Technology Integration in Math, Science, and STEM

Final project for LT 785 – Research Methods in Educational Technology

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I. Statement of the Research Question

How has or will technology improve integration and learning for math, science, and STEM in the K-12 schools?

II. Summary of the Literature

Integrating technology into the classroom is not a new concept, teachers have been introducing technology in the classroom for many years. Technology can be traced to being introduced to increase efficiency all the way back to chalk and the chalkboard. While it may seem a little archaic for an example, it was nonetheless a very advanced piece of technology for its time. A range of new technologies, primarily digital, has become available since the 1990s, and the education field is struggling to learn how to apply them to teaching and learning practices (Cherry, 2014). With today's technology teachers are again staring at a technological turning point such as the chalk and chalkboard. Technology is once again changing the classroom whether or not teachers' are embracing it or not. Recently data has become available to distinguish whether or not technology integration is improving student achievement. Higher levels of technology adoption in teaching and learning provide an opportunity to help bridge the digital divide (Cherry, 2014). In the K-12 industry administrators rely on state test scores to reveal student advancement or decline in Math, Science and Reading. The purpose of this review was to focus on case studies involving technology integration in math, science, and STEM in the K-12 setting to determine if integrating technology helps or hinders students achievement in these subjects. "There is great urgency for K–12 schools to increase the level of technology integration and literacy so their students can develop the 21st-century skills to compete in college and today's workforce" (Luna p. 18). Throughout too much of modern history, western education has mostly consisted of students passively sitting in classrooms, listening to teachers, taking notes, completing assignments, and testing of memorization (Kaszka, 2017). There are many facets to integrating technology successfully, this type of endeavor is not to be taken lightly and may take many years to implement. Integrating technology starts with a foundation of support from administration, commitment of funding, infrastructure upgrades, professional development and continued support. “Schools must continue to become aware of the barriers that do exist and must begin to plan, purchase, and integrate technologies to support the learning of the 21^{st} century” (Hoon, 2006, p. 19). According to Luna (2015) there must also be a societal change from the teachers in the form of being willing to change. Teachers must change their pedagogy, be open minded to further their professional development. Successful professional development was identified as having four influencing factors: teachers needed to have content knowledge, be open to change, and be given training at a time and in a place convenient with continual support (Harlem, 2008). “Past success had shown sustaining a science and technology support program through extensive professional development opportunities provided learning experiences for students resulted in student success in science” (Harlem, 2008, p.28). Throughout this research the importance of strong professional development cannot be expressed enough.

Another important facet of technology integration is the availability of computers in and out of the classroom. “The greatest inequities in computer use are not in how often they are used, but in the ways in which they are used. Poor, urban, and rural students are less likely to be exposed to higher order uses of computers than non-poor and suburban students” (Wenglinsky, 1998, p. 21). Access to technology outside of school can be a challenge for some, which in turn gives those students with unlimited access an unfair advantage. Even so, unlimited access does not automatically mean learning, the content being viewed can either challenge a young mind or have detrimental effects. As more and more schools start to implement a 1:1 program this will become less of an issue if school issued devices are behind a “walled garden” (software allowing students to explore safe material and blocking anything deemed harmful).

While technology integration has many challenges, Johnson (2014) states that teacher resistance is an important hurdle to overcome, some teachers believe students should learn pen-and-paper calculation in order to form a solid foundation to their mathematics learning. Resistance to change will always be a challenge but when all of the fish start swimming in the same direction it becomes harder for one to go against the flow. This refers back to societal change, when technology integration is the social norm it will be less of issue for teachers to resist change. “The vast majority of the teachers either ignore the call to use technology in science teaching or they employ technology in ways which replicate traditional instructional strategies, such as the using PowerPoint lecture presentations” (Roehrig and Guzey, 2012, p.163). In order to combat this resistance studies show professional development is the key to raising teacher comfort level with technology. “Requiring teachers to take subject-specific technology courses in their teacher education program would be beneficial” (Roehrig and Guzey, 2012, p.179).

Hoon (2006) stated, although technologies in classrooms were definitely on the rise, there were divisions among the quantity of technologies present at various schools. Quality and quantity of technology can also be a barrier for some schools that do not have access to the amount of funding and investment it requires to upgrade infrastructure or roll-out a 1:1 initiative. Luna (2015) states technology infrastructure and support are important to have in place otherwise the result could be frustrated teachers and students. The lack of infrastructure, support, devices and bandwidth can cause a technology integration program to fail instantly. Having administration and all stakeholders promoting and upholding the plan is essential to its success. Hoon (2006) also indicates school principals play a vital role in technology integration. Their leadership in this type of endeavor must be infallible as teachers look to them for guidance. Technology support is also an essential facet to a technology integration project. Teachers must be able to rely on the technology support staff to uphold operations. Reliability and consistency are important to teachers as they plan their pedagogy.

Integrating technology has grown out of its infancy and is now approaching maturity. "The use of technology to enhance student achievement in science by moving students from passive observer to active participants" (Harlem, 2008, p.180). We have learned there are benefits to integrating technology correctly. "Technology advocates were correct in asserting technology can be beneficial to student learning. Used properly, technology can lead to gains in academic achievement and positively influence the social environment of the school, reducing teacher and student absenteeism and increasing morale." (Wenglinsky, 1998, p. 36). According to Harlem (2008), the abilities of students to use technology to predict, for decision making, for critical thinking, and for problem solving is the main focus. "When technology was used to support higher order thinking and inquiry-based science lessons, students became more involved and engaged" (Harlem, 2008, p.20). It is important to point out technology must be integrated in a way which encourages students to use and develop thinking skills in order to enhance their learning. "It was founded on the idea students learn best when they are actively, not passively, involved in the learning experience" (Harlem, 2008, p.18). "Use of technology instruction has led to increased student engagement with content and to application outside of the class as teachers collaborate to meet the various needs of their students" (Luna, 2015, p. 30). "Findings indicate computers are neither a cure-all for problems facing the schools nor mere fads without impact on student learning. When used properly, computers may serve as important tools for improving student proficiency in mathematics and the overall learning environment of the school" (Wenglinsky, 1998, p. 6).

The benefits of technology integration in the K-12 industry far outweigh the drawbacks. "Incorporating more technology encouraged students to work collaboratively, use higher order thinking skills, be self-directed learners, and increased student outcomes" (Harlem, 2008, p.187). The advantages of technology integration spills over to other subjects as well. "Taking students from the lecture atmosphere, where each subject is taught separately, to an atmosphere where mathematics, science, and technology education are integrated, will contribute to the amount of knowledge students gain" (Ebrahim, 2000, p.11). "By integrating math, science, and technology education, students will understand the subjects better, it provides them with hands-on activities, which enhances their teaming, instead of only lectures" (Ebrahim, 2000, p.11) When technology integration is applied Kaszka and Slater (2017) describe problem solving as "students' collaboration, inquiry, creativity, and critical thinking while engaged in rigorous standards-based curriculum and authentic and meaningful learning involving real-world and open-ended challenges or problems" (Kaszka and Slater, 2017, p. 245). In a two-phase study integrating Science, Technology, Engineering and Math, Kaszka and Slater gave perspectives on best practices to facilitate hands-on, real-world experiences that not only allow for deeper, more meaningful learning (Kaszka and Slater, 2017). "When used properly, computers may serve as important tools for improving student proficiency in mathematics and the overall learning environment of the school." (Wenglinsky, 1998, p. 6). Kaszka and Slater believe this approach has the opportunity to be clearly superior to the traditional model of learning in which students sit through lectures and engage in labs which may or may not have relevant connection to the lectured material (2017). As the world becomes more technology infused so must teaching and learning. The traditional way of teaching to rows of desks and lecturing while students take notes is going by the wayside.

Another benefit is technology integration applies to real world situations. Not only do students learn troubleshooting skills but according to Ebrahim (2000) they will be able to develop a sense of leadership while being able to collaborate with other students. In the last five years software development has made major progress to futuristic capabilities. Students are able collaborate on papers in real-time, be a voice in the classroom without speaking (via blogs) and see instant test results via online assessments. Teachers are able to upload videos of their lessons, post assignments for absent students and accept homework through a type of drobox. Hoon (2006) states the frequency of software use offered a better understanding into the integration of computers in a school setting. Student and teacher comfort level with software gives them confidence to troubleshoot small issues and help others. Today's generation of students are growing up with technology which holds their attention before and after school, so integrating technology during school makes sense in order to relate content to current pupils. "When learning is fun, students are more likely to be self-motivated and put forth extra-effort" (Ebrahim, 2000, p.17). Outside of the classroom students are spending their free time coding and creating online communities, incorporating this into the classroom makes sense. "Technology education challenges students' intellectual thinking and the ability to be creative" (Ebrahim, 2000, p.16).

Science, technology, engineering and math careers continue to grow and the need for students with these 21st century skills are in demand more than ever. "Math, science, and technology will provide students with the right environment where they can use their skills and talents to solve problems" (Ebrahim, 2000, p.18). Ebrahim (2000) found students who had two or more courses in the integrated math, science, and technology education program scored significantly higher on the science sub-section of the standardized proficiency test than students who did not have any integration. Harlem (2008) acknowledged the use of Web 2.0 technologies during science lessons helped each student be an active participant in the science lesson and increased the amount of control the student had over the learning experience.

The advantages to integrating technology into math, science and STEM are still being recorded, the data indicated students achieve higher test scores when technology is integrated into their instruction. The need for technology integration in STEM subjects at the K-12 level is obvious, the job market is becoming more demanding of these skills all the time. "When students have insufficient knowledge in science, it puts them at a disadvantage for job opportunities in fields related to science and technology" (Harlem, 2008, p.17).

III. Summary and Conclusions

The purpose of this review was to focus on case studies involving technology integration in math, science, and STEM in the K-12 setting to determine if integrating technology helps or hinders student achievement in these subjects. Integrating technology starts with a foundation of support from administration, commitment of funding, infrastructure upgrades, professional development and continued support. Teachers look to administrators and technology staff for guidance and support to help them plan their pedagogy and integrate technology into the curriculum. Professional development helps raise teacher comfort levels with technology making it easier for teachers to not resist change. In addition, when professional development supports the integration of technology, in math and science, the results end with student success.

Technology only becomes beneficial to students when it’s used to facilitate learning and is accomplished through teacher preparation, especially in science, math, and STEM K-12 settings.

As more schools move towards a 1:1 program the integration of technology will become easier to achieve. Today’s generation of students are growing up with technology and its the role of schools and educators to make sure they relate to the content needs of the current students. With the integration of technology in math, science, and STEM programs students will start to become self-motivators and intellectual thinkers, they will put forth extra effort in their learning, their creativity sky rockets, and it gives students an advantage for job opportunities in fields related to math, science, and STEM. Proficiency exams have also shown integrating math, science, and technology educational programs does increase higher test scores and students’ engagement within the classroom.

Today, teachers are integrating technology into science, math, and STEM programs than ever before. Studying the effects of technology integration on student learning, not just in math, science, and STEM programs, technology is the key to unlock student success. Technology is only beneficial to student success when used correctly and it’s the schools’ job to make it possible. As technology continues to change so must schools, teaching, learning, and the integration of new technology to continue benefiting the needs of students, their education, and their future.

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V. Application of the Research in a Typical School/Classroom

Even though some challenges exist, computer technology is making a large push for integration in math and science classes. "By integrating math, science, and technology education, students will understand the subjects better, it provides them with hands-on activities, which enhances their teaming, instead of only lectures" (Egraihim, 2000, p.11). In order to integrate technology into teachers' classrooms they need more than just receiving the devices themselves.

The first step in incorporating technology into math and science classes is obtaining the technology that will take students lesson plans to an entirely new level. Technology advocates were correct in asserting technology can be beneficial to student learning. Used properly, technology can lead to gains in academic achievement and positively influence the social environment of the school, reducing teacher and student absenteeism and increasing morale (Wenglinsky, 1998, pg. 36). Recent surveys by the National Center for Education Statistics have found computer technologies are readily available in schools. One hundred percent of US public schools have computers with Internet technologies and 96% of classrooms have computers with Internet access (Cherry, 2014). Incorporating technology into a classroom is a process many districts are pushing for. With these technologies more commonly available, it is creating classroom settings for teachers to create an environment where teachers no longer need to lecture full-time in the front of the class.

In order to integrate technology into classrooms, teachers need training not only on how it works, but also on the technology itself. A component of Science, Technology, Engineering, and Math (STEM) is collaboration-emphasizing teamwork over individuality (Kaszka, 2017, pg. 57). When working as a team, students learn both the strengths and weaknesses of their classmates and how to best utilize each other to create a technology integrated environment.

Technology education challenges students' intellectual thinking and the ability to be creative. When learning is fun, students are more likely to be self-motivated and put forth extra effort. (Ebrahim, 2000, p.16-17). Teacher training in computer use plays a large part in the ability and willingness to use computers with their learners (Hoon, 2006, pg. 15).

The last key component to technology integration in the classroom is types of software used in the classrooms. The technology tools are used for productivity, communication, research, and problem-solving (Hoon, 2006, pg. 16). With technology so prevalent in society, there are a number of programs also available to be used in classrooms. With so many different types of software available, teachers can integrate technology into their math and science rooms and create a learning environment that will allow students to learn in ways they have never experienced before. If teachers have the proper training, the technology, along with software it creates a learning environment benefiting students.

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Integrating technology into the math, science, and STEM classrooms may need extra support from principals and professional development, but the long-term benefits greatly outweigh these factors. By creating this environment, educational leaders are fostering and nurturing a culture of responsible risk-taking policies while promoting continuous innovation with technology (Hoon, 2006, pg. 16). With the range of new technologies, primarily digital, becoming available since the 1990s, the education field is pushing to learn how to apply them to teaching and learning practices. Many teachers change their teaching practice to incorporate digital technology once they find it increases student achievement and believes they have the support and ability to integrate it into the classroom (Cherry, 2014, pg. 24). Technology integration into classrooms will create a problem-solving environment in which students can take what they have learned and use it throughout their lives.

A14 Appendix A - Analysis of Research

Article Analysis #1

Bridget Malone

1. Bibliographic Reference (APA Style)

Ebrahim, Y. (2000). The influence of an integrated math, science and technology education program on students' performance on the state of ohio math and science sub -sections of the 9th grade proficiency test in a selected high school. Available from ProQuest Dissertations & Theses Global. Retrieved from http://www.ezproxy.dsu.edu:2048/login?url=https://www.ezproxy.dsu.edu:2206/docview/304612253?accountid=27073

2. Type of Research:

T-Test for Equality of Means (2 Sample T-Test)

Levene's Test for Equality

3. Evidence from article you used to determine Type of Research

Ebrahim (2000) stated, "The means and standard deviations were used to report the results of the descriptive statistics of these hypotheses. Since the researcher assumed that the students in this study are representative of a larger population, t-tests were conducted in order to show that the results did not happen due to chance" (p.29).

4. Purpose of the Research

In this study, researcher Yousef Ebrahim's primary purpose was to investigate the influence of the integrated math, science, and technology education program on students' performances on the State of Ohio 9th grade proficiency test. The researcher wanted to know if the integration of math science, and technology in education had an effect on the math and science sub-sections of the Ohio standardized proficiency test, based on gender, and based on ethnicity or race.

5. <u>Instruments Used</u>

The researcher used 1997-1999 Ohio math and science proficiency test results to tests the hypothesis questions revolved around three research questions to draw his conclusions.

6. <u>Validity and reliability of Instruments Used</u>

The Ohio Department of Education ensured the validity of the 9th grade proficiency test. To insure the validity of the proficiency test, the researcher formed content committees who were in charge for ensuring the curricular and content validity. The content committee was hired by the Ohio Department of Education to insure curricular validity. They considered the state's model curriculum guides, sample of graded courses of study from Ohio school districts, standards adopted by national learned societies, and lists of competencies adopted by other states. For content validity, the Ohio Department of Education asked the content committee to judge whether the task was an appropriate measure of students' competencies for the 9th grade. They also were asked to evaluate the appropriateness and fairness of the tasks that were reviewed. After reviewing the data from the test, the committee ensured the appropriateness and fairness of the items.

To test for reliability, the KR-20 reliability index provided information on the internal consistency of the test. The KR-20 was used when items were added together to represent one variable and was used when responses to items were dichotomous, yes/no, or multiple-choice with one correct response. Defined by the Ohio Department of Education, the tests were reliable. The researcher also compared the standardized proficiency test results between the treatment group and the control group keeping in mind students' gender and ethnicity.

7. <u>Subjects</u>

The target audience was eleventh grade students from a large Ohio suburban high school. The researcher looked at the eleventh-grade students' math and science proficiency test results from when they were in ninth grade (1997-1998), in tenth grade (98-99), and when they were in eleventh grade (Autumn 1999 only). Students were divided into two groups, the treatment group and the control group. Students in the treatment group consisted of students in the integrated math, science, and technology education program. Students in the non-integrated math, science, and technology education program were in the control group.

The researcher started with 310 students, 68 were in the non-integrated math, science, and technology education and 242 were in the non-integrated math, science, and technology education program. The technology coordinator of the district generated the list of students. From there, the researcher started limiting the students down by choosing those who attended classes regularly. In the end, the researcher ended up with 58 students in the integrated math, science, and technology education program and 221 there were not. From there, students who were in integrated courses, 8 students had one integrated course and 50 had taken two integrated courses.

8. Results and Conclusions

The results from the test were:

Research Question #1: Students in the integrated math, science, and technology education program had slightly higher mean scores than the students in the non-integrated program.

Research Question #2 (Gender): Male and female students in the integrated math, science, and technology program had slightly higher mean scores in the math and science proficiency test than the students in the non-integrated program.

Research Question #3 (Ethnicity & Race): The researcher could not find enough data for African American, Hispanic, Asian and American Indian students in order to test the effect of the integrated or non-integrate program in their math and science proficiency test scores.

In conclusion, through the study of the ten hypothesis questions that surrounded the three research questions one could say that students who are integrated in math, science, and technology courses receive better test scores than students who are not, in that school district. In order to see if taking integrated courses betters students' test results more schools need to be studied and from all over the world.

9. Possible Influence of Extraneous Variables

One possible influence of extraneous variables is the factor that some of the students' pre-knowledge of the courses they are involved in. This would obviously influence their test scores. The room temperature might have an influence on their test results. Another one might be the time of day the students are tested. Some students test better in the mornings and other do better in the afternoon. The consideration of different testing skills the students had and their ability to do time testing might also is an influence of an extraneous variable.

10. Possible Threats to Internal and External Validity

Since the Ohio Department of Education validated the test, so the possible threats to internal and external validity might be limited. However, since the researcher picked the type of students to test, the validity of the research might have gone down. Out of the number of students the technology coordinator gave the researcher, the researcher decided not to include students with poor attendance, suspension history, expulsion history, and students who were developmentally disabled. Since the treatment group was self-selected, this could threaten the internal validity of this study.

11. Generalizability of Result

The results were done on one large school district. To test to see if there was a wider effect of the integrated math, science, and technology education program on students' math and science sections of the proficiency test, more schools should have been involved in this study. In addition, the researcher hoped to convince administrators and instructors about the good aspects of the integrated courses, but there was only one result with a significant difference. There was a significant difference on the mean scores of science for students who had two or more courses in the integrated subjects and of whom were male students. Other than that, the researcher did not find any substantial amount of data on the other results. The researcher should randomly sample the students in order to have a more accurate representation of the school population.

A14 Appendix A - Analysis of Research

Article Analysis #2

Jennifer Funke

1. **Bibliographic Reference (APA Style)**

Hoon, M. (2006). The integration of instructional computer technology in a K-5 math, science, and technology school (Unpublished doctoral dissertation). University of Southern California.

2. **Type of Research:**

___ Descriptive ___ Correlation

___ Experimental ___ Causal-Comparative

___ Historical ___ Quasi-Experimental

___ Meta-Analysis _X__ Survey

3. **Evidence from article you used to determine Type of Research**

A quantitative approach was the primary strategy of capturing data in this study. A cross-sectional survey questionnaire was administered by the researcher to provide the main source of data (Hoon, 2006, pg.47).

4. **Purpose of the Research**

The primary purpose of Michael Hoon's research study was to gain insights into elementary teachers' integration of computer technology with their students at the Alexander Science Center

School (ASCS). Being conceptualized and designed with an increased focus in the subject areas of math, science, and technology, the ASCS provided a significant setting to study the computer uses of teachers and their students.

5. Instruments Used

The survey instrument used in the study was a modified version of a teacher technology survey developed by Kristine Y. Hogarty, Thomas R. Lang, and Jeffrey D. Kromrey (2003) from the University of South Florida. For the purposes of this study, a paper and pencil form was administered. This survey questionnaire consisted mostly of a series of closed-ended questions specifically chosen to create, ". . . a better understanding of how educators and students use technology in the classroom (Hogarty, Lang, & Kromrey, 2003, p. 140)." This survey instrument began with open-ended demographic data and followed with several closed-ended questions using 5-point Likert-type scales. The final page, added by the researcher of this project, asked a series of four open-ended questions to help more fully explain the findings from the closed-ended questions of the survey.

6. Validity and reliability of Instruments Used

The researchers who developed this instrument tested the survey-questionnaire for reliability and validity with approximately 2,000 teachers. The survey was initially administered in either a paper-and-pencil or web-based form. After respondents returned the surveys, an exploratory factor analysis was done on each section of the survey and the composite scores showed acceptable levels of reliability. The range of the Cronbach's alpha for each section of the survey- questionnaire was between .74 and .92. The instrument's reliability was seen to be strong as, through both methods of conducting the survey, similar relationships were found (Hogarty, Lang, & Kromrey, 2003). The validity of the survey-questionnaire was supported by relationships between instrument subscales and relationships with external variables.

The section of the survey-questionnaire that asked items about the frequency of integration of computers in the classroom was analyzed for reliability. This section investigated the integration of computers into the classroom with regards to use in both individual and group instruction as well as the promotion of both independent and student-centered learning. Also, items included integration with the use of computers as a problem solving/decision making tool and the use of computers as a research, presentation, productivity tool, and communication tool. Cronbach's alpha, again, revealed reliability with this set of items generating an estimated .89 (Hogarty, Lang, & Kromrey, 2003). This data supported an adequate level of reliability.

7. <u>Subjects</u>

The subjects of this investigation were all the classroom teachers employed at the ASCS in the fall of 2005. The number of the population was 30 teachers as these were the subjects identified as teaching in classrooms at the ASCS at the time of the survey. This group was chosen as the population to take the survey because they were the logical group of people to know how the teachers at the ASCS were integrating and using computer technologies with students, how their students were using computer technologies, and about the support systems which existed for teachers in regard to computer technology at the time of the survey. This non-random, convenience population of teachers offered the perspectives of all those being studied (Nardi, 2003).

An assortment of teaching modes was listed and the teachers responded to each mode by indicating how frequently they integrated computers during their instruction using the following scale: (1) not at all, (2) once a month or less, (3) once a week, (4) several times a week, and (5) every day.

According to the survey responses, a limited amount of computer integration occurred at this school. As portrayed in Table 6, the mean responses fell between 2.50 and 1.50. This indicated that the frequency mean of responses from ASCS teachers integrating computers during various modes of teaching fell between integrating computers less than “once a week” to “not at all.”

An important finding derived from teacher responses to the follow-up survey questions was that nine teachers reported having students use computers as presentation tools. The open-ended responses that teachers gave indicated that they were integrating computers into their instruction in a variety of ways, with computers used as research tools and productivity tools as the most common forms of integration. The frequency with which they were integrating computers, however, according to the quantitative survey data, suggests that they were not integrating computers very often during their teaching.

The training that ASCS teachers reported to have had which assisted them in acquiring computer skills enabling them to use computers with their students were most frequently reported as time they spent learning independently. The mean for this response (3.15) indicated that the average response from ASCS teachers fell between learning about the computer via independent learning “to a moderate extent” and “to a great extent.” Teachers at the ASCS also reported having been prepared to use computers as part of their undergraduate coursework between “to a moderate extent” and “to a great extent.” The mean (3.04) indicated the frequency of this response.

The ASCS teachers who provided data for this study were using computers minimally with their students when it came to instruction. The integration and use of computer technology was happening on quite an infrequent basis at the school. Using the LoTi scale developed by Moersch (1995), most of the teachers would probably have been described as being level two users as they were using computer technologies to supplement their existing curriculum rather than using it as an integrated part of instruction. McCain and Jukes (2001) conveyed that if computers are only used as stand-alone instruments, not connected to the daily activities in the classroom, they will not become an integrated part of the classroom and, therefore, not important to student learning.

9. <u>Possible Influence of Extraneous Variables</u>

A possible influence of extraneous variables may have been teachers sharing with each other on how they use technology in their classrooms to other teachers. This could then lead to teachers taking on those responses as their own. It also may be affected by the time of year. As teachers are beginning to integrate technology into their classrooms, they may only use certain times of the year when they have their strongest technology integrated lessons.

10. <u>Possible Threats to Internal and External Validity</u>

Due to the descriptive nature of this study, internal and external validity issues were not prevalent. The purpose of this study was to investigate the ASCS teacher's perceptions of how they were integrating computer technology, how they and their students were using software, and how ASCS teachers viewed existing support systems for computer technology. This study focused on a description of what was happening at the ASCS and, therefore, was not a true or quasi-experiment. The survey instrument used in this study had increased internal validity as research questions were related directly to items in the instrument.

11. <u>Generalizability of Result</u>

This investigation examined the responses of elementary teachers at the ASCS in Los Angeles in the fall of 2005. Therefore, the results were not generalizable to other teachers at other schools beyond the scope of those surveyed at the ASCS. The population of ASCS teachers was not a sample of a larger group in this study. Therefore, the ASCS teachers being studied and the results of findings were not generalizable to a larger population.

A14 Appendix A - Analysis of Research

Article Analysis #3

April Taylor

1.<u>Bibliographic Reference</u> (APA Style)

Wenglinsky, H. (1998). Does it compute? The relationship between educational technology and student achievement in mathematics. Retrieved from https://eric.ed.gov/?id=ED425191

2. <u> Type of Research</u>:

___ Descriptive	**___ Correlation**
___ Experimental	**_X__ Causal-Comparative**
___ Historical	**___ Quasi-Experimental**
___ Meta-Analysis	**___ Survey**

3. <u>Evidence from article you used to determine Type of Research</u>

"The study first compared the information about educational technology among different groups of students to discover any possible inequities in technology use. This report presents findings from a national study of the relationship between different uses of educational technology and various educational outcomes. Data were drawn from the 1996 National Assessment of Educational Progress (NAEP)in mathematics, consisting of national samples of 6,227 fourth-graders and 7,146 eighth-graders" (Wenglinsky, 1998, p. 5)**.**

4. Purpose of the Research

The purpose of the research was to discover any possible inequities in technology use. To determine if computer use is making a difference in mathematics. It found that the greatest inequities did not lie in how often computers were used, but in how they were used.

5. Instruments Used

Data were drawn from the 1996 National Assessment of Educational Progress (NAEP) in mathematics. The data and advanced analysis techniques, to isolate the effects of the computer from the myriad other factors involved in student achievement (p. 4).

6. Validity and reliability of Instruments Used

The state of technology use can be measured from data from the National Assessment of Educational Progress of 1996 (NAEP). NAEP has been administered regularly since 1969 to nationally representative samples of students of various ages and grade levels. The core of NAEP is an assessment that has been given in various subject areas including mathematics, science, reading, geography, and writing. NAEP also includes background questionnaires completed by students, the principals in their schools, and the teachers in the relevant subject area. Students and teachers are asked about their social background, their experiences in school generally, and their experiences in the particular subject area; principals are asked primarily about school policies and practices. While earlier administrations of NAEP did include a few questions about technology, only the 1996 administrations included sufficient information to measure the four indicators listed above.

7. Subjects

Only the 1996 administrations of the NAEP included questions about technology to students in fourth, eighth, and twelfth grades participating in math and science. This report describes technology uses among the 6,627 fourth-graders and 7,146 eighth-graders who took the core NAEP assessment in mathematics.

8. <u>Results and Conclusions</u>

Students who use computers frequently at home demonstrate higher levels of academic achievement, (Wenglinsky, 1998 p. 30). Professional development and higher-order thinking are both positively related to academic achievement: Students with teachers who have had such professional development show higher levels of achievement, as do those who are taught higher-order skills with computers (p. 31).

9. <u>Possible Influence of Extraneous Variables</u>

The data drawn from the NAEP is from a specific point in time, societal norms at this moment in time can possibly have an effect on the attitudes that students have about technology. Also, the study does not take into account different teacher techniques and overall tendency to teach incertain ways, such as to teach higher-order thinking skills.

10. <u>Possible Threats to Internal and External Validity</u>

The study only analyzes technology's effectiveness in one subject area, mathematics. Also, the study is limited to only a few indicators of the organization of technology use; other aspects of technology may be more or less effective. This study also does not take into account more detailed measures of teacher practices (Wenglinsky, 1998 p. 35). Because the data is gathered from a National test, students testing over a period of only a day or two, may not be an accurate representation of the students ability.

11. <u>Generalizability of Result</u>

The data used for this study was drawn from a National database, NAEP which consists of 6,227 fourth graders and 7,146 eighth graders. The data is a large sample which can relate to a general population of students.

Appendix B - Shared Participation in Writing the Final Paper

April Taylor:

Three Articles:

1. Johnson, T. (2014). Grade 5 Math Teachers' Experiences with The Integration of Technology into The Curriculum
2. Luna, A. (2015). Embracing the Challenge of Growing The "T" In STEM and Its Role In Teaching And Learning: A Case Study
3. Wenglinsky, H. (1998). Does It Compute? The Relationship Between Educational Technology and Student Achievement in Mathematics

II – Summary of the Literature

Appendix A – Article Analysis #3

Jennifer Funke:

Three Articles:

1. Cherry, J. E. (2014). Technology Integration In Education: An Examination Of Technology Adoption In Teaching And Learning By Secondary Teachers In Minnesota
2. Hoon, M. E. (2006). The Integration of Instructional Computer Technology in A K–5 Math, Science, And Technology School
3. Kasza, P., & Slater, T. F. (2017). A Survey of Best Practices and Key Learning Objectives for Successful Secondary School STEM Academy Settings

I – Statement of the Research Question

V – Application of the Research in a Typical School/Classroom

Appendix A – Article Analysis #2

Bridget Malone:

Three Articles:

1. Ebrahim, Y. (2000). The Influence of An Integrated Math, Science and Technology Education Program On Students' Performance On The State Of Ohio Math And Science Sub - Sections Of The 9th Grade Proficiency Test In A Selected High School
2. Guzey, S. S., & Roehrig, G. H. (2012). Integrating Educational Technology into The Secondary Science Teaching