One-to-One Technology in Teaching and Learning

Kasey Brown

Department of Education, Sul Ross State University

EDUA 6376: Inquiry Based Research Methods

Dr. Brenda Quintanilla

July 5, 2023

Abstract: This literature review was written to communicate the findings found after thorough research was conducted to determine the effects one-to-one (1:1) computing initiatives can have on teaching and learning. The studies utilized for this literature review connect a wide range of topics pertaining to 1:1 computing that include student motivation and achievement, preferred devices, utilizing the TPACK and TAM frameworks, educator perspectives and perceptions, professional development, inclusive environments, and collaborative learning. At the end of the review, it was determined that in all areas of 1:1 computing it is evident that strong professional development and careful planning is needed to properly implement a successful integration program that supports teaching and learning. The findings of this review determine the need for further, more specific research to be conducted on ways in which 1:1 technology can continue to improve and transform 21st century learning in K-12 environments.

Keywords: one-to-one computing, 1:1 technology integration, one to one technology initiative, 1:1 learning

Introduction

To support 21st century learning, one-to-one (1:1) device initiatives are becoming increasingly popular in classrooms across the globe. Because technology has started making a more prominent presence in teaching and learning, many school leaders and stakeholders have started considering the transition to provide individual devices for students to better support learning. As this trend becomes more popular and gains more traction, there are many key factors that must be considered before making the costly investment to put devices in the hands of students more regularly. This review of literature closely examines studies that have been conducted to provide evidence supporting the effectiveness 1:1 computing can have on both teaching and learning practices, as well as provide the viewpoints and perceptions on the initiatives from both teachers and students.

In a world where the traditional learning atmosphere has unsuccessfully sustained students' positive attitudes towards learning, it is important to begin analyzing the essential role 1:1 technology can play in engaging students in learning (Varier, et al., 2017). However, it is equally vital that careful attention be paid to the many crucial components that come with 1:1 computing. Providing educators with proper professional development that pertains to content and pedagogical practices is a key factor in successfully launching this type of program. (Lawrence et al., 2018; Harris et al., 2016; Musgrove et al., 2021; Morrison, 2019; Varier et al., 2017). Much of the information communicated through this review revert back to the importance of sufficient professional development being provided for teachers before devices are given to students in order to positively impact teacher perceptions and confidences when it comes to implementing technology in teaching.

Synthesis

In the educational realm, 1:1 computing can be identified as a movement in which each student is given a device to use for individual learning purposes in a whole group, small group, or solitary learning atmosphere (Lawrence et al., 2018; Varier, et al., 2017). One-to-one computing efforts really began making a presence in classrooms after the No Child Left Behind Act of 2002 worked to decrease the digital divide happening among student populations and instill digital literacy skills in all students creating equality in learning (Harris et al., 2016). Now, two decades later and post-Covid, it is almost impossible to implement effective teaching practices without the use of technology.

With the vast majority of today's students identifying as digital natives, it is important to begin tailoring instruction to students in the technological language that is embedded into their daily lives (Morrison, 2019). By engineering instruction in a way that speaks to our students, 1:1 learning is thought to have the potential to activate student engagement and increase motivation in learning. Harris et al. (2016) describes how recent technological innovations have been designed to differentiate learning in ways that allow students to experience success on personal levels. In a study conducted on the impact 1:1 usage has on middle school students, Downes & Bishop (2015; as cited in Lamb & Weiner, 2018) found that the integration of technology for middle school students is an effective method used to connect many core practices used in the middle grades to boost engagement.

While technology does have the ability to enhance teaching and learning, the effectiveness of 1:1 learning is not just the presence of technology, but rather the skill level of the teacher integrating the tech tools into learning (Lawrence et al., 2018). In many device integrations, an educator's perceptions of the implementation are major indicators of the success

of the program (Lawrence et al., 2018; Morrison, 2019; Musgrove et al., 2021). Several of the studies evaluated for this review utilized the Technology Acceptance Model (TAM) as a guiding framework to examine technology adoptions when implemented into new environments (Musgrove et al., 2021; Powers et al., 2020; Lamb & Weiner, 2018). The two concepts that exist within the TAM framework are a person's Perceived Usefulness (PU) and a person's Perceived Ease of Use (PEOU). Each of these components are thought to impact a person's Behavioral Intention (BI) when it comes to using technology. These studies used TAM to prove that teacher perceptions of technology can have a direct reflection on how often and in what ways 1:1 devices were used in learning.

Musgrove et al. (2021) conducted a study correlating TAM to the Technological Pedagogical Content Knowledge (TPACK) framework to better understand how a teachers' understanding of TPACK can influence their usage of technology across subject areas. Within the study, it was determined that understanding the TPACK framework affected a teacher's PU and PEOU in math and science instruction. In other words, because these teachers had received training that boosted their confidence in TPACK application, they were able to better perceive and adopt the technology integration into their instruction all while connecting it to content and pedagogy as well (Musgrove et al., 2021).

In taking another glance at TAM, Powers et al. (2020) studied the ways in which teachers at a rural school district were bridging the digital divide for their low socio-economic students by implementing 1:1 technology in ways that encouraged digital literacy and collaborative skills. Because the district that participated in this study made an investment in professional development pertaining to tech integration, the teachers saw the benefits of its usage and were able to increase student engagement, achievement, and motivation among students (Powers et al.,

2020). Each of these studies cohesively connects the idea that teacher perception has immense influence on how well 1:1 learning can be implemented.

To mold teacher perception in a positive manner, studies showed that relevant professional development that pertained to specific content areas contributed greatly to how a teacher perceived 1:1 learning initiatives (Musgrove et al., 2021; Morrison, 2019; Varier et al., 2017; Harris et al., 2016; Lawrence et al., 2018). Morrison (2019) utilized Bandura's self-efficacy theory to prove that teachers would use technology more efficiently and effectively if they believed that they were adept enough in their own technological skills. The study was initiated in order to investigate teacher insights of the professional development they had received for a 1:1 initiative that was implemented in three high schools in North Carolina. By the end of the study, Morrison was able to prove that high self-efficacy can greatly influence the effective use of technology. The study also demonstrated the idea that many teachers desire to receive more content specific training relating to TPACK in order to better incorporate technology in teaching and learning (Morrison, 2019).

Collaborative learning is another trend in education working to equip students with skills needed to enter the 21st century workforce. Participants of many of these studies found that 1:1 learning increased the students' ability to collaborate in small groups by using the tools technology offered to facilitate learning (Varier et al., 2017; Wang, 2022). Wang (2022) found in a study on student-device ratios that students were more likely to collaborate with each other during science inquiry activities when devices were used for virtual manipulatives. In addition, findings from a study conducted by Dawson, et al. (2008; as cited in Powers et al., 2020) found that when provided with proper professional development, most teachers ditched the traditional

methods of learning in order to incorporate collaborative, project-based learning activities into their regular instruction.

Along with supporting collaborative learning, 1:1 device initiatives also support students with Individualized Education Plans (IEPs) who receive accommodations to support learning. With a large number of students with IEPs learning in inclusive settings due to the Individuals with Disabilities Education Act (IDEA), 1:1 devices can provide the support many of these students need (Nieves, 2021). Nieves (2021) highlighted the many assistive technologies that can be provided through devices such as Chromebooks, iPads, and Windows laptops. Many pre-existing features on these devices like text-to-speech and speech-to-text help to accommodate these students in inclusive ways without any extra effort to install them. With inclusion rates continuing to rise across the United States, 1:1 device initiatives offer equitable access that aids in establishing normalized educational settings for all learners (Nieves, 2021).

The installation of 1:1 computing requires a rewiring of current pedagogical practices. It has been proven that merely providing devices does not improve teaching and learning. Pedagogical changes must be prominent above technological advances in order for these initiatives to be successful (Powers et al., 2020). A shift in pedagogy consists of an altered focus in which learning gravitates from teacher-centered to student-centered. Studies support the notion that 1:1 computing affects teachers' practice and control variables and can create a role reversal moving learning from teacher-centered to student-centered (Bergström, 2019). By modifying teaching practices to include technology as a tool for learning, student learning can be improved (Lawrence et al., 2018). Proper training concerning pedagogical shifts in instruction is vital in launching and sustaining 1:1 computing initiatives (Morrison, 2019). By implementing

training that pertains to pedagogy, content, and technology, teacher self-efficacy can be raised, and greater implementation methods can be carried out in the classroom (Morrison, 2019).

Conclusion

One-to-one device integration is a trend that is only just beginning. As classrooms continue to revolutionize around technology, many districts will begin making larger investments in proposals that support the use of individualized learning through devices. With devices becoming more affordable, the possibilities for more schools to implement 1:1 initiatives are more attainable than ever (Morrison, 2019). While device choice is an important aspect of these programs, studies have shown that professional development that properly equips teachers in utilizing the devices is the most important factor that contributes to the sustainability of a new implementation (Varier et al., 2017; Haris et al., 2016; Lawrence et al., 2018; Musgrove et al., 2021; Morrison, 2019; Lamb & Weiner, 2018).

Technology in and of itself will not create transformative learning environments that are conducive to student-centered learning. Rather, teachers who perceive technology as purposeful and impactful will lead the charge in developing learning opportunities that support students and foster 21st century learning skills (Musgrove et al., 2021). As 1:1 initiatives become more and more popular, it is imperative that more research be conducted on what kinds of professional development best support teachers and raise their self-confidence when it comes to utilizing technology. Throughout all of the articles included in this literature review, the lack of research to support the vision of proper implementation across content areas was highlighted by many of the authors.

With the 1:1 trend rising, there is a dire need to not just invest in devices but make a wise investment in equipping educators with both skills and confidence that allows them to properly prepare students for a world that does not yet exist (Morrison, 2019). As this movement progresses, it is important that school leaders begin developing opportunities that support educators in their collaborate efforts to create positive cultures that foster an understanding and love for learning and technology (Lamb & Weiner, 2018). By refocusing the lens and prioritizing the need to equip our teachers with confidence and skills, our students will come out better prepared for the world they are helping to establish.

References

Bergström, P. (2019). Power and control as means to explore teachers' practice in the one-to-one computing classroom: Is there a shift from teacher-centered practice to student-centered practice? *International Conference Educational Technologies,* p. 35-43

Fitchett, P.G., Heafner, T. L., & Lambert, R. G. (2014). Examing elementary social studies marginalization: A multilevel model. *Educational Policy, (28)*1, 40-68.

Harris, J. L., Al-Bataineh, M. T., & Al-Bataineh, A. (2016). One to one technology and its effect on student academic achievement and motivation. *Contemporary Educational Technology, 7*(4), 368-381. Retrieved from https://files-eric-ed-gov.wmlsrsu.idm.oclc.org/fulltext/EJ1117604.pdf

Hohlfeld, T.N., Ritzhaupt, A. D., Dawnson, K., & Wilson, M.L. (2017). An examination of seven years of technology ingetration in Florida schools: Through the lens of the levels of the digital divide in schools. *Computers & Education, 113,* 135-161.

Lamb, A. J., & Weiner, J. M. (2018). Extending the research on 1:1 technology integration in middle schools: A call for using institutional theory in educational technology research. *Middle Grades Review, 4*(1).

Lawrence, A. C., Al-Bataineh, A. T., & Hatch, D. (2018). Educator perspectives on the instructional effects of one-to-one computing implementation. *Contemporary Educational Technology, 9*(2), 206-224. doi:https://doi.org/10.30935/cet.414950

Morrison, K. (2019). Perceptions of the impact of quality professional development on the sustainability of a one-to-one computing initiative at the high school level. *Journal on School Educational Technology, (14)*4, 17-36

Musgrove, A., Powers, J., Nichols, B.H., & Lapp, S. (2021). Exploring the role of elementary teachers' TPACK in the adoption of 1:1 computing across subject areas. *International Journal of Technology in Teaching and Learning, 17*(1), 1-17. https://doi.org/10.37120/ijttl.2021.17.1.01

Nieves, K. (2021). Building inclusive learning environments with 1:1 devices. *Journal of Special Education Technology, (36)*1, 54-59. https://doi.org/10.1177/0162643420923069

Powers, J.R., Musgrove, A.T., & Nichols, B.H., (2020). Teachers bridging the digital divide in rural schools with 1:1 computing. *The Rural Educator, (41)*1, 61-76.

Shapely, K., Sheehan, D., Maloney, C., & Caranikas-Walker, F., (2009). Evaluation of the Texas Technology Immersion Pilot. *Texas Center for Educational Research, (57)*1. 1-168

Varier, D., Dumke, E. K., Abrams, L. M., Conklin, S. B., Barnes, J. S., & Hoover, N. R. (2017). Potential of one-to-one technologies in the classroom: Teachers and students weigh in. *Educational Technology Research and Development*, *65*(4), 967–992. https://doi.org/10.1007/s11423-017-9509-2

Wang, C., & Le, H. (2022). The more, the merrier? Roles of device-student ratio in collaborative inquiries and its interactions with external scripts and task complexity. *Journal of Educational Computing Research, (59)*8, 1517-1542. https://doi.org/10.1177/07356331211010794

Annotated Bibliography

Bergström, P. (2019). Power and control as means to explore teachers' practice in the one-to-one computing classroom: Is there a shift from teacher-centered practice to student-centered practice? *International Conference Educational Technologies,* p. 35-43

This study focused on two secondary teachers in Sweden who taught Social Studies in both academic and vocational settings. The study aimed to examine how teacher-centered and student-centered practices are affected by one-to-one computing initiatives. Each teacher included in the study exhibited either a heavier demonstration of teacher-centered or student-centered. The basis of the study drew upon Bernstein's theory concerning power and control in teacher practice. Through qualitative interviews, the data from the study revealed that the implementation of 1:1 computing is a complex process of events and the success of it depends heavily on the training and perception of teachers. In the end, each teacher's use of 1:1 computing demonstrated patterns that are relevant among teacher-centered and student-centered practices. The study proved that teacher-centered use of devices relied heavily on teacher power and control and placed the teacher as lecturer and used shorter paced activities. The student-centered teaching proved to be based more on real world problem solving that gave the students the opportunity to complete more significant tasks pertaining to their lives. In the end, it was reiterated that more research needs to be done on 1:1 computing and that these initiatives are a process that require special planning.

Harris, J. L., Al-Bataineh, M. T., & Al-Bataineh, A. (2016). One to one technology and its effect on student academic achievement and motivation. *Contemporary Educational Technology, 7*(4), 368-381. Retrieved from https://files-eric-ed-gov.wmlsrsu.idm.oclc.org/fulltext/EJ1117604.pdf

This study was conducted to examine the effects one-to-one learning can have on student academic achievement and motivation. The researchers evaluated two fourth grade classrooms who each operated either in a traditional learning manner or using one-to-one implementation. Assessments given in math and science provided data to determine if student achievement had improved using one-to-one learning, and attendance trends were monitored for both classes to analyze student motivation. By the end of the study, the results for the study were inconclusive as there was not enough evidence to prove that student motivation and achievement were affected by one-to-one computing. Evidence was able to be collected that supported the notion that when educators receive proper training in technology integration and best uses for one-to-one implementation, student achievement and motivation can be improved.

Lamb, A. J., & Weiner, J. M. (2018). Extending the research on 1:1 technology integration in middle schools: A call for using institutional theory in educational technology research. *Middle Grades Review, 4*(1).

In this review, the authors call important attention to the uniqueness of middle school environments and how these qualities should be considered when applying new movements within the institution. The article dissects the idea of institutional theory in which the norms of an institution are uniquely examined before new initiatives are put into place. The authors believe that institutional theory can be used as a tool to bridge gaps and connect the external and internal features that pertain to technology integration, particularly 1:1 initiatives. The article focuses on the idea that educational environments are not static, and stakeholders involved have the potential to establish change to better the environments. Little research has been conducted on considering institutional theory

when implementing change, so the argument of this article campaigns for more research to take place over technology integration using institutional theory as a basis of design.

Lawrence, A. C., Al-Bataineh, A. T., & Hatch, D. (2018). Educator perspectives on the instructional effects of one-to-one computing implementation. *Contemporary Educational Technology, 9*(2), 206-224. doi:https://doi.org/10.30935/cet.414950

To investigate how an educator's perceptions of technology can affect the product of student learning, teachers from a private, Catholic high school in central Illinois were surveyed and interviewed. Using Likert type scales and structured interviews, participants were asked to examine how the one-to-one bring-your-own-device initiative in their school had changed teaching and learning in their classroom and reflect on their own personal experiences and perceptions with the technology implementation. Of the 26 teachers who completed the surveys, three of them were selected to participate in the interviews. The experience and confidence levels with technology for these three teachers ranged from novice to veteran. By the end of the study, it was concluded that most teachers felt that the one-to-one initiative had improved learning some and that a teacher's perception of technology has a powerful influence on how it impacts learning. The authors reiterated the importance of providing adequate professional development in order for teachers to best utilize technology integration in learning.

Morrison, K. (2019). Perceptions of the impact of quality professional development on the sustainability of a one-to-one computing initiative at the high school level. *Journal on School Educational Technology, (14)*4, 17-36

This qualitative analysis explored the perceptions educators have on professional development that relates to technology integration, particularly one-to-one initiatives. The study looks at three nontraditional North Carolina high schools that heavily require teachers to digital learning resources and obtain adequate knowledge about the TPACK framework. The authors spend a great deal of time stressing the importance of implementing professional development over content specific technology integration before, during, and after tech use in the learning. Survey results from teachers indicated that most teachers felt high self-efficacy when it came to using technology, but desired to receive more content specific training through their districts.

Musgrove, A., Powers, J., Nichols, B.H., & Lapp, S. (2021). Exploring the role of elementary teachers' TPACK in the adoption of 1:1 computing across subject areas. *International Journal of Technology in Teaching and Learning, 17*(1), 1-17. https://doi.org/10.37120/ijttl.2021.17.1.01

Research for this study set out to determine how a teacher's prior knowledge of the technological, pedagogical, and content model (TPACK) can affect their use of one-to-one computing in all subject areas. The study evaluated the correlation between a teacher's perceived ease of use (PEOU) and perceived usefulness (PU) when it comes to applying one-to-one learning. The study examined all four core subject areas and surveyed results for whole group and small group instruction. At the conclusion of the study, it was determined that TPACK had an impact on the PEOU for whole group and individualized science instruction and individualized math instruction. TPACK also heavily influenced the PU for whole group science and individualized math instruction. However, the findings reported that TPACK had minimal impact on both the PEOU and

PU for instruction in English language arts or social studies. The final conclusion supported the idea that knowledge of TPACK can help support a one-to-one adoption in the areas of math and science, but not so much for English language arts or social studies.

Nieves, K. (2021). Building inclusive learning environments with 1:1 devices. *Journal of Special Education Technology, (36)*1, 54-59. https://doi.org/10.1177/0162643420923069

This article was written to highlight the areas in which a 1:1 initiative can support inclusive learning for students with learning disabilities. The article discusses the potential 1:1 devices can offer students with disabilities by increasing instructional support and boosting student motivation, participation, independent working skills, and organization. The article looks at assistive technologies (AT) that are available through many 1:1 devices, particularly iPads, Windows laptops, and Chromebooks and explains the many accessibility features that can be used to support learning. The article concludes by noting the rise in inclusion rates across the United States and further explains how 1:1 device initiatives can provide equitable support for all learners.

Powers, J.R., Musgrove, A.T., & Nichols, B.H., (2020). Teachers bridging the digital divide in rural schools with 1:1 computing. *The Rural Educator, (41)*1, 61-76.

The authors of this research article look at a rural school district in Florida in order to determine how teachers within the school district implemented the new one-to-one computing initiative. Using mixed research methods, the authors surveyed and interviewed teachers to determine how their perceptions of technology impacted their use and what motivated them to use the technology with their students. The findings from the study concluded that increased student engagement, individualized instruction, and

teacher efficiency and productivity were main reasons for using the technology. Establishing digital literacy, collaboration, and assessment purpose were a few of the main ways teachers used the technology. The study's final conclusions noted that rural teachers made efficient use of the technology they had and encouraged more research be conducted on technology integration in rural school districts.

Varier, D., Dumke, E. K., Abrams, L. M., Conklin, S. B., Barnes, J. S., & Hoover, N. R. (2017). Potential of one-to-one technologies in the classroom: Teachers and students weigh in. *Educational Technology Research and Development*, *65*(4), 967–992. https://doi.org/10.1007/s11423-017-9509-2

With one-to-one initiatives becoming more popular in modern classrooms, it is important to understand which devices are best to support these individualized learning environments. This study looked at six devices that were used across a combination of 18 elementary, middle, and high school classrooms. The goal of the study was to determine strengths and weaknesses among devices and pinpoint a superior choice. The devices distributed were Dell Laptops, iPad Minis, Windows Tablets, Nexus7s, Google Chromebooks, and Kindle Fires. Soon after the study was underway, the Kindle Fires and Nexus7s were deemed inadequate for use, so were no longer used for the study. Teachers were given time to utilize the devices and asked to participate in interviews throughout the research process. The data from the interviews determined that device preference generally depended on grade level and use. The authors recommended that school districts pilot more than one device before making a large investment in technology, as this study did not provide evidence that one device is superior to another.

Wang, C., & Le, H. (2022). The more, the merrier? Roles of device-student ratio in collaborative inquiries and its interactions with external scripts and task complexity. *Journal of Educational Computing Research, (59)*8, 1517-1542. https://doi.org/10.1177/07356331211010794

Using a three-round quasi-experiment, the authors of this study examined a primary school in China to determine if one-to-one (1:1) device ratios are more conducive to collaborative learning than having on device per group (1:m). One of the study's main objectives was to determine how external scripts and the complexity of tasks can have an effect on collaborative learning when students are put into groups to complete scientific inquiry activities. By studying four different classrooms with different dependent variables, it was determined that 1:m device student ratio (DSR) had the potential to deposit more collaborative learning conversations because students were more likely to depend on each other during learning. However, 1:1 collaboration was more beneficial when students were faced with a simpler task to compete. Overall, when comparing the two modalities, it was determined that each method can contribute to collaborative learning depending on external support and task orientation.

Appendix A

Harris, J. L., Al-Bataineh, M. T., & Al-Bataineh, A. (2016). One to one technology and its effect on student academic achievement and motivation. *Contemporary Educational Technology, 7*(4), 368-381. Retrieved from https://files-eric-ed-gov.wmlsrsu.idm.oclc.org/fulltext/EJ1117604.pdf

Following educational acts like the Goals 2000: Educate America Act of 1994 and the No Child Left Behind Act of 2001, this quantitative study takes on the role of discovering the effects one-to-one (1:1) technology can have on student achievement and motivation. By establishing the key advantages technology can play in teaching and learning, the study dove into the idea that 1:1 technology can improve student performance and motivation. The authors collected data from two fourth grade classrooms in the same Title 1 school district from central Illinois. They focused on two different assessment pieces, Discovery Education Assessments and Pearson's envision Math's Topic Tests, given throughout the school year, as well as paid close attention to attendance trends among the two classes.

The authors reiterated their belief that technology in learning is a 21st century skill that is necessary to benefit both students and teachers. After explaining the recent adoptions in curriculum by the state of Illinois including the Common Core State Standards and the Partnership for Assessment of Readiness for College and Careers (PARCC) for the 2013-2014 school year, it became painstakingly clear how necessary it is for school districts to begin providing equal and opportune access to technology for both teachers and students. The schools participating in the study are engulfed with a larger percentage of low-income families, only increasing the digital divide that No Child Left Behind set out to decrease. Because of this

deficit, many of these students exhibit minimal prior knowledge when it comes to technology use and demonstrate low digital literacy skills.

The study's overarching goal was to investigate if 1:1 technology improves student academic performance, as well as increases student motivation to learn. The study was written to be useful for state legislators, school administrators, and classroom educators who are looking to turn their classrooms into technology rich environments. Before presenting the findings of the study, the authors addressed a few of the major barriers in educational technology today- cost, infrastructure, and professional development for teachers. While the issue of cost and infrastructure will vary by school, the barrier of professional development is an external factor that can, and should, be addressed. The idea that technology should be used as a tool to aid best teaching and learning practices within a classroom and not replace them was well established throughout the article. It is important for careful considerations to be made about training teachers to effectively use 1:1 technology within learning before expecting positive results to be rendered.

Careful research was also conducted to get the perspective of educators on the topic of 1:1 technology. It was interesting to learn that while many teachers believed that this approach could create better hands-on approaches to learning, many teachers felt like technology made teaching more difficult and complex in the long run. Most teachers found that because there was such a substantial amount of change that had to take place regarding the switch from traditional learning to 1:1 learning, there seemed to be more resistance from more educators. This resistance can be tied to lack of confidence in the technology that links back to lack of professional development in the proper use and benefits of these tools. Teaching with technology is a new

dynamic that can alter the roles of students and teachers in learning. This type of paradigm shift requires proper training and support to fully get teachers invested in the benefits of the idea.

The study consisted of a 1:1 implementation classroom of 25 students and a traditional classroom of 22 students. While it was predicted that the difference in numbers could minorly skew the results, it wasn't believed to have affected them in any major way. The first comparison looked at six Topic Tests given over the enVision Math curriculum. The results from the data showed that the scores of the 1:1 implementation classroom for two of the six tests were well above the traditional classroom results. However, the scores for two other tests given found that the traditional classroom scores were well above the 1:1 implementation scores. The other two scores came within two points of each other and were split. Overall, the results panned out to be relatively equal. In looking at the Discovery Assessment scores collected, two out of three assessments were just slightly higher in the 1:1 implementation class than those of the traditional classroom.

After collecting all the data and examining the results it was discovered that newness of the technology could have contributed to the higher scores for some of the assessments in which the 1:1 implementation class scored higher. However, there wasn't enough evidence based on the scores of the assessments to truly conclude that the 1:1 implementation class produced higher student achievement. Upon looking at student motivation through attendance records, the data did not yield desired results. While they hoped that the use of technology would boost student motivation and affect attendance rates, the authors found that this was not the case. It had to be considered that most fourth-grade students do not have complete control over their own attendance and inhibit less autonomy when it comes to learning and attending school. For this reason, the attendance data wasn't entirely credible or reliable for this study.

Overall, the study that set out to prove that 1:1 technology improves student achievement and motivation fell short. The data collected demonstrated that technology did not play a major role in impacting either achievement or performance. However, it was determined that teachers who are inspired by technology and educate themselves on the best practices for implementing such technologies in everyday learning do have the power to improve student achievement and motivation.

Lawrence, A. C., Al-Bataineh, A. T., & Hatch, D. (2018). Educator perspectives on the instructional effects of one-to-one computing implementation. *Contemporary Educational Technology, 9*(2), 206-224. doi:https://doi.org/10.30935/cet.414950

With one-to-one computing making more frequent appearances in modern classrooms, it is important to begin looking at what kind of benefits this kind of environment contributes to learning. While there is substantial research that demonstrates changes happening in teaching and learning in these 1:1 environments, there is little data supporting the impact this approach has on instructional success. Much research has been done to prove that increasing technology access in classrooms can improve teaching and learning. However, in conducting these studies, there is one important factor that must be considered-the perceptions from the teachers. Teachers are crucial stakeholders when it comes to educational movements, and their attitudes towards new ideas and practices play a major role in whether these ideas are successful.

The authors of this study set out to determine how an educator's perception of technology impacts its success in a one-to-one teaching environment. The study took place in a private, Catholic school located in a suburban community in central Illinois. The school district implemented a one-to-one bring-your-own-device (BYOD) initiative on their secondary campus that required students to provide their own devices for learning. Using mixed methods of

research, the researchers conducted surveys and interviews with teachers with a wide range of years of experience, educational background, and content areas. The participants in the quantitative study included 26 teachers, counselors, and administrators, while the qualitative portion included interviews with three teachers who were all classroom teachers before, during, and after the 1:1 implementation. Their experiences ranged from 4 years of teaching to 30 years, and their content areas varied by department.

The data collected through the study set out to answer three research questions: (1) What are the educators' perceived changes in student learning during the implementation of a one-to-one technology program? (2) What possible teaching and learning changes took place during the implementation of a one-to-one technology program? And lastly, (3) What are the experiences of educators who implement a one-to-one technology program? To examine student learning, each of the participating educators completed Likert style surveys.

When asked if the educators believed that student learning had improved with 1:1 implementation the majority of those surveyed believed that learning had improved some. When asked how often devices were used in the classroom, a large majority responded that devices were used daily. These results yielded the most relevant data pertaining to the research questions because they prove that 1:1 implementation has produced some improvement in learning since the initiation of the program. As data was collected on the uses of the one-to-one technology, it was determined that most teachers used the devices to access digital course materials, such as textbooks. Very rarely were the devices used for formative or summative assessment purposes.

The last piece of quantitative data collected evaluated the teachers' observations of changes in student learning. The most cohesive piece of evidence gathered from the survey concluded that most educators strongly disagree that students experience fewer distractions in

class when using the technology. However, many of them also agreed that students were able to use technology more fluently, demonstrated better organizational skills, and were more likely to ask for help from a peer since the implementation.

To provide another means of legitimizing the data, three participants were selected to participate in structured interviews. These participants ranged in variation of experience, teaching field, and confidence levels with technology. The anonymous teachers were identified under the pseudonyms Ms. Clark, Mrs. Brown, and Mr. Anderson. Ms. Clark had 4-10 years of teaching experience and taught a foreign language class. Mrs. Brown taught math and had 21-30 years of teaching experience, and Mr. Anderson taught social studies and had 11-20 years of experience.

The first interview question targeted the changes that had transpired in the classroom with the integration of 1:1 learning. Mr. Anderson and Ms. Clark revealed that their students were using the devices daily, while Mrs. Brown said her students rarely used the devices in her math class. Mr. Anderson had his students use the devices for notetaking, accessing online materials, and conducting online research. Ms. Clark had her students use the devices mostly for accessing digital course materials. Mrs. Brown indicated her students generally only used a calculator app on a device if they did not have access to a traditional calculator.

Secondly, the participants were asked to compare student learning before and after the implementation of devices. They were encouraged to specifically detail any ways learning had improved or declined by using devices. Mrs. Brown indicated that she did not believe the implementation of the technology had improved learning in any way. She discussed a high concern for decreased work ethic, attention span, and perseverance in students since using the technology. Ms. Clark communicated that it was difficult to tell if the implementation had

improved or harmed learning because of the variety of variables to be considered. She expressed similar concerns to Mrs. Brown by mentioning student distractions, lack of motivation, and a diminished feel for reality. She agreed the devices could sometimes be useful, but many times just served as a distraction. On the contrary, Mr. Anderson cited many substantial improvements in learning during his class time. Because his social studies class is centered around discussion, he highlighted the benefits of students being able to immediately research and fact-check information in order to support scholarly conversation among peers. He felt that the quality of questions that were taking place in his classroom had drastically improved and that higher levels of thinking were taking place frequently. Mr. Anderson disagreed with the other two teachers on the idea that the technology contributed to distractions. His opinion was that there wasn't an issue with more students being distracted, rather the students who were already distracted were now more distracted than before. Overall, Mr. Anderson was not able to pinpoint any negative effects of the technology use.

As the researchers concluded their interviews, they began asking the participants if they had recommendations for other topics that should be discussed in the interviews that could contribute to the research. All three teachers expressed the importance of teachers receiving professional development over ways to appropriately use technology in ways that promote higher levels of thinking and improve learning. Mr. Anderson emphasized that it is important for teachers to understand technology as a tool that is only as powerful as the teacher implementing it. Mrs. Brown discussed that student work ethics seemed to have changed since technology was implemented and that it would be important to be further researched.

At the conclusion of the quantitative and qualitative analyses, it was concluded that an average amount of educators found learning to be slightly improved with the implementation of

1:1 learning. The findings revealed from this research are important to the topic of 1:1 implementation because they reiterate the importance of teacher confidence supporting impactful uses of technology in learning. Through various methods, this study provided information supporting the idea that frequency of technology use does not impact learning. However, the quality in which the technology is used can produce positive impacts. The data also supports the theory that technology cannot be used to replace traditional learning but should be used to transform learning. Research has clearly demonstrated that when traditional learning methods are merely replaced with a device, there is minimal to no improvement on learning. Redesigning pedagogy in a manner that includes technology can demonstrate substantial strides in learning. For a 1:1 implementation to be successful, it is important that teachers receive training over properly adapting the technology and remolding the pedagogical practices around it. It is the marriage of all of these elements that can make this type of implementation impactful.

Morrison, K. (2019). Perceptions of the impact of quality professional development on the sustainability of a one-to-one computing initiative at the high school level. *Journal on School Educational Technology, (14)*4, 17-36

Recent educational trends have relied heavily on the use of technology within learning. Knowing our students are digital natives immersed in connectivity has caused many school leaders to examine the ways in which these students are being prepared for jobs that do not yet exist. Teachers are expected to create learning opportunities for students that are digitally enhanced and promote higher levels of thinking. One-to-one learning initiatives have become more affordable, therefore more schools are quickly putting devices in the hands of every student. While all these proposals are heading in the right direction, it is important that time and

money also be spent on training teachers to not just use the devices but utilize them in ways that support content and pedagogy.

The author of this article addressed the dire need for appropriate professional development to be provided for teachers in order for one-to-one initiatives to remain sustainable. The study used a qualitative analysis to survey and interview teachers and administrators from three nontraditional high schools in North Carolina. North Carolina has recently initiated a movement that expects all teachers in all grade levels to incorporate technological skills throughout all subject areas. The North Carolina State Board of Education expects all teachers to be familiar with and implement the Technological Pedagogical Content Knowledge (TPACK) model when incorporating technology in the classroom. Because of this initiative, these three North Carolina high schools were ideal subjects for this study.

In requiring teachers to include digital learning skills in their daily teaching, it must be remembered that most teachers were not taught using the same methods that they are being asked to use in their classrooms. This idea does not make teachers unwilling to change, it just calls for an urgent need to provide adequate professional development. The author spends an abundant amount of time in the article detailing how the roles of learning have changed with the use of technology. Teachers are no longer the keeper of the knowledge within learning, but rather are encouraged to facilitate learning and inspire students to think more independently and take control of their own learning. With technology being the key that opens the door for that kind of learning, strategic professional development opportunities must be created to offer thorough support.

Along with the TPACK framework, the research in the article is also supported by Bandura's self-efficacy theory. This theory supports the idea that people will engage in activities

if they perceive themselves as competent in said areas. This study set out to prove that teachers would use technology more efficiently in learning if they had higher confidence in their own abilities to use the devices. With one-to-one initiatives becoming more and more popular, this study's main objective was to investigate teacher perspectives of the professional development they had already received over the implementation and how it supported the sustainability of the program.

A study done by Shapely, Sheehan, Maloney, and Caranikas-Walker (2009) examined the accomplishments of a technology integration movement that was implemented in 21 middle schools across Texas in 2003. When surveying teachers, the study found that most of them believed that one of the major barriers facing effective technology implementation is that of poor professional development. Sufficient professional development boost teacher self-efficacy, thus increasing the efficient use of technology in learning.

Strengths in either TPACK or technological self-efficacy do not produce efficient use of technology in learning. It is the combination of the two that make one-to-one initiatives work for students and teachers. In the surveys conducted by the author, participants were asked about their personal perceptions of the quality of professional development they had received after the implementation of the one-to-one computing initiative. Most teachers within that survey reported that while they felt confident in their use of technology, they would have liked to have received more training on how to best incorporate technology with their specific content areas. The author believed that it would be a crucial error to assume that a teacher's high self-efficacy relates to an advanced ability to properly utilize technology.

The article was not specific about what forms of professional development had been provided to the teachers. However, when surveyed on how effective the professional

development that was provided for the campuses was, most teachers believed that the training they desired needed to be more content specific. It was made clear through the surveys and interviews that most of the teachers had a desire to use the technology, but found they needed applicable training that allowed them to experiment with the technology firsthand and collaborate with their colleagues.

When surveyed about the frequency of their technology use before and after training, almost every statistical number rose with the daily use of technology rising by 10%. This piece of the study further supported the idea that many teachers express a willingness to incorporate technology into their teaching and learning. Most teachers responded that they feel confident in their use of hardware and software and desired to have less training on those skills and more opportunities to learn about tying technology to content and pedagogy.

When asked about the connection between the time spent on professional development and its value for the teaching of their lessons, most teachers indicated that some of the opportunities were valuable to their teaching but made them want to adjust their instructional practices. This data led to the conversation of instructional coaches and how they can be useful to aid teachers in effectively applying what is learned in professional development to their classroom practices and adjusting their instructional routines. It is important to consider that throughout all the research conducted in this article, most teachers saw value in professional development. They just expressed a desire to receive more content specific professional development, rather than broader trainings that target blanket skills.

In wrapping up the article, the author recommended that professional development be implemented before and during one-to-one computing initiatives that support content and pedagogical practices. The importance of conducting surveys among stakeholders often to assess

needs and desires was also encouraged. After reviewing the data, the author concluded that professional development that provides collaborative opportunities among peers can support best practices in using technology for instruction. One-to-one initiatives are important and can drastically improve the teaching and learning environment. However, for these initiatives to remain sustainable, there must be investments made in giving teachers the professional development they want and need by training them to connect technology with content and pedagogical practices.

Musgrove, A., Powers, J., Nichols, B.H., & Lapp, S. (2021). Exploring the role of elementary teachers' TPACK in the adoption of 1:1 computing across subject areas. *International Journal of Technology in Teaching and Learning, 17*(1), 1-17. https://doi.org/10.37120/ijttl.2021.17.1.01

The authors of this study examined the important technological, pedagogical, and content model (TPACK) framework and its role in supporting 1:1 computing for instruction among elementary school teachers. The study set out to determine whether a teacher's own relationship and knowledge of TPACK would impact the perceived ease of use (PEOU) and the perceived usefulness (PU) of a 1:1 model of learning. The study examined the impact TPACK can play in an elementary teacher's orientation of 1:1 computing across the four core subject areas of mathematics, science, English language arts (ELA) , and social studies. Because TPACK encompasses technology, pedagogy, and content knowledge, the study was used to determine how much influence this popular framework has on a teacher's ability to impactfully implement instruction in a 1:1 setting.

The researchers used the Technology Acceptance Model (TAM) as a means for inspecting each teacher's implementation of a 1:1 model across the varying subject areas. TAM was

originally created to help market the potential for emerging applications in the mid-1980s and has continued to be utilized as a guiding lens for researching technology adoption within research literature. TAM theorizes the idea that a person's (PU) and (PEOU) have a direct impact on their Behavioral Intention (BI) to use the technology. The goal of the study was to examine the external variable of TPACK and its effect on an educator's PU and PEOU when it comes to successfully implementing 1:1 instruction by asking three research questions (1) To what degree do teachers' perceived ease of use of 1:1 and perceived usefulness of 1:1 predict their reported use of 1:1 for instruction in math, science, ELA, and social studies? (2) Is the relationship between teachers' perceived ease of use of 1:1 and their reported use of 1:1 for each subject moderated by teachers reported TPACK? and (3) Is the relationship between teachers' perceived usefulness of 1:1 and their reported use of 1:1 for each subject moderated by their reported TPACK?

The benefits of 1:1 computing in the classroom far outweigh the hindrances. Many researchers have observed students working more creatively, critically, and efficiently when they have ready access to digital components. Teachers also report that 1:1 learning scenarios allowed them to better structure their planning and teaching, access a plethora of professional materials, and communicate more effectively with peers and colleagues. Taking all of this into consideration, it is important to note that the authors frequently reiterated the trending notion that professional development for teachers over this topic is vital in successfully launching and maintaining a 1:1 computing program.

As data was collected for this study, it was interesting to learn how little priority social studies instruction plays in many schools. Because the subject of social studies was left out of the No Child Left Behind Act, studies have shown that far less time is spent teaching social studies

than any other core subject. Research has also shown that there is generally limited educational technology used to teach social studies, as most instruction comes from textbook readings and corresponding comprehension questions (Fitchett et al., 2014).

This quantitative study looked at consistent variables across four subject areas in grade levels ranging from second through fifth grade from a large Florida school district. After weeding through survey results, 258 teachers were selected to complete surveys asking specific questions about (1) the subject area they teach, (2) how often students are engaged using devices, (3) perceived ease of use and usefulness, and (4) application of TPACK in teaching and learning. Each item in the surveys were adapted from a 5-point Likert scale with endpoints generally ranging from (5) extremely likely to (1) extremely unlikely. Upon surveying the teachers and evaluating the data, frequency tables were created for each surveyed area to determine numerical evidence of TPACK's effectiveness on technology use.

Criterion variables of individual instruction and then whole group instruction served as the predictor variables for the studies. Upon collecting data and analyzing results, it was concluded that teachers' PU of 1:1 and PEOU of 1:1 were significant predictors for the use of 1:1 in all subjects in both whole group and small group settings. These results supported the formerly known notion that a user's PU and PEOU can influence how new information is taken in and applied. In addressing the second research question, the study found that TPACK had a significant impact on both whole group and individualized science instruction as well as individualized math instruction. The third research question finding reported that TPACK also had a significant impact in whole group science instruction and individualized math instruction.

Upon reading the results, it can be concluded that TPACK did not show to play a significant role in the PU or PEOU relationships and instruction involving ELA or social studies.

However, upon interviewing teachers of these subjects, it is still evident that the technology is being used in productive manners, it is just inconclusive on whether a teachers' TPACK is impinging on instruction in those content areas. It is also important to know and understand the availability of programs available to the content areas of math and science versus those that apply to ELA and social studies. In recent years, ELA has become more complicated due to the rising of new literacies that need to be taught on top of basic reading, writing, and vocabulary skills. It is also possible that the lack of mandates for standardized testing for social studies could contribute to the lack of rigor involved in prioritizing social studies instruction.

Overall, it can be concluded that a teacher's PU and PEOU when it comes to 1:1 computing can be strengthened and better supported by TPACK for individualized math instruction and individualized and whole group science instruction. The findings from this study should encourage administrators to develop and strengthen their educator's knowledge of TPACK before initiating 1:1 implementation. It is important to focus on the inner workings of TPACK and build on the understanding that each component of the framework works to better the other areas. It would be interesting to compile further research on this topic and determine more specific instructional practices that were initiated to demonstrate TPACK within learning across grade levels and content areas.

Powers, J.R., Musgrove, A.T., & Nichols, B.H., (2020). Teachers bridging the digital divide in rural schools with 1:1 computing. *The Rural Educator, (41)*1, 61-76.

Oftentimes, rural school districts are tasked with many barriers that larger, more suburban districts rarely face. Not only are there infrastructure and funding constraints, but these rural districts are generally composed of large populations of low socio-economic status students. All these challenges together only widen the digital divide and can only set these students further

behind when it comes to developing the 21st century skills they will need to enter the workforce. In an effort to gain an understanding of how teachers in a rural district use the technology they do have to begin bridging gaps, the authors of this study examine a rural district to determine the purposes and motivating factors for using technology in learning.

A recent study by Hohlfeld et al. (2017) concluded that students in low socio-economic schools were found to utilize technology most often for skill and drill activities, while students who are in higher socio-economic schools used the technology to develop higher order thinking skills. These statistics support the fact that there is a great need to narrow the gap between the two in order to create more equal learning environments for all students. One-to-one (1:1) computing initiatives are generally thought to create equal opportunities by providing access to digital instruction tools for students who otherwise do not have access to devices. To better understand how learning can be transformed through 1:1 computing in rural school districts, the authors of this study worked with a small, rural school district in Florida to better understand how they used the technology after a 1:1 implementation, as well as what motivated them to use it frequently in their classrooms.

To help paint a better picture and best understand the parameters that can come with a rural school district, it is important to look at the demographics of the area. The school district that was used for this study consisted of a varied student population with 47.1% being White, 39.9% being Hispanic/Latino, 8.1% being African American, and .9% being Asian. The estimated annual family income for the area was $39,587 and the US Census showed that 31.5% of the people living in the county between the ages of 18 and 24 years of age did not obtain a high school diploma. The district had recently developed a team of teachers to establish a Digital Classroom Plan that worked to create a plan to accomplish long-term goals, one of which

included implementing 1:1 computing across the district. Within a year of establishing the plan, all middle school and ninth grade students were operating in a 1:1 computing manner. To support the plan, teachers within the district received training from a district technology camp that was committed to providing professional development opportunities that provided teachers with hands-on training that best supported technology integration in their classrooms.

For this study, the Technology Acceptance Model (TAM) was used as a guiding framework to assess the teachers' use and understanding of 1:1 integration. When looking at TAM, it is important to understand two variables: perceived usefulness (PU) and perceived ease of use (PEOU). A person's PU is defined as the point to which they believe that using technology would benefit them, while a PEOU is the point to which they believe that using technology would be effortless. It is believed that these two variables influence a person's Behavioral Intention (BI). External factors like support, professional development, and educational software can influence a person's use of technology and should be considered.

While all schools face technology barriers, particularly when it comes to initiating 1:1 computing, rural districts generally have an even harder time with these initiatives for a variety of reasons including funding, replacement costs, professional development, and lack of devices. This study examined two methods of instructional purposes (whole group and individualized instruction) to determine the factors that motivated and encouraged teachers to use 1:1 technology in learning. They also set out to determine the ways in which most rural teachers preferred to use the devices in their instruction. Using mixed research methods, 46 teachers completed surveys asking questions pertaining to the established research questions and two teachers were interviewed to collect qualitative data. After combining the results for both the quantitative and qualitative data, common themes were established for each question.

When asked about what motivated teachers to use 1:1 computing as an instructional tool, a majority of the teachers replied with answers that were centralized on student engagement, individualized instruction, and teacher productivity. Many teachers communicated that 1:1 use in the classroom helped students to acquire future ready skills and that they were often times more engaged in the lessons when they were delivered via technology. Another common area of strength of 1:1 computing that was highlighted was the ability to better provide individualized instruction for students. It was noted that the initiative provided the opportunity for students to learn at their own pace and receive differentiated instruction through the devices. Teacher productivity had also increased with the use of the devices which led to more time for teachers to focus on students.

The second research question examined the methods in which teachers were using the technology for learning. The most common responses involved digital literacy tools, collaboration opportunities, and assessment. Many teachers mentioned using the Internet to create engaging lessons that also fostered digital literacy skills, while others taught their students things like how to correctly type in URLs and determine valid sources during research projects. One-to-one computing also opened the door for creating collaborating experiences for students by allowing them to combine research efforts to create digital presentations or work in partners to create demonstrations of learning. Assessment was the third most prominent use of 1:1 computing within the data results. The results showed that many teachers used computers for both formative and summative assessments and favored the many benefits digital assessments can bring to enhancing instruction.

In conclusion, the study found that a person's PU and PEOU were relevant predictors pertaining to the instructional use of 1:1 computing. When teachers felt confident about the

technology and saw the benefits, they were more likely to use it in everyday learning. While the specific statistics of the study varied from classroom to classroom, overall, it was determined that most participants of the study used technology in an individualized manner. The data from the study clearly showed that the teachers were most motivated to use the technology because they saw an increase in student engagement. All of these findings can be used to support the notion that 1:1 initiatives can positively impact teaching and learning, even in rural communities.

It is important for rural school districts to not be forgotten as technology begins to take a permanent residence in classrooms across the United States. This study is important to the research that pertains to 1:1 computing because it proves that leaving these rural districts out only widens the digital divide. All students deserve to have equal learning opportunities and opportune access to technology to develop 21st century learning skills. The authors of this study highlighted the importance of providing professional development for these rural districts, as lack of training can influence technology use in the classroom. They also encouraged the continued research of 1:1 implementation in rural districts in an effort to bring attention to the barriers rural school districts face in keeping up with technology trends that improve student learning.

Varier, D., Dumke, E. K., Abrams, L. M., Conklin, S. B., Barnes, J. S., & Hoover, N. R. (2017). Potential of one-to-one technologies in the classroom: Teachers and students weigh in. *Educational Technology Research and Development*, *65*(4), 967–992. https://doi.org/10.1007/s11423-017-9509-2

Traditional learning environments are quickly losing relevance among today's classrooms. In an effort to develop more future-ready students, technology has become an increasingly vital tool for learning at all ages. However, the proper use of technology comes with

many barriers including high costs, infrastructure restraints, and the need for additional professional development for teachers. Adequate access to technology promotes the ability for students to develop higher levels of critical thinking skills and problem-solving abilities, and fosters collaboration and communication among peers.

To instill 21st century learning in today's classrooms, many school districts are weighing the possibilities of implementing one-to-one (1:1) technologies to promote technology rich learning. This qualitative study promoted the use of six devices and their instructional implications on teaching and learning to determine if there was a superior device districts should lean towards purchasing. The study was conducted across a combination of 18 elementary, middle, and high school classrooms in a diverse, mid-Atlantic school district. The overall goal of the study was to determine instructional strengths and weaknesses among these specific devices and their use in classrooms ranging from elementary to high school. Both teachers and students were included in interviews to reveal how the use of 1:1 technology impacted teaching and learning. The results of this study were to be used to guide district administrators in making future decisions on fully implementing 1:1 learning environments.

Bruce and Levin's taxonomy of educational technology established the framework for documenting and analyzing the use of 1:1 technology in classrooms. The topics within this taxonomy focused on four main categories: inquiry, communication, construction, and expression. The division of these categories helped determine whether the technology in this study was being used to create more student-centered learning environments that supported 21st century learning.

In many cases, 1:1 initiatives have been found to foster learner-centered classrooms with a more constructivist approach. There are many studies supporting the role shift that moves the

teacher from a primary director role to that of facilitator within a classroom. Studies have also demonstrated that this constructivist approach combined with 1:1 implementation has proven to improve student achievement and increase student motivation and engagement. Supporting studies concluded that schools with lower student-technology ratios demonstrated higher gains in academic performance, lower dropout rates, and better graduation rates.

The study consisted of a side-by-side comparison in which six devices were distributed evenly among 18 classrooms ranging from elementary to high school. In selecting the teachers to participate in the study three criteria were taken into consideration: current use of technology to establish the four categories of Bruce and Levin's taxonomy, current integration within the district's infrastructure, and their personal perception on the impact technology can have on student learning and engagement. The devices distributed were Dell Laptops, iPad Minis, Windows Tablets, Nexus7s, Google Chromebooks, and Kindle Fires. Once the study was underway, the Nexus7 and Kindle Fire were removed from the study and not considered in the final findings due to major complications reported during primary teacher reflections. The interviews conducted with the teachers who used those devices were still used for data and analysis.

The findings from the study were demonstrated using three main categories and eleven themes that guided the central idea of the data. The three categories were: (1) technology integration and factors influencing implementation, (2) impact of devices on instruction and opportunities to promote 21st century skills, and (3) impact on student engagement and motivation. Within the category of integration and implementation, six themes were considered: initial learning curve and start-up issues, need for less district control, lack of internet access and parental permission, specific device features that influenced implementation, differences by

content area, and differences by school level. The category pertaining to the impact the devices had on instruction and 21 century learning skills consisted of three themes: opportunities to enhance 21st century learning skills, transition to learner centered environment, and opportunities for immediate feedback. The last category of impact on student engagement and motivation was made up of two categories: increased efficiency and student self-direction and differing teacher and student views on the impact of motivation and engagement.

Upon analyzing the data for each individual category, the study supported mostly positive benefits that can come from 1:1 implementation. The preference of device generally depended on the age of the student and task that needed to be completed. Most elementary students preferred tablets, while the older students preferred laptop devices with extendable keyboards. The use of the devices across grade levels solidified the importance of this movement to establish 21 century skills as well as create learner-centered environments that encourage students to become self-directed learners. The findings from this study educate districts on the possibilities of creating collaborative learning environments where students are immersed in accessible technology daily.

Though most findings were positive, it would be important for any school district researching 1:1 implementation to consider many other factors including the district's current infrastructure, desired goals for implementation, and student and teaching input. The ideal device will vary by grade level, and it was recommended by the authors that districts pilot test more than one device before making large investments in just one device. Through interviews with teachers and students, it was concluded that different devices were preferred for different reasons among learners and educators. This resulted in an inability to properly differentiate and determine a superior device for a 1:1 implementation. Instead, it is recommended that districts

create strategic goals that aim to renovate learning environments to move towards the adoption of a more purposeful 1:1 implementation.

The study reiterated the belief that the devices themselves are just a tool that aids in the learning process. Well trained and enthusiastic educators are the key to properly implementing educational technology into learning that accelerates learning and produces 21st century thinkers. While it is important to research the best devices to purchase, it is also important to consider and ensure that educators are trained on using the devices as the power of success lies in their hands.

Research Question: To what extent does effective professional development enhance the efficacy of 1:1 learning programs in the 4th grade classroom?