worked in the past will not necessarily work for them in the present or future (Goldsmith & Reiter, 2007).

The SEPHS's special education mathematics scores did increase to an acceptable number on the 2011 test, making AYP in that subgroup. In fact, the school made AYP in 24 of the 25 subgroups in the high school. However, the economically disadvantaged student subgroup did not make AYP on the mathematics portion of the 2011 state test, the PSSA. Because mathematic proficiency was not obtained in consecutive years, regardless of subgroup, the school was labeled as a school needing improvement and was placed in the School Improvement 1 category (Pennsylvania Department of Education, 2012b). Various levels of school rankings exist in the state of Pennsylvania, ranging from Making Progress, to Warning, to School Improvement 1, School Improvement 2, Corrective Action 1, Corrective Action 2, and so on. If schools continue to fail to make AYP they face the possibility of being taken over by a state educational agency.

In 2012, despite scoring above the state average once again in mathematics, reading, and writing, SEPHS was placed in the School Improvement II category when it did not make AYP in the subgroup for IEP/ special education mathematics (Pennsylvania Department of Education, 2012c). The local problem for SEPHS is straight-forward: The high school is not meeting AYP in all subgroups. Specifically, the high school has not scored sufficiently in its special education and low socio-economic sub-groups on the mathematics portion of the PSSA and the high school has been labeled as a school that needs improvement. In response to the scores and label, an online remediation program was purchased, but no evidence exists that this remediation program positively affects student test scores.

Beginning in the 2012 - 2013 school year, the state of Pennsylvania began using the Keystone Exams to access proficiency for its high school students at the end of the algebra 1, literature, and biology courses. The state had previously tested its students at the end of 11th grade for all students in mathematics, reading, and writing using the PSSA. Besides the change in testing at the end of 11th grade to testing students at the end of certain courses, students could also retest on the exams on which they did not score proficient. Despite any changes from the state, the SEPSD continued to look for ways to assist its lowest performing students.

Rationale

Evidence of the Problem at the Local Level

The topic of improving test scores is not unique to high schools in Pennsylvania or in the United States. However, the idea of SEPHS being on a "watch list," "underperforming," or being labeled with a "school needs improvement" tag is unique to its community. In 2010, 2011, and 2012 the school demonstrated mathematic proficiency rankings in all but one subgroup of the PSSA. Regardless, the state labeled the high school as underperforming and not meeting AYP. As indicated earlier, the entire community supports public education and takes pride in its typical successes. The low test scores are a major concern for all members of this educational community and serves as a driving force to evaluate programs and improve.

After reviewing the original Keystone Exam data in August 2013, the high school administrators, department heads, and data team members looked to provide all their students, including the IEP/ special education and economically disadvantaged students, an extra resource to help increase their proficiency rates on future standardized tests. Beisinger and Crippen

(2008) conducted studies that showed online remediation programs can enhance the number of students passing state performance exams as compared with those not using an online remediation program.

According to Paadre (2011), summer school programs did not result in a statistically significant increase in mathematics performance. Ziolkowska's (2007) studies show that the earlier the remediation, the more effective it is for student improvement, compared with late arriving remediation, such as summer school. SEPSD administrators purchased Study Island, an online remediation program, to raise their students' performance on upcoming Keystone Exams.

The Study Island program assessment contains a series of online multiple choice questions in several disciplines which are aligned to specific state standards. The students at SEPHS using the Study Island program work on specific mathematic content aligned with the Pennsylvania Common Core State Standards. Benchmark testing is conducted for students and remediation assistance is provided for students to work toward proficiency.

The SEPHS administrators decided to place the students who did not reach proficiency on the May Algebra 1 test, and would have to retest in January, in a remediation program called Math Lab. The students were place in the Math Lab for the start of the school year in September to remediate their deficiencies for the January retest. The Math Lab class consists of students reporting to the back of the library for one period per week, instead of a normally scheduled study hall, where the students worked individually on a computer utilizing the Study Island remediation program.

The remediation program was purchased with an expectation that students participating would demonstrate a significant increase in academic performance. Studies have shown a positive correlation between student performance on exams and students doing online homework assignments (Arora, Rho, & Masson, 2013). Working directly with the high school mathematics department, the researcher wants to make sure the online remediation program meets that expectation. This study will involve a quantitative quasi-experimental study to determine whether the Study Island program significantly increased student achievement on the January 2013 Keystone Exam.

In the first month of the 2013 – 2014 school year, the students in Math Lab took the Study Island mathematic benchmark test. The company that makes Study Island asserts that its benchmark testing is aligned with specific state standards and that the program can accurately predict whether students will score advanced, proficient, basic, or below basic on upcoming state exams.

Evidence of the Problem From the Professional Literature

Since 2001 and the passage of NCLB, U.S. schools have sought to increase test scores. NCLB has forced states to rethink their practices and is credited with spurring many improvements to public education. Some schools have seen significant improvements in subjects such as mathematics. Some states have created an algebra exit exam that students needed to pass to graduate (Neher & Plourde, 2012). The graduation requirement forced districts to align curriculum to state standards, create detailed sequencing steps, and use specific content language (Neher & Plourde, 2012). Teachers in Mississippi and Tennessee believed that NCLB

utilizes best instructional practices, influences what they teach, and motivates their students to graduate (Vogler & Burton, 2010).

On the other hand, not all educators are proponents of NCLB. Some schools have adjusted their traditional educational practices to increase test preparation time while sacrificing time for other non-tested subjects, such as electives (Musoleno & White, 2010). Some of these efforts have been effective, but some border unethical (Wright, 2009). Dee and Jacob (2010) wrote that the NCLB law's effect has not matched its ambitious goals of substantial increases in performance and closing the achievement gap between subgroups. Others believe that standardized testing is ineffective (Pinder, 2013) and may actually decrease overall learning (Hayden, 2011). Despite some detractors of NCLB, it appears to be the primary school evaluation tool being used today and in the near future.

With the increase in standardized testing, schools need to have a plan for students who do not pass, or show proficiency, on the standardized testing. They need to create remediation programs for those students not showing proficiency. Several studies have examined remediation and its positive effects. For example, according to James and Folorunso (2012) remediation and proper feedback significantly and positively affect student achievement. Positive feedback and its significant effect on student achievement are key components of self-efficacy.

Definitions

Adequate Yearly Progress (AYP) A measurement defined by the NCLB to determine how every public school and school district in the country is academically performing on their state's standardized tests (Yell, Katsiyannis, & Shiner, 2006).

Elementary and Secondary Education Act (ESEA) President Lyndon Baines Johnson signed this into law in 1965. It provided grants to improve education to low-income students (ESSA, n.d.).

Every Student Succeeds Act (ESSA) President Barack Obama signed this into law on December 10, 2015. It reauthorizes the ESEA to provide equal opportunities to all students (ESSA, n.d.).

Keystone Exam The name for the standardized tests administered in the state of Pennsylvania used to determine AYP as defined in the NCLB starting in the 2012-2013 school year in the subjects of algebra 1, literature, and biology (Flaherty, 2013).

No Child Left Behind (NCLB) A bipartisan bill passed by Congress in 2011. The bill is a reauthorization of the ESEA, which included Title I, an aid program for disadvantaged students. NCLB supports standards-based education reform, although each state develops its own standards and assessments. All students in specific grade levels take these assessments to receive federal school funding. NCLB expanded the federal role in public education with the premise that setting high standards and goals will improve student education (Daly et al., 2006).

Online The term used to describe a connection to the internet or a computer (Cook-Wallace, 2012).

Online Remediation Program A program connected to the internet or a computer that assists students toward proficiency on skill based assessments (Keller, 2012).

Pennsylvania System of School Assessment (PSSA) The name for the standardized tests administered in the state of Pennsylvania used to determine AYP as defined in the NCLB up until the 2012-2013 school year (Flaherty, 2013).

Remediation Program A class, course, or any extra help given by educational personnel to students underperforming on skill based assessments to improve their scores (Winston, Van Der Vleuten, & Scherpbier, 2013).

Study Island An online remediation program that assists students with problems tailored to individual student needs to improve performance in content specific areas (Study Island, n.d.).

Significance

The purpose of this study was to evaluate the effectiveness of the Study Island online remediation program. Results from this study could influence decisions on whether the district should continue to use the program. If the study shows that no significant difference in student scores occurs, the program may be dropped or altered. If the study shows a significant increase in student scores, district personnel may consider purchasing other online remediation programs.

Research Question and Hypothesis

The research study will focus on the impact of the Study Island online program as a remediation tool for students taking the Pennsylvania state exam, the Keystone Exam. The research question that will determine the project is: Is there a significant difference between SEPHS students who used Study Island intervention and those who did not use Study Island

intervention in terms of a change between pre (May 2013) and post-test (January 2014) Algebra I Keystone Exam scores?

Research has shown remediation programs have been able to assist students in improving test scores. Online math remediation programs have shown mixed results; some have been statistically significant in improving student scores whereas other programs have not shown a significant increase. The local problem is that students have scored below proficient on the state's standardized mathematic testing. School personnel purchased an online remediation program and the study will evaluate its effectiveness. The hypothesis is that there is a significant difference on the January Algebra 1 Keystone Exam score between students who are not proficient in May and participate in the Study Island intervention and students who are not proficient in May and do not participate in the Study Island intervention.

Review of the Literature

The literature review will cover Bandura's self-efficacy concept, Skinner's behaviorist learning theory, as well as numerous topics on remediation, learning, and technology. The search was conducted in two places, through the Walden University library and Google Scholar. Searches included various combinations of the terms *Bandura*, *self-efficacy*, *Skinner*, *behaviorist learning theory*, *technology*, *classroom technology*, *computer-based remediation/learning*, *secondary mathematics remediation*, *internet learning*, *on-line learning*, *self-paced learning*, *computer assisted instruction*, and *educational technology*.

Theoretical Base

The concept of self-efficacy is the informing theory for this study. According to psychologist Bandura (1994), self-efficacy is "the belief in one's capabilities to organize and execute the courses of action required to manage prospective situations" (p. 71). In other words, self-efficacy is an individual's belief in his or her ability to be successful, or not successful, in various situations.

According to Bandura (1977), self-efficacy has four major sources: mastery experiences, social modeling, social persuasion, and psychological responses. Mastery experiences is the idea that successful completion of a task strengthens ones' self-efficacy, whereas an unsuccessful task weakens ones' self-efficacy. Students that have been placed in the Math Lab receive the opportunity to experience successful completion of problems with the use of the Study Island software. As the problems are answered correctly, the students' self-confidence rises and so do their beliefs that they can be successful on future math exams.

Social modeling is seeing other people similar to one self being successful, which leads people to believe they can be successful also. The Math Lab computers are next to each other in a small area in the back of the library. Students can easily see their peer's excitement and successes using the software.

Social persuasion is the idea that people can, through positive encouragement, be persuaded to accomplish a goal they would not have been able to accomplish without the encouragement. Using the Study Island software, which offers encouragement by immediate

feedback on questions and a sense of accomplishment, students can progress from underperforming on pretests to proficient on posttests.

Psychological response is the idea that people's own reactions to situations affect their self-efficacy and success. Students using the Study Island software and answering questions correctly will increase their belief that they will be successful on future exams, thus increasing their self-efficacy.

In the past few decades, incorporating technology into the classroom for better teaching and learning has become an important issue (Yuan-Hsuan, Waxman, Jiun-Yu, Michko, & Lin, 2013). Wong, Yin, Yang, and Cheng (2011) studied a computer-assisted program to assist students on completing two column proofs. Their study showed that learning environments on the computer can improve medium and low achieving students' scores on certain mathematical topics.

Peiró i Gregòri, Merma Molina, and Gavilán Martín (2014) wrote that high school students could obtain significant increases with the addition of a computer-based instruction. The computer-based instruction can pin point student strengths and weaknesses. According to Cooper (2011), remediation that focused on individual student differences, as compared with remediation in a larger group, was more successful in directly addressing individual student needs. In other words, the more specific the remediation is for each student, the more successful the remediation program is for each student participant. Research conducted at the Interdisciplinary Research Center on Emerging Technologies at the University of Montreal in Canada focused on student learning in the remediation process. The research showed that

students learn best when tutorial tools are specifically tailored to each student's needs. Remediation on specific mathematical areas helps students obtain knowledge (Wang, 2009), allowing students to learn individually in their own ways (Konrad, Fowler, Walker, Test, & Wood, 2007).

An effective way for students to learn is when the remediation tool can identify student weaknesses and create a sequence of steps to improve the student levels of learning (Najjar, 2008). The sequence of identification and improvement of student weaknesses are the key components of an effective remediation tool. Campbell (2011) wrote that students completing measurable educational outcomes can predict the eventual completion of a milestone, which could be the passing of a standardized exam. These scores can be used to make estimations on future student test results.

Parkhurst et al. (2010) used a technology component to target individual math facts to increase math performance. Research also indicates that content delivered via the internet can sometimes be more beneficial to students when compared with the traditional classroom (Tsai, Chuang, Liang, & Tsai, 2011). Thomson (2010) wrote that the online format is better suited to individual learning as compared with the traditional classroom because students are able to have more in control of their own learning. Students can work on individual concepts and problems, then advance in the program when they master that concept. The self-paced model allows all students to work at their own pace, which is a benefit to special education students. In addition, computer technology showed a greater increase in math for special need students than that of general education students (Silverman & Clay, 2010). Online programming uses many practices

that demonstrate significant gains for secondary students, including special education students by meeting their needs as defined in their IEPs.

Hughes, Phillips, and Reed (2013) studied students who were exposed to a self-paced computer program. They discovered that students exposed to a self-paced computer teaching program had some benefits compared to those not using the self-paced computer program. Kim's 2012 research focused on personalized learning environments of online remedial mathematics courses. Kim discovered that the strengths of such programs are the ability to customize strategies for individual students' weaknesses and make the program personalized (Kim, 2012).

In 2010, Schornick wrote that United States schools, as a whole, using traditional teaching methods are not providing the mathematical background necessary for its students to compete internationally when compared with other nations using some form of online instruction. Aliasgari, Riahinia, and Mojdehavar (2010) found that computer-assisted instruction increases student learning and also improves student attitudes toward mathematics. A meta-analysis discovered a significant increase of mathematics achievement for students who use computer technology compared with students using traditional instruction (Li & Ma, 2010).

Ross and Bruce (2009) theorized that a computer program could assist those who struggle in the remediation process. The computer program could provide the learning content and sequence of instruction (Ross & Bruce, 2009). With online learning, the students also engage in independent learning and use more self-directed concepts. Silverman and Clay (2010) also

detailed that mathematics learning can take advantage of the collaborative nature of the Internet and the permanent nature of the online interactions.

Mundia (2010) wrote that repeating a class or grade did not guarantee student success. Therefore, other alternatives must be found to assist students during their coursework. Bachman (2013) wrote that with an increase in students needing assistance, developmental courses, or tutoring, remediation is becoming more and more part of our educational process. Bachman also focused on how students are looking more positively towards remediation as it is becoming more common place in schools.

Remediation programs and interventions have shown positive student improvement in assisting students (James & Folorunso, 2012). George (2010) suggested the most effective pieces for student remediation are motivation-based, such as graded homework, tests, and subject specific tutorials. The best way to determine the effectiveness of a remediation program, according to George is through standardized testing.

The behaviorist learning theory also informed this study. Skinner (1958) found that "behavior is shown to be shaped and maintained by its 'reinforcing' consequences rather than elicited as conditioned or unconditioned response to stimuli" (p. 972). One of the most famous studies that used the behaviorism theory was Skinner's (1948) study of a rat that hit a lever that led to the dispensing of a food pellet. Quickly, the rat was positively conditioned to push the lever and was rewarded with food to eat. Likewise, a response that led to negative consequences, conditioned that behavior not to be repeated. Behaviorism's theory of reinforcement has influenced many aspects of education previously and continues to mold it with

the recent addition of technology to the classroom (Ebert, n.d.). Positive reinforcement in behaviorism is similar to social persuasion in self-efficacy.

Both the self-efficacy model and behaviorism relate to mastery and progression of topics, which are key ideas in educational technology. For example, in 1958, Skinner described teaching machines which were boxes that students could use to enter their answers to questions. These machines gave immediate feedback to the student with correct or incorrect responses. If the student answered correctly, a different question followed. If the student was incorrect, the student received the same question until he or she answered correctly (Skinner, 1958). The reinforcement from "the machines" is classic behaviorist principles, and the advancement to the next question is a key piece of online drill and practice learning. The mastery of topics and progression to the next topic is a key idea in the self-efficacy model as well.

More recent research has been conducted linking behaviorism and educational technology. Sutton (2003) wrote that behaviorism theories have, in part, led to the development of important instructional advancements particularly in instructional software and computer-assisted instruction. Shield (2000) wrote about the use of drill and practice programs with individual instructions and individual feedback and noted that learning through feedback and reward can be motivational. Similar to computer games people play recreationally where advancement is contingent on success at a lower gaming level, students are rewarded when they answer correctly and move to the next question in the prescribed sequence in the Study Island program (Ebert, n.d.). When students answer questions incorrectly, they stay with the same type of question. When students answer questions correctly they progress to different types of

questions, such graphing linear equations to geometry based questions. How students psychologically respond to these changes and situations affects their self-efficacy and future success.

Shield (2000) concluded that behaviorism currently drives educational practices where competencies and standards have become the main, almost exclusive, evaluator. Shield compared today's curriculum of memorized, or mastered, small pieces of information that are utilized to solve higher-level, real world problems, with behaviorist theories of reinforcement and learning on a prescribed path. In a place with fellow students achieving individual success, students utilized social modeling to help them achieve success themselves.

Online remediation programs have been increasingly more popular in the last few years. Top educators in the state of California, among other states, have changed their primary thinking on remediation and how it is delivered (Cooper, 2014). Self-paced remediation courses use technology to engage students and advance to the next topic when they have mastered the concepts, as opposed to predetermined time schedules. Online remediation programs force students to be more disciplined and become active participants in their learning (Cooper, 2014).

Implications

This study determined if the Study Island program used in Math Lab significantly improves academic performance at the SEPHS. I anticipated that the study would show that the Study Island program did help high school students prepare for the Algebra 1 Keystone retest. Maloy, Edwards, and Anderson (2010) discovered that a different online mathematics tutoring system improved academic performance for fourth graders in Massachusetts. Online

remediation programs provide increased mathematic help to students by focusing on specific student deficiencies discovered from a benchmark exam. If the program does not improve student performance, the implication is that the district will not pay for renewal of the program and will need to look for other ways to remediate its students.

After the data was collected and analyzed, I anticipated that students who participated in the Math Lab would see an increase in their scores due to the extra math assistance. I was interested to see how much improvement was made and whether it was statistically significant. If the program successfully improved student performance, the implication is that the district will continue the use of the program and possibly examine other similar remediation programs for different grade levels and different disciplines, such as biology and literature.

Summary

SEPSD purchased an online remediation program to help improve student academic performance on the state's end-of-year standardized math test for its students. Studies have been completed that have shown that online remediation programs can help students to improve academically. Does Study Island have a significant positive effect for the SEPHS students?

Section 2: The Methodology

Introduction

Program efficiencies "focus on the relevancy of content and on implementation practices in order to identify ways in which to improve upon program delivery, services, and administration" (McNeil, 2011, p. 1). Program outcomes focus on evaluating all stakeholders and their learning. An outcomes-based quantitative quasi-experimental study is a method that measures results against indicators (McNeil, 2011). For this study, the evaluation of the program will be whether students using Math Lab improved mathematical knowledge on the Keystone retest.

Design

Using a convenience sample, this quasi-experimental study was informed by the self-efficacy and the behaviorist learning theories. A quantitative quasi-experimental study was used to determine whether the implementation of the online remediation program resulted in a statistically significant difference in student scores for students at the Pennsylvania high school. In today's era of increasing accountability to federal and state mandates, effective programs for student learning are vital. With limited resources, but greater expectations of schools, every program is critical in the increased competition for funding (McNeil, 2011).

I used a quasi-experimental design because the student participants were not randomly assigned, also called ex post facto to design. Creswell (2012) described quasi-experiments as being common to educational research because artificially creating groups would create disruptions to classroom learning. Students scoring below proficient on the May Keystone Exam

were placed in the Math Lab course for one period in a 6-day cycle. Fullmer (2012) discovered the placement of students in tutoring sessions showed gains from the pretest to the posttest, supporting the effectiveness of tutoring sessions. According to Wenner, Burn, and Baer (2011), online tutorials assigned asynchronously with a topic being taught in class can successfully increase student skills. They used pre and posttest data in their research. The research in this study also used pre and posttest data.

The population for the study was students in the SEPHS, Grades 9-12. The sample/ selection of participants were the Math Lab students who used the online remediation program, Study Island. A comparison group was also formed. The comparison group was composed of non-proficient students who, for some reason, were not placed in the Math Lab course. These students' scores on the January retest were compared with the students who had the Math Lab.

Instrumentation and Materials

Quantitative data from the state's Keystone Exam were used. Verbert, Manouselis, Drachsler, and Duval (2012) wrote that collecting and using the proper datasets is important in the teaching and learning process. The data collection instruments were the end of Algebra 1 course Keystone Exam in May and the January Algebra 1 Keystone Exam retest. The dependent data were of the same students at two points in time. Using the data to impact learning and instruction to each student is vital (Fullan, Hill, & Crevola, 2006) and the ultimate criterion for evaluating a remediation program is standardized testing (George, 2010).

The archival data used in the study were already collected by the Pennsylvania Department of Education (pre-test in May 2013 and post-test in January 2014). The reliability and validity assessment values are high because the instruments have been created.

Research Design

The most effective design in acquiring the information needed for this study is the quasi-experimental design. According to Creswell (2012), the quasi-experimental design is the most appropriate approach because the students were not randomly assigned groups into the Math Lab. The students not achieving proficiency on the May end-of-course exam, needing the math remediation, and having a study hall in their schedule, were assigned to the Math Lab course. There were also students who were not scoring proficient, but who were unable to be placed into the Math Lab. This second group of students made up the comparison group for the Math Lab students.

The goal of this study was to determine whether the Study Island program is making a significant difference for the students in the SEPHS. The study used both a pretest and posttest design. After the scores of the May Keystone Exam were received in the summer, an attempt was made to place as many students who scored in the basic and below basic category into a course called Math Lab. The Math Lab course used an online remediation program called Study Island. Studies have shown that learning environments on the computer can improve medium and low achieving students on certain mathematical topics (Wong et al., 2011).

All students in the Math Lab were given a benchmark exam at the beginning of the school year. The Study Island program contains benchmark tests with questions that are closely

aligned to the Pennsylvania Common Core. The Study Island program developers claim that students who achieve a proficient score on the benchmark test will demonstrate proficiency on the Keystone Exam. Likewise, the program claims that students who score below proficiency on the benchmark test at the beginning of the school year will score below proficiency on the Keystone Exam at the end of the school year without some sort of remediation throughout the school year.

The high school operates on a 6-day cycle. Students attending Math Lab attended one class period every 6 days. For example, a student's schedule could be Math Lab on Period 2, Day 1 with study hall the other 5 days of the school schedule during Period 2. In addition to the traditional math period class every day of the week, the extra Math Lab period gives the students seven math periods every 6 days of school.

The high school also operates on a modified block schedule with many variations of courses. Some courses run every period all year long, some are double period classes meeting every day for a semester, some are double period classes meeting on alternate days, and some meet 4 days out of a 6-day cycle. Some students have study halls assigned to them every day in the 6-day cycle for a certain period, some have them every other day in a certain period, and some are only 2 days out of a 6-day cycle. With the wide range of types of classes, student schedules do vary greatly, as do their study hall periods and opportunities for Math Lab classes.

A limitation of this study would be the isolation of the Study Island program. Students at the SEPHS not only receive remediation through Study Island, but receive instruction throughout

the school year. With students in different math courses and with different teachers, improvement will come from other areas besides the Study Island program.

The study also looked at the scores from students who were not proficient on the May Keystone Exam, but were not able to be placed in the Math Lab course. Comparing the two groups, those in Math Lab and those not in Math Lab, will increase the study's validity.

Sampling Procedures

The sampling method used was the convenience sample. According to Lodico, Spaulding, and Voegtle (2010), the convenience sample is best when a limited amount of resources are available. When I placed the students in the Math Lab course, I looked simply to replace a student's study hall period with a Math Lab period.

The population for the study was the students from the SEPHS High School who scored below proficiency on the May end-of-course Algebra Keystone Exam. I anticipated the number of students who scored below proficient on the exam and were placed in the Math Lab course to be in the 150 to 200 range. There were 201 students who were placed in the Math Lab course.

Not all the students who scored below proficiency on the May Keystone Exam were placed in the Math Lab. For various reasons 207 students were not able to be placed in the Math lab. Some students did not have an available study hall to be replaced with the Math Lab. For example, vocational technical students spend 4.5 periods at the technical school, travel back to SEPHS for the start of sixth period, and then have their four core classes: English, math, science, and social studies. There were no opportunities for these students to be placed in Math Lab because they do not have any study halls.

The study's participants were students who were not proficient on the May Keystone Exam. The two groups in the study were those in the Math Lab class using the Study Island program and those not in the Math Lab class.

Data Collection Methods

Archival data was collected from the May 2013 Algebra 1 Keystone Exam and January 2014 Algebra Keystone Exam. In order to collect this data, I obtained permission from the SEPSD District Superintendent. To ensure the safety of all participants, I also applied and received IRB approval.

Two sets of dependent scores were collected for the SEPHS students who were not proficient on the May Keystone Exam. The two sets of quantitative data were collected from the May Algebra 1 Keystone Exam (pretest) and the January Algebra 1 Keystone retest (posttest).

Research Question and Hypothesis

Do students who are not proficient on the May Algebra Keystone Exam and participate in the Study Island intervention differ from students who are not proficient on the May Algebra Keystone Exam and do not participate in the Study Island intervention on the January Algebra 1 Keystone Exam retest?

H_0: There is no significant difference on the January Algebra 1 Keystone Exam score between students who are not proficient in May and participate in the Study Island intervention and students who are not proficient in May and do not participate in the Study Island intervention.

H_a: There is a significant difference on the January Algebra 1 Keystone Exam score between students who are not proficient in May and participate in the Study Island intervention and students who are not proficient in May and do not participate in the Study Island intervention.

The research question: Is there a significant difference between SEPHS students who used Study Island intervention and those who did not use Study Island intervention in terms of a change between pre (May 2013) and post-test (January 2014) Algebra I Keystone Exam scores?

Data Analysis

The students who had remediation were assigned the numbers 1001 through 1201 and their scores were recorded for the May 2013 exam and the January 2014 exam. The students who did not have remediation were assigned the numbers 2001 – 2207 and their scores were also recorded for the May 2013 and January 2014 exam. For both groups, the difference in scores (January score – May score) was calculated and used in the analysis. Sample Data Table is below. The complete data table can be found in Appendix B.

Table 1

Sample Data Table

Student No. #	Remediation Yes=1; No=2	May 2013 score	Jan 2014 score	Difference
1001	1	1484	1488	4
1002	1	1462	1491	29
1003	1	1492	1472	- 20
. . .				
2001	2	1497	1495	- 2
2002	2	1454	1452	- 2
2003	2	1445	1460	15

A two-sample independent *t*-test was performed on the difference scores at the 5% significance level where H_o = there is no significant difference in the change in Algebra 1 Keystone Exam score from May to January between students who receive Study Island remediation and those students who do not receive Study Island remediation and H_a = there is a significant difference in the change in Algebra 1 Keystone Exam score from May to January between students who receive Study Island remediation and those students who do not receive Study Island remediation. The independent variable for the test is remediation or no remediation with Study Island and the dependent variable is difference in test scores.

To perform this significance test, six assumptions must be true to continue with the analysis.

Assumption 1: The first assumption is that the dependent variable is measured on a continuous scale and in this particular case, the dependent variable can take on values in the range (-600, 600).

Assumption 2: The second assumption is that the independent variable consists of two categorical independent groups. In this study our independent variable takes on the values of Study Island remediation or no Study Island remediation.

Assumption 3: The observations are independent of each other. In this study, the scores of the students in the remediation group have no effect on the scores of the students in the non-remediation group and vice versa. At the same time, the students within each group do not have an effect on other students within the same group.

Assumption 4: The fourth assumption is that there are no significant outliers in the differences between the two groups. Performing a Shapiro-Wilk Test generated a modified boxplot that showed no outliers for the Study Island student group but did show one outlier (280) for the non-Study Island student group (see Figure 1).

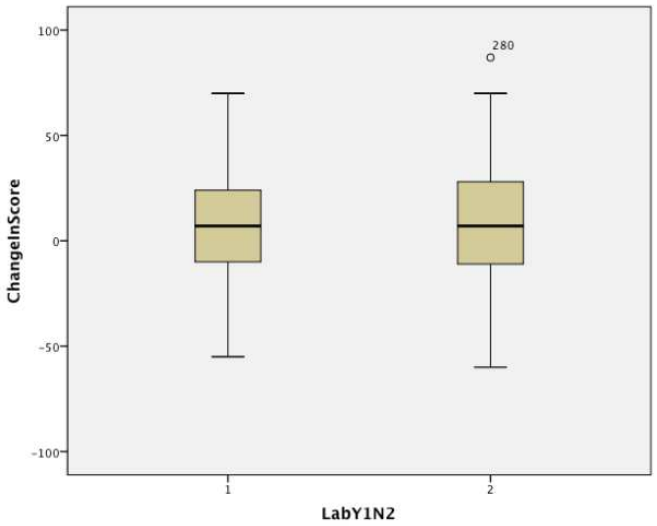

Figure 1. Modified boxplot showing change in test scores for students. The first graphic represents students who used Study Island, and the second graphic represents students who did not use Study Island. The single outlier is shown as a point with 280.

Assumption 5: The fifth assumption is that the distribution of differences in the dependent variable is approximately normally distributed. As shown in Table 2, the Shapiro-Wilk Test for Normality yielded no significant difference from normality for neither the students who took Study Island remediation (*W = 0.996, p = 0.899*) nor for the students who did not take Study Island remediation (*W = 0.995, p= 0. 734*). Since both of these p-values are greater than .05, the data is normal.

Table 2

Results of Shapiro-Wilk Test for Normality

Change in score	Statistic	dif	p
Used Study Island	.996	201	.899
Did not use Study Island	.995	207	.734

Assumption 6: There needs to be homogeneity of variances. As shown in Table 3, the Levene's F-Test for Equality of Variances showed a significant difference between the two group's variances ($F = 4.477$, $p = .035$).

Table 3

Results of Levene's F-Test for Equality of Variances

Change in score	F	p
Equal variance assumed	4.477	.035

Because the significance level is less than our alpha of .05, we conclude that there is a significant difference between the two group's variances. That is, the assumption of homogeneity of variance is not met. Therefore, we will use the data results associated with the 'Equal variances not assumed' (Table 4).

Table 4

Independent Samples Test

	t-test for Equality of Means						
	t	df	Sig (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower	Upper
Change in score (Equal Variances not assumed)	.032	401.457	.974	.084	2.582	-4.991	5.159

Note: Equal variances not assumed

The SPSS independent sample t-test was conducted. There was no significant difference in the change in scores on the Algebra 1 Keystone Exam scores from May 2013 to January 2014 for students who participated in the Study Island remediation and students who did not participate in the Study Island remediation, $t(401) = .032$, $p = .974$.

Ethical Practices and Participant Protection

To ensure standardization and ethical practices, student names were not used, but rather a number for student differentiation. In district record keeping, students are identified with a school ID number. I asked the District Administrator collecting the data for me to remove the school ID from each student record before giving the data to me. In any printed materials for the study, I assigned a number each record, thus ensuring that anyone familiar with the district's ID numbering system is not able to identify any particular student.

Assumptions, Limitations, Scope, and Delimitations

There are limitations of this quantitative quasi-experimental study and things to consider before deeming the Study Island program as effective or not effective. Data that shows student scores increasing from a May exam to a January retest does not simply mean that the Study Island is successful. An assumption made for the study is that only Math Lab and the Study Island program were factors in increasing student achievement. Students continued to work and receive instruction in their traditional classroom and take math classes.

A potential limitation of the study is the actual verification of student usage or effort using the program. Although students are assigned to the Math Lab, maybe a student is absent

on the day of Math Lab. Two students might also put in significantly different effort using the program.

A delimitation of the study is that it is focusing only on the students who were previously not proficient on the Algebra 1 Keystone Exam. This program might be beneficial to students before the exam, but the study is looking at the program as a remediation tool.

Another thing to consider would be the amount of time a student spent utilizing the Study Island program. Students would have varying amounts of time utilizing the program. Future research could look into the original pretest scores of the participants. For example, should a student one question from being proficient on the pretest be categorized the same as a student 15-20 correct answers from being proficient? Lower scoring students have a bigger chance of improvement, while the student one question from proficient only needs to improve slightly. These pieces are vital for the validity of the research and will allow other researchers to replicate the study and to advance research into other areas or directions.

Conclusion

The data from this study shows that the way the SEPHS is currently implementing the Study Island program in the Math Lab class is not having a significant impact on improving student scores on the Algebra Keystone Exam. I anticipated the data would show that the Study Island program would be successful in raising student scores for the Math Lab participants.

Moving forward, I have found no evidence in educational literature that suggests online remediation would be detrimental to a high school student's learning and improvement. The implementation of the Math Lab will need to be tweaked or a different remediation plan will

need to be put in place. Section 3 presents the project, a white paper and PowerPoint presentation.

Section 3: The Project

Introduction

As seen in Section 2, the data results show that the way the SEPHS is currently implementing the Study Island program in the Math Lab class did not significantly improve student scores on the Algebra Keystone Exam when students retested. Analysis of the data collected showed no significant difference in the change in scores on the Algebra 1 Keystone Exam scores from May 2013 to January 2014 for students who participated in the Study Island remediation and students who did not participate in the Study Island remediation.

In section 3, I provide an overview of the development of the study's project. This section also provides a rationale for the project, goals of the project, and a literature review. In the literature review, I examine elements of previously implemented successful remediation programs in an attempt to identify common themes of successful interventions and components of successful remediation programs.

At the conclusion of the Literature Review, a list of successful remediation strategies and content will be listed to be included in the project. The project genre is a policy recommendation with detail. The position paper is a white paper, which is in Appendix A. The white paper will present options to the decision makers in the SEPSD - eliminate the Math Lab class, modify it somehow, or provide a new remediation tool to provide a better remediation for the students of SEPHS.

Rationale

After collecting the data and analyzing the data, my chairperson suggested I use a white paper for this study's project. I was not familiar with white papers, so I conducted a short literature review on the term *white papers*. Using the term "*white paper*" in Google produced 13,200,000 results. Using the term "*white paper*" in Google scholar produced 3,560,000 results. Performing an advanced search in ProQuest, through the Walden University Library, produced 7,752 results from a peer-reviewed, full-text, post 2011 search.

White papers were originally used by the British government to disseminate policy, but are becoming more and more commonplace in business and professional workplaces (Willerton, 2012). Sakamuro, Stolley, and Hyde wrote that "Originally, the term white paper was used as shorthand to refer to an official government report, indicating that the document is authoritative and informative in nature. Writers typically use this genre when they argue a specific position or propose a solution to a problem, addressing the audience outside of their organization" (n.d.). The lengths of white papers vary in length. An average white paper is five to 12 pages long, with governmental reports being, sometimes substantially, longer (Stelzner, 2007). The white paper for this project is 12 pages.

A white paper is a persuasive essay based on the results of research that will be used to educate decision makers and stakeholders of an issue and to provide a research-based solution in an easy to understand format (Gordon & Gordon, 2003; Madden, 2009). "A white paper assignment completed for a community client can provide a valuable learning experience that benefits students" (Willerton, 2012, p. 1). Sakamuro et al., wrote "Typically, the purpose of a

white paper is to advocate that a certain position is the best way to go or that a certain solution is best for a particular problem" (n.d.). This particular white paper is not an official government report, nor to argue or advocate a particular position, but it is used to propose research-based solutions to the problem of coming up with better remediation ideas for the students in the SEPHS.

The data analysis in Section 2 shows that the way the SEPHS is implementing the Study Island program in the Math Lab has not been successful. In other words, the students in the Math Lab are not showing statistically significant increases in their retest scores as compared with students retesting that are not in the Math Lab. A white paper was chosen as this project's genre to disseminate information to the decision makers of the SEPSD in an easy to read and understand format. The white paper presents six research-based recommendations to the decision makers of the SEPSD. With the information from the white paper, the decision makers of the SEPSD can choose the best recommendation or combination of recommendations that would most benefit the retesting students in the SEPHS.

Project Description

The white paper contains an introduction, description of the local problem, a data analysis of the study, implications of the data on the SEPHS and SEPSD, research-based recommendations, a conclusion, and references. Willerton wrote "Effective white papers focus on providing useful information that helps readers learn about a topic or make a complex decision" (2012, p. 2). For the decision makers in the SEPSD, the white paper is an easy to read document, without fancy scholarly language, presented in an easy to understand format. The

white paper presents six options of how to improve remediation options for the students in the SEPHS. The six recommendations are research-based from other successful remediation programs.

Depending on the number of recommendations selected by the decision makers would determine the timeline and resources. Several could be implemented immediately, such as changing students' schedules to additional days in the math lab, while others would take longer to implement, such as the purchase of new programs which would need to be research on the best fit for the SEPSD. The roles and responsibilities of the students would remain the same – they will continue to be asked to do their best on state assessments and in any remediation program. Teachers' roles could change due to some of the recommendations.

Review of the Literature

The literature review for section three will focus on previous studies that have been conducted on remediation programs and successful practices in Algebra classrooms. I will focus on the studies that have demonstrated positive results in remediating students. I will compare and contrast elements of those research-based effective intervention programs to the Math Lab course at SEPHS.

For the literature review, several search terms, in varying order and combinations, were used. The main terms were: remediation programs, interventions, strategies, intervention programs, intervention strategies, successful interventions, computer based remediation, online remediation, successful online strategies. The Walden University Library was used mostly to initiate searches. In the Walden University Library, ProQuest was the primary database to search

for peer reviewed articles with ERIC used to find a few articles. Google and Google Scholar were used to find additional sources.

Results of this study show that the Math Lab course and Study Island were not significant in improving student performance on the Algebra 1 Keystone Exam retest. The literature review will investigate other research based remediation programs that have been successfully implemented and make recommendations to improve learning for the students of SEPHS in the Math Lab as well as the Algebra classroom.

Thorvaldsen, Vavik, and Salomon (2012) conducted a case-control study on the use of information and communication technologies (ICT) in 9th grade mathematics classrooms. The study focused on best practices of how ICT was used on two 9th grade Algebra classrooms. One classroom used "ICT for research, exploration, and calculation as part of a more coherent, relatively open-ended pedagogy" (Thorvaldsen et al., 2012, p. 224), while the other classroom was the control group using ICT as the instructional tool without the teacher's assistance. The study discovered that the specific technology used in the instructional process did not make a difference in improving student scores, it was how the technology was used that made a difference in improving student scores. The results of the Thorvaldsen et al (2012) study aligned with the Math Lab and Study Island at the SEPHS. Putting students on computers with no teacher guidance in the library was not a magic solution for student improvement on the Algebra Keystone Exam - other research based solutions must be investigated.

Janosz (2012) and Cameron, Connor, Morrison, and Jewkes (2008) wrote that low engagement times for students leads to lower academic performance as compared to students in class with higher engagement time. Flower, McKenna, Muething, Bryant, and Bryant (2014) studied the effects of a program designed to keep kids on task for a longer period of time. The study focused on the class wide group reinforcement program called the Good Behavior Game (GBG). The results showed that the GBG program led to a decrease in off-task behavior in the classroom when implemented as compared to a class without the GBG program implemented. Mitchell, Tingstrom, Dufrene, Ford, and Sterling, (2015) also studied the GBG and reported decreases in disruptive behaviors. Adding a group reinforcement program to the curriculum or remediation program at SEPHS could improve student engagement time and thus increase student performance.

Viadero's (2010) article noted flaws in the 1990s push for U.S. students to have taken Algebra by ninth grade. "The push towards algebra resulted in higher failure rates, lower grades, no improvement in test scores and no more likelihood of attending college" (Viadero, 2010, p. 1). To better prepare its students for the Algebra 1 Keystone Exam and retest, the SEPSD needs to look at the mathematics curriculum in its elementary and middle schools to make sure its students are properly prepared entering Algebra 1, regardless of grade level. The school district can use some sort of readiness test to determine if a student is "Algebra 1 ready." Many Algebra readiness tests or placement exams are available on line, or the district could create one of its own. If the student is not ready, a two-year program to include a pre-Algebra readiness piece and then the actual Algebra course should be the course placement for the student.

Zbiek and Larson (2015) made three evidence-based recommendations to improve student success in the Algebra classroom. The three recommendations were: "1. Use solved problems to engage students in analyzing algebraic reasoning and strategies. 2. Teach students to use the structure of algebraic representations. 3. Teach students to intentionally choose from alternative algebraic strategies when solving problems" (Zbiek & Larson, 2015, p. 698).

Chow (2013) found that subject specific professional learning communities (PLC) are important pieces for school improvement, teacher development, and improving instructional practices. Similarly, Hilliard (2012) wrote that professional learning communities create environments of trust, collaboration, and sharing to improve teachers' own skills and prepare students effectively. The SEPHS does utilize PLC for their core subjects, including mathematics.

Jitendra et al. (2009) found positive results studying schema-based instruction (SBI). The SBI is a research based intervention that uses schematic diagrams, problem solving strategies, and multiple solution techniques to help students solve proportion problems. Almost 2000 7th grade students using the SBI showed significant improvement, as compared to the control group, when retesting nine weeks later on a state test, as well as specifically on proportion problems (Jitendra et al., 2009). Since proportions are in the Algebra curriculum and on the Keystone Algebra 1 Exam, the use of the SBI could be beneficial to all students in the SEPHS Algebra classes, as well as the Math Lab course.

Alagic and Alagic (2013) wrote that student mathematical learning is typically done by direct instruction in the ordinary classroom. Tuttle (2007) determined that the use of technology often increases student learning. The increased motivation is a key piece of the learning. He also wrote that new technology must be paired with properly trained teachers with the skills and ability to instruct with the new technology (Tuttle, 2007). On the other hand, McDonald, Polnick, and Robles-Pina (2013) found that high mathematical gains were more associated with teachers using standards-based teaching practices, and focusing on the students' conceptual understanding of mathematics, making connections between other disciplines and math, and the importance not using the textbooks as the primary instructional tool.

Granberg and Olsson (2015) studied a software program called GeoGebra. The study indicated that GeoGebra was geared at improving students' collaboration and creative reasoning through collaborative activities aimed at improving their shared thinking. The study also identified GeoGebra as being successful in teaching trial-and-error strategies and argumentative skills. Vasquez's (2003) study suggested using an algorithmic technique in instruction in the developmental mathematics classroom. With a four phase approach of teacher modeling, practice, transition, and independent work, the student's ability to discover patterns and make conjectures improves. This philosophy of learning can reach many learning styles (Vasquez, 2003).

Similarly, Platko's 2011 study about an online intervention program and mathematical achievement, it was determined that students with a low initial test score showed a significant increase in their second test score after utilizing the online program. Students in this study were

given access to the intervention program every day. The students either worked on the program for forty-five minutes after their math class or sometime during the day in a "math focused study hall" (Platko, p 21). Every day working on the intervention program is a much greater time compared to the students in the SEPHS working in the Math Lab class one class period every six school days. Increasing the number of days a student is in Math Lab could produce increases similar to the ones shown in Platko's study.

Lauer et al. (2006) conducted a meta-analysis on supplemental programs conducted outside of the typical school day. The supplemental programs were conducted either after school or in the summer. The study indicated small positive effects on these types of programs and a larger effect on programs that focused on a specific topic, such as reading. Similarly, Wagner's (2013) study focused on an online intervention strategy conducted after school. The study compared two groups of students, one utilizing the online program after school and one that did not participate in the after school remediation program. The study did show an increase in student scores for those students who participated in the online intervention after school. Conducting the math intervention after school or during the summer, as compared to during the school day, is different than what is currently practiced. Paying teachers to stay after school, or in the summer, to tutor the students could be a cost alternative to hiring more teachers for the regular school day, although there would be disadvantages on after school or summer activities for the students and potentially the teachers. This could be an alternative option to hiring new staff members, which brings an increase in salary and the benefits package for each contracted position.

Varying instruction and changing instruction design could be avenues to explore at the SEPHS. Kasmer and Kim (2012) studied the benefits of student predictions in the middle school algebra class. Two classes were compared and the class that used prediction techniques outperformed the other class. Changes to the instructional design could also include the flipped classroom, where the student views the lecture and notes as homework and class time is devoted to checking for understanding and guided practice (Herreid, & Schiller, 2013). The flipped classroom moves the instruction away from direct instruction to a student centered approach (Sams, & Bergmann, 2013). The Promoting procedural fluency is the ability of students to choose the correct procedure in solving problems, not simply memorizing math facts. Booker (2011) surmised that students can discover their mathematics difficulties through diagnosis and develop ways to become mathematically successful. At SEPHS this could be implemented by having the teachers solve homework problems using more than one methods and even have a test question asking for two methods. In a long range goal, this concept could be incorporated into the two middle schools in the district. With the Math Lab not demonstrating the expected success, these could be different classroom instruction methods explored at SEPHS.

Ferguson (2014) studied the effects of digital game-based instruction. The study examined student scores on North Carolina's end-of-course Algebra 1 exam. The study compared scores from a group of students that were taught using traditional mathematical instruction versus students taught with a combination of digital game-based instruction and traditional instruction. In their 2010 study, Johnson and Mayer indicated GBL "provides many benefits to learners such as active engagement, information-based skills, decision-making skills,

innovation, problem-solving skills, knowledge construction, and discovery learning" (as cited in Ferguson, 2014, p. 40). But, the results of this study found that, in this school, digital game-based instruction did not have a significant impact on student scores. The result contradicted findings in numerous previous studies that showed digital game-based instruction had a positive impact on student learning. This is similar to my study where online remediation did not show significant student increases, but other studies did show increases. These two studies do not mean that online remediation and digital game-based instruction are not beneficial to students, just not in these two places.

Cooper (2011) referred to National Council of Teachers of Mathematics standards and noted that inclusion of written communication is an important component because it leads to a deeper understanding of the concepts and processes of mathematics. With an increase of the use of technology in the classroom, combining technology and writing in a mathematics classroom by using chat rooms, forums, and blogs can have very powerful benefits to today's students (Cooper, 2011). These technology tools can lead to a better "depth of understanding of material, express their understanding, record their thinking, and communicate" (Cooper, p. 80, 2011) with their teacher or classmates. In the Study Island program, the majority of questions are multiple choice with some questions being a different variety such as fill in the blank. The teachers do have the option to turn on/off constructed response questions. Since a communication piece is present in Study Island, the teachers could spend extra time on the written responses or if Study Island is discontinued, the SEPHS should pursue purchasing a program that has that communication piece in it.

Currently, teachers in the Math Lab course are not asked to assist, tutor, or give feedback to the students. The teachers are assigned the Math Lab as a duty, similar to study hall duty. If the Math Lab class was a teaching period, the teachers could provide observation, feedback, and provide further skill practice to the students in the Math Lab course. If the Math Lab became a teaching period, teachers would teach less than the traditional number of classes at the SEPHS. If the traditional number of classes taught per teacher is lowered, more teachers would need to be hired to offset the loss of sections due to the Math Lab, which would have an impact on the school district's budget.

This literature review investigated other research based remediation programs that have been successfully implemented at other settings. In the literature review, several recommendations were identified to improve learning for students that could be applied at SEPHS in the Math Lab as well as the Algebra classroom. Concerns arise over the achievement of students on international math tests, as well as quality mathematical instruction. Quality instruction in the Algebra classroom is essential for future success in subsequent math classes in high school and college.

"According to the U.S. Department of Labor and the US Bureau of Labor Statistics (2013), jobs in computer and mathematic related fields are projected to grow by 18% in the next 10 years; this growth rate is larger than the projected 11% average growth for all occupations" (Hughes, Witzel, Riccomini, Fries, & Kanyongo, G. Y., 2014, p. 36). Improving Algebra instruction and remediation is important not only for improving

Keystone Exam scores but in preparing students for finding quality jobs in the 21st Century work force.

Project Evaluation

Andawei (2015) wrote that good project evaluation techniques can improve the effectiveness and success of the project. Makarova and Sokolova (2014) wrote that some of the common steps in project evaluation include development of a model, quantitative data to evaluate, transparency in evaluating the results. The project evaluation table below has four columns: recommendations, the school district personnel who are responsible for initiating the recommendation, anticipated timeline for implementation of the recommendation, and the ultimate quantitative evaluation measure.

Table 5

Project Evaluation Table

Recommendations	Responsible	Timeline	Evaluation Measure
Increase the frequency that students attend/ access the course	Master Scheduler for SEPHS	Summer 2016 for the start of the next school year	Student Algebra 1 Keystone Exam scores
Make the Math Lab course a teaching period and not a duty period	Board of Directors would need to approve the hiring of new staff, Master Scheduler or SEPHS	Hire new teaching staff in the summer of 2016.	Student Algebra 1 Keystone Exam scores
Incorporate the use of an incentive program for students enrolled in the Study Island program	Curriculum and Instruction office to investigate the proper incentive program for the students at SEPHS	2016-2017 school year for implementation at the start of 2017-2018 school year	Student Algebra 1 Keystone Exam scores
Create a two-year program for students not mathematically ready to take Algebra 1.	Curriculum and Instruction office to revamp curriculum and create pre-Algebra course.	2016-2017 school year for implementation at the start of 2017-2018 school year	Student Algebra 1 Keystone Exam scores
Eliminate the Math lab course and incorporate remediation into the classes where students are preparing for the retake.	Curriculum and Instruction office to modify scope and sequence of math courses as well as future mathematic courses	2016-2017 school year for implementation at the start of 2017-2018 school year	Student Algebra 1 Keystone Exam scores
Discontinue the use of Study Island, conduct research on alternative remediation programs, and select alternative program.	Curriculum and Instruction office to investigate proper remediation program for the students at SEPHS	2016-2017 school year for implementation at the start of 2017-2018 school year	Student Algebra 1 Keystone Exam scores

Project Implications

I believe the project will have an immediate impact on social change at the local level. School and District leaders can quickly see from the data that the way that the Math Lab is being implemented is not being successful for its students. The impact could range from teachers changing the work performed in the Math Lab to the hiring of additional highly qualified mathematics teachers. Staff could be reassigned to different teaching or duty assignments, as well as the possibility of in course curriculum changes. Of course, any of these changes mentioned would have an impact on the high school's budget which affects the entire school district.

Beyond the local level, the impact could be felt in the Study Island program. Managers and salespeople can offer research based advice to school districts/ new clients on the best way to implement their program. Their advice could be along the lines of stating that using the program once a week does not show students gains, while using it on multiple days or every other day does indeed show student growth.

Conclusion

The Literature review conducted in section three looked at several effective remediation programs. Common traits of the programs were identified and included in the white paper for presentation to the district decision makers in the SEPHS. Section four will look to identify the strengths of the research, the project's limitations, as well as its implications, applications, and directions for future research.

Section 4: Reflections and Conclusions

Introduction

In Section 4, I will identify the strengths of the research, the project's limitations, as well as its implications, applications, directions for future research, and the project's potential effect on social change. Section 4 will also include several self-reflection pieces. The self-reflections will include what I learned as a scholar, a practitioner, a project developer, and a project evaluator.

Project Strengths

The strength of the project the easy to understand white paper with suggestions to improve student learning in the SEPHS. At the presentation, or at first glance at the white paper, the decision makers in the SEPSD and SEPHS will know that the way the Math Lab is currently being implemented is not successful for the students. The white paper will present several research-based recommendations to the decision makers of the SEPSD. In the literature review in Section 3, I show several research based ideas from previously conducted studies and the white paper will present these suggestions that have shown to be significant in helping remediate students and improve algebra instruction.

Recommendations for Remediation of Limitations

The limitations for the project addressing the problem are common in education. The two major limitations are money and time. If the SEPSD had unlimited funding, it would be easier to recommend hiring more teachers, smaller class sizes, more remediation teachers, extra periods of Math Lab, and more Math Lab teachers. Knowing that the white paper will be

presented to the superintendent and assistant superintendent of the school district, I will make realistic recommendations taking budget constraints into account.

I recommend a slight increase in staff and hiring one new math teacher. The addition of the new math teacher would increase the district budget, but the benefits of more Math Lab teachers and smaller class sizes in other math classes would show benefits throughout the mathematics program.

Scholarship

Throughout the writing process, I learned a great deal about scholarship. I learned as an educational leader that I cannot jump to conclusions. I need to conduct a thorough study of a problem and research past studies to come to an effective research-based solution.

In my study, I believed that the Math Lab conducted for one period would benefit the students. In reality, the Math Lab was not remediating students at a statistically significant level. My initial response was to increase the amount of time and number of days in the Math Lab. After reflecting on the notion that the program was not working and might need to be increased, I realized I needed to have solid research to support my claims when presenting them to my supervisors. Conducting a second literature review and preparing a white paper with several suggestions of improvement would allow the decision makers in the SEPSD to make the best decision for the district.

Project Development and Evaluation

Throughout the project, I learned a great deal about project development. I learned to take one step at a time and the importance of each step. In reality, each project or study will

have many important steps and decisions. Using the data and previous research to guide the decision making process are essential for educational best practices.

In the evaluation of my study, I thought the data would result in the Math Lab program having a statistically significant positive effect on student's retesting. When the data came back, I found that this was not the case. I learned to take the data results and use them to create the white paper to make suggestions modifying the Math Lab or consider other remediation programs.

Leadership and Change

As a leader, I learned that you cannot jump to conclusions and take the first thing that is given to you as the absolute answer. I learned that I need to be led by what the data shows. My initial though was that the Math Lab would help the kids --- how could a remediation period not help students? When the data did not show what I expected; I needed to research other remediation programs and see what made them successful. To recommend a change in a program, I could not immediately recommend having more days of Math Lab; I needed to do a literature review of many programs that are showing success. An effective leader cannot have preconceived ideas on how to solve problems. To enact changes, the leader has to be led by data, research-based solutions, and best practices.

Analysis of Self as Scholar

As a scholar, I learned I need to be more diligent before making a final decision. I need to not jump to conclusions and go with my first instinct. I learned the power of a thorough

literature review and to make decisions and recommendations only after conducting and finding a research based solution.

Analysis of Self as Practitioner

As a practitioner, I learned the learning is never over. To be successful in education, I need to continue learning from others. I plan to continue to learn from other educators' successes and failures. Every day is a learning opportunity for students as well as educators. I can learn from my victories and from my defeats.

Analysis of Self as Project Developer

As a project developer I learned that the literature review has to be completed before coming up with the solution. I thought I had the simple answer to improving the Math Lab -- add more days, until I thought about it. There is a program the students are using that is not being effective, so the answer must be to add more days of the program. After thinking about that, I needed to conduct research to find other ideas for recommendations. Once more research was conducted; other possible solutions were discovered for the improvement of the Math Lab course, as well as other remediation programs.

The Project's Potential Impact on Social Change

The study determined that the online remediation program did not increase student scores for the students at the Pennsylvania high school compared with students retesting and who were not in the remediation program. The second literature review and white paper provide six research-based recommendations for the SEPSD. The recomendations include ways to improve the Math Lab course, eliminate the course, or purchase a different remediation program.

I believe the project will have an immediate impact on social change at the local level. School and District leaders can quickly see from the data that the way that the Math Lab is being implemented is not being successful for its students. The students of the SEPSD would benefit from the research with a better remediation program in the SEPHS. The research based suggestions, once implemented, should lead to the positive social change in the imcrease of mathematics achievement. The decision needs to be made to change to a different program or change how the program is being implemented. The impact could range from teachers changing the work performed in the Math Lab to the hiring of additional highly qualified mathematics teachers.

Beyond the local level, the impact could be felt in the Study Island program. Managers and salespeople can offer research based advice to school districts/ new clients on the best way to implement their program. Their advice could be along the lines of stating that using the program once a week does not show students gains, while using it on multiple days or every other day does indeed show student growth.

Implications, Applications, and Directions for Future Research

I believe there are three important pieces of the study. First, simply purchasing a remediation program and having student's work on it does not guarantee student success. The second is that a remediation program that has been successful at one place might need to be modified to be successful at another. There is no one solution to student success. Finally, the study can be easily replicated for future research. With simple replication, it will be easy to show what exactly has been successful and make recommendations for even more research.

After the implementation of the modified and improved version of Math Lab or the new program, student Algebra Keystone scores can be collected again in May, for initial test takers, and then again in January for the re-testers. Scores can again be compared between students that participated in the remediation and those that did not participate in the remediation program to determine if the changes have been successful.

Conclusion

Section four of the study identified strengths of the research, project limitations, as well as implications, applications, and directions for future research. The section also includes several self-reflection pieces. These were personal reflections on what I learned as a scholar, practitioner, and a project developer.

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Appendix A: The White Paper

A White Paper on Evaluation Options for Math Lab and Study Island Program at SEPHS

This white paper provides a summary of the quantitative quasi-experimental study analyzing an online high school mathematics remediation program called Study Island. Students that scored below proficient on the end of course Algebra 1 Keystone Exam were required to retest in January of the following school year. Approximately 200 of the non-proficient students at SEPHS were placed in a course called Math Lab, which utilized the Study Island program. In addition, another approximately 200 non-proficient students were not able to be placed in Math Lab due to scheduling issues, but the students were still required to retest in January. The study compared the scores of the two sets of students to determine if the Math Lab class and the Study Island program were beneficial to the students of SEPHS. This white paper provides the results of the study and provides recommendations from research based successful remediation programs on how to improve options for the students at SEPHS.

The Problem

The No Child Left Behind (NCLB) Act passed in 2002. NCLB established proficiency rates for schools and school districts nationwide. Previously, SEPHS has not scored high enough in its special education and low socio-economic sub-groups on the mathematics portion of the Keystone Exam and the high school has been labeled as a school that needs improvement. NCLB defines a subgroup as needing 40 or more students in a school to be considered a tested subgroup. SEPHS is a large high school and has 21 tested subgroups. In the latest round of state

testing, SEPHS achieved proficiency in 20 out of the 21 tested subgroups. One subgroup in the school scoring below proficient subgroup labels the entire school as underperforming.

The local problem that drove this study is that the SEPHS wanted to improve its student scores on its end of course Algebra 1 Keystone Exam. In response to the scores and label, an online remediation program, Study Island, was purchased and a course called Math Lab was created in an attempt to raise student performance on state testing. The high school assigned the below proficient students, whose schedule allowed for the change, to the Math Lab course where they use Study Island to prepare for the retest in January.

Research Question and Hypothesis

Do students who are not proficient on the May Algebra Keystone Exam and participate in the Study Island intervention differ from students who are not proficient on the May Algebra Keystone Exam and do not participate in the Study Island intervention on the January Algebra 1 Keystone Exam retest?

H_a: There is a significant difference on the January Algebra 1 Keystone Exam score between students who are not proficient in May and participate in the Study Island intervention and students who are not proficient in May and do not participate in the Study Island intervention.

Data Analysis

The students who participated in the Study Island remediation were assigned the numbers 1001 through 1201 and their scores were recorded for the May 2013 exam and the January 2014 exam. The students that did not have remediation were assigned the numbers 2001 – 2207 and

their scores were also recorded for the May 2013 and January 2014 exam. For both groups, the difference in scores (January score – May score) was calculated and used in the analysis. To test the null hypothesis, an independent samples t-test was performed on the difference scores (original Keystone Exam and retest) at the 5% significance level.

Data Results

The analysis determined that there was no significant difference in the change in scores on the Algebra 1 Keystone Exam scores from May 2013 to January 2014 for students who participated in the Study Island remediation and students who do not participate in the Study Island remediation, $t(401) = .032, p = .9274$.

What implications does the data have for SEPHS and the school district?

Results of this study show that the Math Lab course and Study Island were not significant in improving student performance on the Algebra 1 Keystone Exam retest. Mahmood (2003) stated that there is not an assembly line method of teaching and remediating students. Research has indicated that even the best computer-based programs cannot alone improve student performance. The most effective programs offer a well-rounded approach to include a balance of enrichment and discovery, cooperative learning and specific instruction (Corbett, Koedinger, & Hadley, 2001). After conducting a literature review on successful remediation programs and compiling beneficial traits it is apparent that modifications can be made to the SEPHS Math Lab to create a better situation for student growth. The following are possible recommendations of changes to the SEPHS Math Lab Course.

Recommendations

Recommendation 1: Continue using the Math Lab course and Study Island program, but increase the frequency that students attend/access the course.

Hannafin and Foshay (2006) found significant gains for high school student test scores could be possible with the addition of a computer-based remediation tool. In their study, students spent four days a week in a computer based instructional course and one day with an instructor working on various skills, such as test-taking skills and critical thinking skills. A significant correlation between the student scores and the program usage was identified. The passing rate increased from 40% to 84% for the students who utilized the computer based instruction. Currently, the students in the Math Lab class at SEPHS attend one day out of a six-day cycle and are only enrolled in the class if it fits into their schedule. Applying the results from the Hannafin and Foshay study, increasing the number of days from one to say three days in the Math Lab may improve student scores.

Similarly, Platko's 2011 study about an online intervention program and mathematical achievement, it was determined that students with a low initial test score showed a significant increase in their second test score after utilizing the online program. Students in this study were given access to the intervention program every day. The students either worked on the program for forty-five minutes after their math class or sometime during the day in a "math focused study hall" (Platko, p 21). Likewise, Calcut (2015) focused on a specific online program remediating math students. The students worked on the program for four weeks and for thirty minutes each day. The results of the study showed a significant increase in math scores for the participants.

Again, the theme of the daily intervention appears in contrast to the SEPHS frequency of one time per every six school days. Increasing the number of days a student is in Math Lab could produce increases similar to the ones shown in Platko and Calcut's studies.

Recommendation 2: Make the Math Lab a teaching period and not a duty period as it currently is at SEPHS.

Good teaching cannot be replaced by any tool or technology (Kozma, 2001). The presence of computer technology hardware does not by itself produce desirable scoring in math (Li, 2004). Various reports of successful computer-based remediation have included an element of teacher instruction. The program put into use by Hannafin and Foshay (2006) focused on faculty training and required students to spend one day per week with teacher-led instruction. Cheung and Slavin's 2013 meta-analysis on educational technology supported a positive, but small, gain to enhance math achievement.

McLaughlin, Veale, McIlwrick, de Groot, and Wright (2013) conducted a study on identifying key steps in the remediation process for medical students. They wrote that students having difficulty learning in their program had success when they received "immediate feedback and the opportunity for further practice" (p. 2). Although their study focused on students training to be in the medical field and not secondary education, their theories of immediate feedback and additional practice are similar to best practices in secondary classrooms. Immediate feedback on student answers and additional practice on incorrect answers are both features of the Math Lab which could be enhanced with immediate teacher feedback and teachers

creating additional practice problems in the Math Lab. DeBruler et al., (2014) wrote that the most important part for student learning is the teacher.

Currently, teachers in the Math Lab course are not asked to assist, tutor, or give feedback to the students. The teachers are assigned the Math Lab as a duty, similar to study hall duty. If the Math Lab class was a teaching period, the teachers could provide observation, feedback, and provide further skill practice to the students in the Math Lab course.

If the Math Lab changes from a duty period to a teaching period, Math Lab teachers would need to teach less traditional classes to meet the constraints of the SEPSD teachers' union contract. If the traditional number of classes taught per teacher is lowered, more teachers would need to be hired to offset the loss of sections due to the Math Lab, which would have an impact on the school district's budget. Given the results of the study, making the Math Lab at SEPHS a teaching period instead of a duty period would be well justified. In order to keep class sizes similar, this recommendation would require the hiring of one certified math teacher.

Recommendation 3: Incorporate the use of an incentive program for students enrolled in the Study Island program to further motivate and inspire them to master higher levels in the courseware.

In a study by Punches-Guntsch and Kenney (2012), a reward program played an important role in making their remediation program a positive experience. Students can be motivated by both tangible items (snacks or prizes) or by intrinsic rewards via progressing through a remediation program and improving exam scores.

Gettinger and Walter's 2012 study investigated student engagement times. They discovered that students are on task 45% to 50% of their time, or off task 50% to 55% of the time. Cadima, Doumen, Verschueren, and Buyse (2015) studied the importance of child engagement and Mitchell, Tingstrom, Dufrene, Ford, and Sterling (2015) studied the effects of a program designed to keep kids on task for a longer period of time. Their study focused on the class wide group reinforcement program called the Good Behavior Game (GBG). The results showed that the GBG program led to a decrease in off-task behavior in the classroom when implemented as compared to a class without the GBG program implemented. Lynne's 2015 investigation of the GBG also yielded positive aspects. Adding a group reinforcement program to the curriculum or remediation program at SEPHS could improve student engagement time and thus increase student performance.

Mireles, Acee, and Gerber (2014) studied an intervention model called Fundamentals of Conceptual Understanding and Success (FOCUS). Their study discovered evidence that the FOCUS intervention increased math proficiency for the students using it. The model included incentives as well as the course being credit bearing. One difference in the FOCUS model and the Math Lab class at SEPHS is there is no course credit assigned to the Math Lab course. If the number of days per week the class meets is expanded, as suggested previously, perhaps a course credit or course grade could be assigned to the Math Lab course. With those changes, perhaps the students would put forth more effort in the Math Lab course.

Recommendation 4: Create a two-year program for students not mathematically ready to take Algebra 1. The two-year program could consist of a pre-Algebra year and then the actual Algebra course the second year.

A 2015 study on the proper grade level to take Algebra offered several discussion points and suggestions. Howard et al. (2015) wrote "algebra-for-all policies" (p. 57), where all students take Algebra 1 at a certain grade – either 8th or 9th grade, scored lower on college readiness studies as compared to students who took Algebra 1 when prepared. They reported that the best scenario for students is to take Algebra at the appropriate grade and "address the lack of preparedness in a systematic manner throughout students' elementary and middle school experiences" (Howard et al., p. 57, 2015). To better prepare its students for the Algebra 1 Keystone Exam and retest, the SEPSD needs to look at the mathematics curriculum in its elementary and middle schools to make sure its students are properly prepared entering Algebra 1, regardless of grade level. The school district can use some sort of readiness test to determine if a student is "Algebra 1 ready." If the student is not ready, a two-year program to include a pre-Algebra readiness piece and then the actual Algebra course should be the course placement for the student. Perhaps the pre-Algebra class could have features of blended learning in it. Garrett Dikkers, Whiteside, and Lewis, (2014) wrote of the many benefits of blended learning in assisting student learning.

Recommendation 5: Eliminate the Math Lab course. Incorporate remediation into the classes where the students are preparing for the Algebra 1 Keystone Exam retake.

Gernert (2014) studied the impact of the Study Island program on high school students and their reading proficiency. The study focused on the integration of the Study Island program into the curriculum. The results indicated that student proficiency scores were significantly higher after students worked on the Study Island program alongside traditional coursework. Integrating the remediation program into the curriculum is a different approach than the current Math Lab's "extra period" of math approach.

Smith's (2014) research brief reviewed research on instructional practices in Algebra 1 classrooms. The brief provided recommendations for program developers and administrators using best practice methods discovered. Recommendations included reconsidering traditional Algebra teaching methods as well as promoting procedural fluency and conceptual understanding. The brief's recommendations "have implications for instructional design, curricular materials, teacher evaluation, and professional development" (Smith, p. 2). With the Math Lab not demonstrating the expected success, both recommendations could be explored at SEPHS. Traditional teaching methods include drill and practice, nightly homework, and memorization of basic math facts. Changes to the instructional design could include the flipped classroom, where the student views the lecture and notes as homework and class time is devoted to checking for understanding and guided practice (Tucker, 2012). Chen, Wang, and Chen (2014) believe that the flipped classroom is underutilized and has the potential for significant student benefits.

Promoting procedural fluency is the ability of students to choose the correct procedure in solving problems, not simply memorizing math facts. Procedural fluency allows students to

build their own strategies to solve a wide range of problems (Samarji, 2012). At SEPHS this could be implemented by having the teachers solve homework problems using more than one method and even have a test question asking for two methods. In a long range goal, this concept could be incorporated into the middle schools and high schools in the district.

Recommendation 6: Discontinue the use of Study Island, conduct research on alternative remediation programs, and select one of the alternative programs.

Success has been evident using other computer-based learning tools, similar to Study Island. One tool, called Plato, is a standards-based online learning program that was developed by the same company as Study Island. After positive results were discovered with limited access to the courseware, the rural PA district expanded to a 1:1 program for all its high school students. The rural high school was able to boast a 16% increase in the Pennsylvania School Performance Profile from the 2011-2012 school year to the 2012-2013 school year. The recommendation is for the SEPSD to get a free, or small, trial for a select group of students to work on Plato and compare to results against Study Island or to eliminate Study Island.

Other options could be the Carnegie Learning Algebra Cognitive Tutor or the ALEKS Algebra Course. Sabo, Atkinson, Barrus, Joseph, and Perez studied the two tutoring systems in their 2013 study. The tutoring systems were used in a 14-day summer school for students that failed high school algebra during the regular school year. The study discovered that both tutoring systems produced significant increases in student learning of algebra (Sabo, Atkinson, Barrus, Joseph, & Perez, 2013). In 2014, Tigueros, Lozano, and Sandoval wrote about integrating technology in the mathematics classroom while focusing on the importance of the

teacher in the integrated classroom. The results of the 2014 study connect with the Math Lab and Study Island at the SEPHS. Putting students on computers with no teacher guidance in the library was not a magic solution for student improvement on the Algebra Keystone Exam. Other research based solutions must be investigated.

Tomlinson's (2014) book, *Differentiated classroom: Responding to the needs of all learners,* looked into numerous topics on student learning. Tomlinson wrote that for teachers to reach the needs of all students, teachers need to differentiate their instruction. Utilizing technology and writing were key suggestions, as well as asking questions in different ways. In the Study Island program, the majority of questions are multiple choice with some questions being a different variety such as fill in the blank. The teachers do have the option to turn on/off constructed response questions. Since a communication piece is present in Study Island, the teachers could spend extra time on the written responses or if Study Island is discontinued, the SEPHS should pursue purchasing a program that has that communication piece in it.

Conclusion

The Math Lab course was created and the Study Island program was purchased to help students on the PA Keystone Exams. Bernard's 2013 study on student achievement and the use of Study Island showed an increase of student scores, but the current implementation of Study Island at SEPHS does not contribute to a significant increase in student scores for the students participating in the Math Lab compared to students who retested and were not in the remediation program. McLaughlin, Veale, McIlwrick, de Groot, and Wright (2013) wrote that "not all learners will be successful in their remediation, but providing mentorship and an organized

approach to remediation can at least improve their chances" (p. 4). Recommendations were made from research of successful remediation programs and included increasing the frequency that students have access to the Study Island program, offer an element of teacher instruction during the Math Lab, utilize incentives to keep students motivated, creating a two-year Algebra readiness program, eliminating Math Lab and incorporating remediation into the students' coursework, and purchasing an alternative remediation program.

The six recommendations suggested a wide range of options to look into. All six have research supporting their past successes. Any of these recommendations could help the students of SEPHS in their state testing as well as assisting them on their path towards graduation.

Concerns continue to arise over the achievement of students on international math tests, as well as quality mathematical instruction. Quality instruction in the Algebra classroom is essential for future success in subsequent math classes in high school and college. Hughes et al. (2014) also found that SBI, model-based interventions, and concrete representational-abstract sequence had significant effects on students learning in the Algebra classroom. Lane, Menzies, Ennis, and Oakes' 2015 book provided strategies for effective classroom management and instructional ideas. Cavanaugh (2015) added that online student learning also is advantageous to students entering the workforce.

"According to the U.S. Department of Labor and the US Bureau of Labor Statistics (2013), jobs in computer and mathematic related fields are projected to grow by 18% in the next 10 years; this growth rate is larger than the projected 11% average growth for all occupations" (Hughes et al., 2014, p. 36). Improving Algebra instruction and remediation is important not

only for improving Keystone Exam scores but in preparing students for finding quality jobs in the 21st Century work force.

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Appendix B: Student Keystone Scores

Student No. #	Remediation Yes = 1; No = 2	May 2013 score	Jan 2014 score	Difference
1001	1	1484	1488	4
1002	1	1462	1491	29
1003	1	1492	1472	-20
1004	1	1477	1464	-13
1005	1	1470	1480	10
1006	1	1497	1452	-45
1007	1	1470	1468	-2
1008	1	1470	1491	21
1009	1	1478	1502	24
1010	1	1496	1534	38
1011	1	1485	1468	-17
1012	1	1489	1484	-5
1013	1	1489	1488	-1
1014	1	1495	1502	7
1015	1	1487	1506	19
1016	1	1489	1523	34
1017	1	1481	1513	32
1018	1	1496	1527	31
1019	1	1478	1495	17
1020	1	1466	1456	-10
1021	1	1485	1534	49
1022	1	1485	1495	10
1023	1	1474	1472	-2
1024	1	1493	1476	-17
1025	1	1492	1484	-8
1026	1	1485	1460	-25
1027	1	1486	1460	-26
1028	1	1485	1480	-5

1029	1	1497	1506	9
1030	1	1470	1523	53
1031	1	1481	1452	-29
1032	1	1489	1506	17
1033	1	1485	1464	-21
1034	1	1489	1502	13
1035	1	1496	1561	65
1036	1	1481	1472	-9
1037	1	1492	1495	3
1038	1	1485	1491	6
1039	1	1492	1538	46
1040	1	1492	1464	-28
1041	1	1492	1491	-1
1042	1	1494	1464	-30
1043	1	1489	1509	20
1044	1	1484	1447	-37
1045	1	1485	1456	-29
1046	1	1498	1553	55
1047	1	1492	1491	-1
1048	1	1481	1499	18
1049	1	1488	1495	7
1050	1	1496	1523	27
1051	1	1481	1488	7
1052	1	1444	1468	24
1053	1	1478	1468	-10
1054	1	1496	1516	20
1055	1	1489	1476	-13
1056	1	1486	1472	-14
1057	1	1492	1523	31
1058	1	1492	1509	17
1059	1	1474	1484	10
1060	1	1474	1468	-6
1061	1	1489	1480	-9
1062	1	1489	1509	20
1063	1	1486	1468	-18
1064	1	1492	1549	57

1065	1	1478	1452	-26
1066	1	1481	1447	-34
1067	1	1493	1499	6
1068	1	1498	1520	22
1069	1	1482	1464	-18
1070	1	1488	1520	32
1071	1	1492	1545	53
1072	1	1439	1452	13
1073	1	1496	1513	17
1074	1	1492	1520	28
1075	1	1458	1516	58
1076	1	1470	1484	14
1077	1	1489	1506	17
1078	1	1496	1506	10
1079	1	1470	1530	60
1080	1	1485	1523	38
1081	1	1495	1488	-7
1082	1	1482	1480	-2
1083	1	1496	1513	17
1084	1	1453	1495	42
1085	1	1489	1527	38
1086	1	1478	1499	21
1087	1	1482	1476	-6
1088	1	1496	1484	-12
1089	1	1489	1509	20
1090	1	1491	1509	18
1091	1	1478	1488	10
1092	1	1478	1513	35
1093	1	1485	1484	-1
1094	1	1481	1484	3
1095	1	1478	1484	6
1096	1	1498	1502	4
1097	1	1497	1476	-21
1098	1	1492	1506	14
1099	1	1474	1452	-22
1100	1	1497	1442	-55

1101	1	1489	1509	20
1102	1	1485	1442	-43
1103	1	1424	1464	40
1104	1	1444	1468	24
1105	1	1485	1484	-1
1106	1	1496	1502	6
1107	1	1492	1468	-24
1108	1	1489	1468	-21
1109	1	1485	1516	31
1110	1	1466	1472	6
1111	1	1484	1488	4
1112	1	1487	1484	-3
1113	1	1489	1472	-17
1114	1	1478	1472	-6
1115	1	1498	1468	-30
1116	1	1497	1495	-2
1117	1	1489	1527	38
1118	1	1470	1476	6
1119	1	1474	1516	42
1120	1	1485	1491	6
1121	1	1478	1516	38
1122	1	1466	1456	-10
1123	1	1485	1502	17
1124	1	1478	1442	-36
1125	1	1474	1464	-10
1126	1	1497	1491	-6
1127	1	1496	1491	-5
1128	1	1496	1506	10
1129	1	1492	1464	-28
1130	1	1462	1491	29
1131	1	1484	1506	22
1132	1	1489	1541	52
1133	1	1497	1491	-6
1134	1	1496	1523	27
1135	1	1496	1516	20
1136	1	1494	1509	15

1137	1	1462	1495	33
1138	1	1477	1432	-45
1139	1	1458	1472	14
1140	1	1493	1491	-2
1141	1	1486	1484	-2
1142	1	1474	1491	17
1143	1	1453	1476	23
1144	1	1484	1447	-37
1145	1	1474	1495	21
1146	1	1478	1484	6
1147	1	1496	1523	27
1148	1	1462	1502	40
1149	1	1486	1480	-6
1150	1	1474	1502	28
1151	1	1470	1460	-10
1152	1	1474	1516	42
1153	1	1466	1456	-10
1154	1	1492	1502	10
1155	1	1478	1432	-46
1156	1	1478	1464	-14
1157	1	1485	1509	24
1158	1	1474	1476	2
1159	1	1484	1527	43
1160	1	1485	1516	31
1161	1	1481	1523	42
1162	1	1478	1509	31
1163	1	1399	1402	3
1164	1	1466	1438	-28
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