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The Impacts of One-to-One Technology on the Engagement and Achievement of Middle School Students

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Abstract

This literature review discusses the many effects, both positive and negative, of educational technology on 21st century students. The specific problem at hand is determining the true effects of this technology integration on students' overall levels of academic engagement and achievement. More specifically, the purpose of this research is to determine the potential effects of technology integration on middle school students' engagement and achievement. The review begins by examining the history of technology in education and how it has progressed over the years. Moving forward, the review then examines the perceived role of technology in education. From there, the review examines the revealed need for proper professional development for teachers in order to afford them the opportunity to integrate and implement educational technology in appropriate ways in order to allow for the most positive effects possible on student engagement and achievement. Moving forward, the review discusses the many positive effects of technology on student engagement and achievement prior to exploring the contrary negative effects of the technology found by other researchers. The review closes by exploring a major gap that limited the intended research, discovering that there is little research on the effects of technology on middle school students' engagement and achievement, thus causing need for further research in this specific area in the future.

The Impact of One-to-One Technology on the Engagement and Achievement of Middle School Students

Many of today's twenty-first century students have never witnessed the absence of technology in their classrooms. From the time many of them entered elementary school, they entered a classroom in which the teacher had a device, and in many cases, they, too, were equipped with a device as a result of the move toward the one-to-one technology model. In fact, in 2017, the Consortium for School Networking found that 40% (approximately 5,500) of the school districts within the United States were following the one-to-one model (Medlin, 2019). While technology is not brand new to the classroom (became more popularized during the 1980s), the push for the integration of technology is largely in part to the No Child Left Behind Act of 2002 (NCLB), as the United States government began to seek digital literacy among students by the time, they completed eighth grade (Harris, Al-Bataineh, & Al-Bataineh, 2016). As a result of this push and the pressures brought on by NCLB, schools are facing more and more pressure to deliver positive test results, and specifically, they are facing pressure to prepare today's students for the technological world in which they will be released. The problem, however, is determining the true effects of this demand of technology integration on students' overall levels of academic engagement and achievement.

Understanding that technology is now at the helm of almost everything in society, it is understandable that the rapid integration and implementation of technology in education is necessary in order to prepare students for the real world and the workforce. However, as technology begins to become more prevalent in today's schools, it is important to consider the intended role of technology and observe the overall effects of the technology on today's students. Specifically, it is crucial to observe the impacts of technology on the overall engagement and

achievement of students resulting from the heightened use of technology in the classroom. With this in mind, this literature review focuses on the history and role of technology in education, and the overall beneficial and negative impacts of technology in education. This literature review also seeks to highlight any recurring themes within the literature as well as any gaps that may be present, thus identifying areas needing further research. Overall, the purpose of this research is to determine the potential effects of technology integration on middle school students' engagement and achievement.

The topic of technology in education is a broad one, and therefore, it was essential to begin this research by first identifying the history of the use of technology in education and then narrowing the search from there. Once discovering the history of technology in education, it was important to determine the many roles in which it has played over the years in order to fully understand how and/or why it has taken off so rapidly in the 21st-century classroom. Through identifying the foundation of technology in education and its role in the classroom, it was clear as to why this research was necessary. Moving forward, engagement and achievement were at the forefront of the key words guiding the research; however, reminded of the broadness of the topic, the results began to become overwhelming, but a few key themes began to make themselves clear. A reoccurring idea in the literature that continued showing itself was the idea of professional development, thus focusing the search on professional development's role in effective technology integration as it was apparent that it played a major role in how technology could affect students. This then led the search to focus on the specific effects of technology concerning the positive and negative effects on engagement and achievement. It was important throughout the process as new themes emerged to continue to keep engagement and achievement as a guiding principal within each theme. The focus of the research, however, was not only on

technology's effects on student engagement and achievement, but it was specifically intended to be focused on middle school students' engagement and achievement. It became quickly evident that there was a lack of research focused on middle school students in contrast to the vast amounts of research on early childhood and post-secondary students. Therefore, it was important to piece the available research together and understand what its implications were for the students in between these two groups on each end of the spectrum. All the while, it was essential to narrow the focus of the research to that which has been peer-reviewed and has been performed within the past 10 years to ensure its relevancy and accuracy. This process was conducted primarily through the DeWitt Library only search engine through Northwestern College.

The History of Technology in Education

For many, accessibility to technology is essential in order to complete the objectives and tasks required of many jobs and settings today. This necessity of having technology made its way into the educational setting as the United States increasingly involved itself within the geopolitical Cold War race with the Soviet Union (Christensen, 2019). While the initial technology integration was very basic, this step to begin involving technology in education became the catalyst for more detailed technology integration further down the road in the 1980s as Steve Jobs' Apple computers began being integrated into the classroom (Christensen, 2019). Although Cold War tensions died down and eventually came to a halt in 1991, the ideology of raising a better, more knowledgeable and productive society did not end. "Two past presidents saw the need for fundamental change in education to keep American students in competition with technology with other students from around the world" (Harris et. al, 2016, p. 3). President Clinton signed the Goals 2000: Educate America Act in 1994 to further promote educational technology, and then President Bush signed the No Child Left Behind Act into law just eight

years later in order to close achievement gaps, specifically through the use of technology (Harris et. al, 2016). These laws helped lay the foundation for the drastic implementation of educational technology in classrooms, but President Obama's Race to the Top fund for education is what has truly sparked the push for one-to-one technology in today's classrooms as his funding has made the accessibility to technology for each student greater than ever before (Harris et. al, 2016).

The Role of Educational Technology

While the initial role of technology integration in the classroom appeared to be part of a simple geopolitical battle, as years have progressed, research now shows that technology is much more than that. "The role of technology in the field of education is four-fold: it is included as a part of the curriculum, as an instructional delivery system, as a means of aiding instructions and also as a tool to enhance the entire learning process" (Raja & Nagasubramani, 2018, p. 34). In agreement, Harris et. al (2016) suggests that when considering the role of technology in the classroom, it should be viewed as a tool rather than simply a means to replace an existing methodology (Harris et. al, 2016).

Heidenrich (2013) conducted an interview and focus group-based qualitative study on the connection between students' learning and its ties to technology use. The study entailed 16 high school students taking part in five interviews and two focus groups. The results of the study rendered a variety of different themes such as technology being more effective when not used in isolation, as well as overall access to technology impacting access to learning (Heidenrich, 2013). Further, Keengwe, Schnellert, and Mills (2012) performed research specifically focused on the academic impact of a one-to-one laptop initiative of a Midwestern high school, examining 105 students from grades 10-12. While only focusing on the perceptions of students with district issued devices, they utilized a survey instrument to gather data on perception as well as school

records for gathering academic achievement data. A Likert scale revealed that close to 93% of students agreed that the one-to-one device made learning easier, and 85% agreed that their work was improving because of having the device. The research consistently shows that there is not only a push for a more student-centered classroom, but it also shows a positive correlation between one-to-one devices and student achievement (Heidenrich, 2013; Keengwe, Schnellert, & Mills, 2012). The one-to-one model appears to be necessary due to the need for differentiated instruction. Scholars claim that the traditional education system, void of the use of technology integration, fails to afford students the opportunity the individualized, differentiated instruction in which they need (Christensen, Johnson, & Horn, 2012; Leer & Ivanov, 2013). It is believed that the use of technology in the classroom and its ability to provide a student-centered, individualized, differentiated instruction, will better provide today's students with a 21st century education (Leer & Ivanov, 2013). Mitchell, Wohleb, and Skinner (2016) argue that this is necessary because students expect the classroom to reflect their everyday lives, which evolve heavily around the use of technology (Mitchell, Wohleb, and Skinner, 2016).

Not only is technology necessary for reflecting the current everyday lives of students, but research shows that it is also necessary for preparing them for their future everyday lives in the work force (Clough, Jones, McAndrew, & Scanlon, 2008; Ra, Shrestha, Khatiwada, Yoon, & Kwon, 2019). Jackson, Lower, and Rudman (2016) performed a qualitative survey study to examine the apparent lack of skills among graduates entering the workforce. While performing this study, the researchers discovered a study by the Deloitte and Manufacturing Institute showing "more than 600,000 manufacturing jobs were unfilled because of the lack of workers with the science, technology, engineering, and math skills required of the jobs" (Jackson, Lower, & Rudman, 2016, p. 2). Further, their own 100-participant survey reflected a similar disparity

between workforce preparedness as 76.5% of industry leaders claimed there was a gap in necessary skills, one of those being a lack of technological skills (Jackson, Lower, & Rudman, 2016). A potential problem presented itself during this study as only 48.5% of educators appeared aware that there is a disparity, thus suggesting a larger sum of teachers who are missing the potential positive effects technology in the classroom could have on students.

Further, scholars believe that the role of technology, as a means to enhancing the learning process, will completely change the concept of the modern-day classroom into more of a collaborative space for students to gather together and learn (Leer & Ivanov, 2013). Yang and Baldwin (2020) state, "Technology can also be used to support collaboration and communication. Learners can engage in asynchronous and synchronous communication, work with a wide range of media, in groups or individually, and for various purposes" (as cited in Mioduser, Nachmias, & Forkosh-Baruch, 2017; Yang & Baldwin, 2020, p. 2). Likewise, Raja and Nagasubramani (2018) state, "Technology has revolutionized the field of education" (Raja & Nagasubramani, 2018, p. 33). However, as the role of technology appears to be to drastically change the modern-day education system, further research shows that this cannot be done without careful attention to the way technology is implemented (Bickerstaff & Monroe Ellis, 2012). This appears to be one of the biggest issues with the use of educational technology, and it appears to be a common reason for negative effects on students' engagement when using technology. While performing a meta-analysis study of over 196,000 participants included in 69 different studies to determine the relationship between student engagement and academic achievement, Lei, Cui, and Zhou (2018) explore several different domains of engagement such as cognitive, behavioral, and emotional engagement. The evidence from the study reveals a clear positive correlation between student engagement and academic achievement, therefore

suggesting that when student engagement is low, student achievement is also likely to be lower (Lei, Cui, & Zhou, 2018).

The Need for Technology-Based Professional Development

Due to the increasing demands for teachers to evolve their teaching methods to reflect the needs of today's learners, teachers must receive professional development on the latest research-based methods and in a way that is more likely to lead to high implementation rates (Darling-Hammond, Hyler, & Gardner, 2017; Raja & Nagasubramani, 2018; Harrell & Bynum, 2018). Technology integration dominates the conversation of the needs of today's learners, yet the professional development that teachers are receiving is not adequate enough for them to successfully implement it in their classrooms (Darling-Hammond et. al, 2017; Hyndman, 2019; Heidenrich, 2013; Parette, Hourcade, & Blum, 2011).

A lack of professional development for teachers inhibits the ability for technology to have a positive effect on students' engagement, and therefore, their achievement (Harrell & Bynum, 2018). Today's students are born into a world where they are naturally digital natives, but many of today's teachers responsible for reflecting those students' everyday lives within their classrooms are digital immigrants, and they are not being equipped with the proper professional development to afford their students the greatest benefits of their technology accessibility (Hyndman, 2013). In conjunction with this idea, Heidenrich (2013) conducted a research study with 16 high school students involving them in interviews and focus groups to determine the effects of technology use and integration in their classrooms. A major theme revealed in the research was the effects of teacher comfortability with technology. When teachers are more comfortable with the technology, they are more likely to integrate into their lessons more effectively, thus leading their students to be more engaged (Heidenrich, 2013). Heidenrich

(2013) found in his research that when teachers were more comfortable with technology, they were more likely to integrate it into their instruction rather than utilizing it as an isolated tool. In agreement with Heidenrich's (2013) findings, Nikolopoulou and Gialamas (2013) conducted a research study finding a lack of confidence in technology use as a major barrier for successful technology integration as it leads them to feel less prepared and limits their ability to utilize technology in ways that will positively affect student engagement and achievement (Nikolopoulou & Gialamas, 2013). Throughout the study, the research examined the years of experience teachers had working with computers in early-childhood settings, specifically looking at the levels of confidence teachers had with working with the technology. When examining 134 female teachers in Athens, Greece, a subscale was used to measure levels of confidence with the technology. Results showed that the lack of technical support and training necessary for proper technology integration led to a lack of efficiency in technology integration, thus, limiting the potential for positive effects of the integration of the technology for the students (Nikolopoulou & Gialamas, 2013).

In order for teachers to receive successful professional development, the professional development needs to match the idea of the student-centered classroom. In the student-centered classroom, individual student needs are met through individualized instruction and differentiation. In order to provide teachers with the necessary professional development in order to integrate technology in a way that positively impacts student engagement and achievement, teachers need to receive one-on-one training from a coach (Alaniz & Wilson, 2015; Davis & Curry, 2019; Dinse de Salas, Rohlfs, & Spannagel, 2016). Dinse de Salas et. al (2016) performed a study providing teachers with additional professional development on technology integration to examine the levels of efficiency in technology integration. When proper professional

development is provided, teachers are not only more comfortable with integrating the technology, but students also reap greater benefits (Dinse de Salas et. Al, 2016; Brenner & Brill, 2016). Brenner and Brill (2016) conducted a two-phase, sequential explanatory study with a mixed-methods approach examining the best instructional technology integration strategies. Data was conducted using surveys and interviews with male and female early career educators. It was determined that college educational programs can assist in providing proper technological professional development classes so that teachers will be more prepared from the time they enter the field, and it is believed that they can then help coach their peers once they are in the field (Brenner & Brill, 2016). When completing surveys and interviews, participants in education programs in college who were provided with technology training in their programs claimed to have greater confidence and a greater likelihood of effective, efficient technology integration when they got into their own classrooms. As a result, students would also presumably benefit as well. The surveys further asserted that when technology integration is not a focus in educator programs, it leads to barriers down the road for technology integration. Without proper training, the effects of technology on students will not reach its fullest, positive potential (Brenner & Brill, 2016).

Effects of Educational Technology

As technology has become more widely integrated in classrooms, it can have a variety of different effects on students. Literature reveals that the use of technology can be influenced by a variety of different factors such as teacher development and confidence, technology accessibility, developmental appropriateness, and more (Brenner & Brill, 2016; Harrell & Bynum, 2018).

Positive Effects. Harris, Al-Bataineh, and Al-Bataineh (2016) conducted a quantitative study on fourth grade students from Illinois to determine the overall effects of one-to-one technology on

student achievement and motivation. The study focused on 25 students in a one-to-one classroom and 22 other students in a traditional classroom. After a series of several different tests, students in the one-to-one classroom scored 16.71% higher on the test than their counterparts in the traditional classroom. On another test, the one-to-one classroom again scored higher than the traditional classroom, scoring just over 10% higher, thus suggesting that one-to-one technology has a positive impact on student achievement.

Technology can have several positive effects on students. Students' attitudes toward content can improve when technology is effectively integrated (Ankiewicz, 2017). Carefully crafted questionnaires and research tools examined through factor anlaysis, show that among secondary-aged students, the majority of students had positive attitudes toward technology, yet had little concept of technology (Ankiewicz, 2017). A very surprising finding considering the digital age in which they are being raised. With that in mind, however, student upbringing and the overall usage of technology in their homes can greatly affect their attitude toward technology and its overall effectiveness toward their education as well (Ankiewicz, 2017). However, despite a lack of concept of technology, it appears that the use of technology improves student attitudes, thus leading to learning that is more powerful (Heidenrich, 2013). The use of technology in classrooms is still found to lead to improved student motivation and engagement (Costley, 2014). Heidenrich (2013) also found that the learning is more powerful when utilizing technology because students are afforded the opportunity to take greater ownership of their work (Heidenrich, 2013).

Beyond improving students' attitudes, motivation, and engagement, some studies have shown that technology is especially beneficial for English Language Learners (Liu, Navarrete, & Wivagg, 2014; Nemeth & Simon, 2013). Liu, Navarrete, and Wivagg (2014) conducted a case

study over a span of two years at the middle level for one year and the elementary level for the second year to determine the effects of an iPod Touch mobile device initiative in the district. Participants of the study were two middle level teachers and their students and two elementary level teachers and their students. They collected data through interviews, observations, and surveys. Over 50% of students in the study revealed that the technology was beneficial, thus showing that technology devices can bring forth several positives for ELL students as they provide teachers with quick access to differentiated instruction and provide students with differentiated instructional support (Liu et. al, 2014). The use of instructional technology can also benefit ELL students through extending their learning using online books, leading to greater student engagement (Liu et. al, 2014; Pierce, 2016). Educational technology also provides teachers with the ability to equip dual language students with tools to enhance their learning experiences, thus leading to greater engagement in the regular classroom setting (Godzicki, Krofel, and Michaels, 2013; Nemeth & Simon, 2013). Godzicki, Krofel, and Michaels (2013) conducted a study surveying 116 dual language learners from first to eighth grade revealing that they were more engaged when technology was involved as student engagement and levels improved by 9% when technology was used (Godzicki et. al, 2013). A second group of students believed to be benefitted by the use of educational technology is students from low socioeconomic families. The use of one-to-one technology could benefit low-income students, better preparing them for the use of technology, claiming that further down the road, without the school device, they may not ever have the opportunity to use such technology (Daugherty and Dossani, 2014). Kim, Hagashi, Carillo, Gonzales, Makany, Lee, and Garate (2011) performed a quantitative study on the effects of mobile technology learning devices in both rural and urban Mexican schools with 160 participants. It was found that these students, heavily from low-

socioeconomic backgrounds, benefitted greatly by the devices as students from each area improved in literacy development while using the devices over a 16-week span. It was also determined that the technology allowed for greater levels of parental involvement in the students' education as a result of the technology.

Another powerful positive that has been revealed by research is the ability to promote family involvement and communication through the use of technology, leading to greater levels of student achievement (Kim et. al, 2011). Olmstead (2013) discovered through a mixed-methods study involving surveys and semi-structured interviews that the use of technology allows teachers to communicate better with parents outside of the classroom, keeping them further involved in their child's progress. Of the 204 parents in the study, 94% reported that the use of technology for communication purposes would be valuable, as it would lead to greater parental involvement and student motivation (Olmestead, 2013). This proposes that through greater involvement afforded to families, students' overall levels of achievement will improve as well.

Negative Effects. While many researchers have found that there several positive effects of technology use in classrooms, research also shows that several positive effects are conditional, and it can have many negative effects on student engagement and achievement as well. When technology is not utilized appropriately, effectively integrated into lessons, or is simply used as a replacement rather than a new tool for deeper learning, it fails to yield the positive effects in which it is intended.

Ankiewicz (2019) performed an extensive review of previous literature on student attitudes towards technology and the instruments used to determine those attitudes such as Pupils' Attitudes Towards Technology questionnaires administered both in the Netherlands and

the United States. He also examined other qualitative studies, and it was determined that the majority of secondary students hold positive attitudes as a result of technology use. Rupnik and Avsec (2019) conducted an empirical study of 180 students from various schools in grades six and eight. A total of 92 males and 88 females were involved in the study, and most students appeared to have a positive attitude toward technology. However, while using a Likert scale to measure attitude towards technology, sixth grade students appeared to have more positive attitudes than those in the eighth grade, which was connected to student motivation levels. This brings forth the idea that students in lower grades of middle school may be more positively affected by technology than those in higher grades. On the contrary, the number of resources that are inaccessible to students due to blocked resources, lack of funding, etc., students can become frustrated and resentful of the technology (Heidenrich, 2013). As a result of this frustration, students can become more disconnected from the lesson, leading them to lower levels of engagement and achievement. Ardies, Maeyer, Gijbels, and van Keulen (2015) studied the factors contributing to student attitudes towards technology through a study of 2, 973 students involving the use of a two-part questionnaire based upon the Pupils' Attitudes Towards Technology and 25 Likert-scale questions. The questions focused on background variables such as gender, grade, access to technology at home, and then six different factors of attitude towards technology such as interest, boredom, career aspirations, etc. (Ardies et. al, 2015). It was determined that student characteristics are heavily reliant upon their attitudes toward technology (Ardies et. al, 2015). More importantly, their research reveals that middle school students specifically gain a more negative attitude toward technology, thus leading them to have lower levels of engagement and achievement as a result of using the technology (Ardies et. al, 2015).

While some may believe that one-to-one technology is beneficial for low-income students who would not have devices otherwise, Ardies et. al (2015) suggests that positive attitudes and benefits of technology are found greater among those with devices at home or with parents who work with technology, thus leading one to believe that if lower socioeconomic students do not have that at home, they would be less likely to benefit from the use of technology and would instead have a greater sense of resentment toward the technology (Ardies et. al, 2015). Adding to this finding, Kemp, Preston, Page, Harper, and Dillard (2014) took part in an extended conversation that was then peer-reviewed to identify various emerging themes, and it is suggested that the effects of technology are heavily influenced by the way the teacher implements the technology. Even so, technology is considered not truly helpful for all students (Kemp, Preston, Page, Harper, & Dillard, 2014). In addition, in consideration of how technology in the classroom is designed to match the everyday lives of students, if low-income students do not have technology at home, and the instruction does not match their outside lives, studies show that this can in fact drag down student attitudes, leading to lower engagement and achievement (Stefl-Mabry, 2010).

Additionally, while performing a quantitative research study of 33 fifth-grade students in a social studies class, Chu (2014) discovered that technology, when used improperly or with poor design, has a negative impact on student achievement. While performing the study, students were divided into a control group and experimental group with the control group continuing to receive traditional instruction, and the experimental group was provided instruction involving the use of technology. Learning achievement tests (a pre- and post-test) and questionnaires were created to acquire data. The results showed that students using the technology achieved far lower than those in the control group, but it was determined that poor design and/or use of the technology could

be to blame, thus furthering the notion of how essential proper professional development on technology use can be for rendering positive effects (Chu, 2014).

Technology, at times, can become more of a distraction and source of disruption than a tool for positive engagement (Gong & Wallace, 2012). It is also believed that rather than enhancing education, technology also has the ability to lower the work ethic and integrity of students due to the ease of plagiarism (Gong & Wallace, 2012). Additionally, while technology is believed to increase and enhance communication, technology has the potential to lower communication/personal skills due to the lack of requirement for face-to-face interaction (Gong & Wallace, 2012; Aagaard, 2015). During a qualitative study, Aagaard (2015) observed and interviewed a group of 25 Danish students and found that they often wandered to exploring websites and content unrelated to the content of their lesson. It was also determined that the technology often led to delayed responses. It appears at times that for every presumed positive effect of technology, there is a contradicting negative effect to accompany it.

Gaps in the Literature

While this literature review was intended to explore the many effects, positive and negative, of technology, while also briefly exploring the history of technology in education, the intention of the research was primarily to observe the effects of technology on the engagement and achievement of middle school students. Much research has been performed on the effects of technology on student engagement and achievement in general, but for the most part, a plethora of research has been conducted around early childhood education. Additionally, there has been a lot of research recently on the effects of technology on engagement and achievement of collegiate undergraduate students. However, it appears there has been far less research done on the effects of technology on middle school students specifically.

Future Research

As a result of this research and review of the literature, and in response to the lack of literature on the effects of educational technology on middle school student engagement and achievement, future research could, and should, be performed in the middle school setting around the idea of the effects of educational technology on middle school students. Middle schools were created from junior high schools in an attempt to be more developmentally responsive. Therefore, the instructional strategies used for middle level students play a major role in ensuring the developmental responsiveness of the school. Understanding that technology is now such a vital part of middle school students' lives, it is believed that more research needs to take place on its effects on their engagement and achievement to ensure that schools and teachers are implementing and integrating technology in ways that are positively effective. It is also crucial to identify which groups of students are being affected by the use of technology and how it is affecting them. Utilizing a series of different tools such as semantics, surveys, observations, and more, future research would determine the exact effects of technology on middle school students' engagement and achievement.

Conclusion

Technology has been a part of education, although in very different forms, since the early 1960s, becoming more prevalent in the 1980s, and dominating the world of education by the early 2000s with the emergence of the internet and greater accessibility to technological devices. As the use of technology in education has changed rapidly, the world outside of the brick and mortar walls of schools has changed even more rapidly. As a result, schools across the nation and teachers are being forced to adapt in order to provide students with an education that mimics the world in which they are being raised. In order to do this, teachers are in desperate need of

professional development, but the traditional methods of professional development are no longer effective.

Due to the lack of effectiveness of professional development, teachers lack confidence in their ability to utilize technology, so despite the knowledge of the clear need for technology integration, many teachers are reluctant to do so, and when they do, they do not do it well. The end result of this is that students are becoming frustrated and less engaged in class. Due to the lack of student engagement, the academic achievement of students suffers. However, when technology is integrated appropriately, it is believed, according to research, that there are several positive effects to be rendered. Student engagement and achievement are believed to improve when technology is integrated appropriately, but not necessarily for all students. While some believe that technology is beneficial for low-income students, others determine otherwise. It is believed that the classroom should match the outside lives of students, and for some, technology use is not a match.

Further, technology brings the ability for a more student-centered method of teaching, thus affording students greater opportunity to learn at a pace fitting for them. Additionally, it is believed by many that the use of technology enhances communication and collaboration among students; however, some research has determined otherwise. Ultimately, there are a variety of groups that have the potential to be both positively and negatively impacted by the implementation of one-to-one technology in schools today, but this is only primarily clear among early childhood students. Further research still needs to be conducted among middle school students in order to fulfill the desires of this literature review.

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