GENERATIONAL DIFFERENCES OF TEACHERS IN THE INTEGRATION AND USAGE OF TECHNOLOGY IN THE CLASSROOM

By
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ABSTRACT

While many researchers address the issue of how teachers use technology and others study how different generations value and use technology in their own lives and in their education, there is a lack of knowledge that addresses whether or not generation affects how teachers use technology in their own classrooms. Additionally, there is a debate in the research regarding the efficacy of computer technology as a means of transforming educational practices and revolutionizing education. Is it possible that digital natives will succeed in transforming teaching practice through the use of 21st Century computer technology?

The key research question of this study is, "Does generation determine the way teachers use technology in the classroom?" The sub-questions are:

- o What do these differences look like between generations?
- o Are Millennials able to transform education through their understanding of technology?
- o Do Millennials have an innate understanding of efficient and productive uses of computing in education?

An interview study was utilized to access direct and timely information on this topic. Thirty teachers participated in a one-hour semi-structured interview to ascertain their opinions on how technology affects their teaching practices. The interview data was coded through the lens of the Will, Skill, Tool framework to understand how and why the teachers either utilize or avoid technology in their teaching.

The results of this study demonstrate some differences between the generations in the way they use and implement technology in their classrooms. Both Generation X and Baby Boomer teachers see computers as a resource that they like to have in their classrooms to provide resources to their students whereas Millennial teachers rely on and expect to use technology.

While most Millennial teachers believe it is much easier to do project and inquiry-based learning with computer resources, they do not see it as a radical transformation of goals or practices. They use the computers to be more efficient and productive with planning, grading and delivering content. While technology does expand and enhance resources, it has not produced the change in teaching expected by advocates for computers in schools, in any generation of teachers, including Millennials.

ACKNOWLEDGMENTS

I would like to thank all of my professors in the ELPS department at KU. I would like to especially acknowledge a few who played a key role in this project. Dr. Micky Imber for inspiring me to pursue this topic and giving me insight into the patterns and history of school reform in the United States. To Dr. Arugn Saatcioglu, my supervisor, thank you for training me how to research, write, and most importantly, to believe in my capability to complete this project. To Dr. Deborah Perbeck, I thank you for always being a phone call or email away to give me encouragement, advice, motivation, and compassion that has enabled me to complete this journey.

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"Now all glory to God, who is able, through his mighty power at work within us, to accomplish infinitely more than we might ask or think." Ephesians 3:20 NLT

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Chapter 1 Introduction

This study seeks to determine if teachers in the Millennial generation integrate technology differently than teachers of previous generations. While other researchers have done studies that attempt to explain how and why teachers integrate technology, it is usually through the lens of the ability of the individual teacher, the amount of support from the school administration or the unyielding nature of school bureaucracy. This study attempts to determine if the generational differences in familiarity and value afforded to technology affect the way teachers utilize technology in their classrooms.

Research Questions:

Does generation determine the way teachers use technology in the classroom?

- What do these differences look like between generations?

- Are Millennials able to transform education through their understanding of technology?

- Do Millennials have an innate understanding of efficient and productive uses of computing in education?

Advocates of computer-based learning reflect a similar view of past educational reformers, that traditional teaching is

> a common form of instruction where teachers generally teach to the whole group of students in a class, show high concern for whether students are listening, concentrate mostly on subject matter and academic skills, and, in general, control what is taught, when, and under what conditions (Cuban, 1982).

These advocates suggest that this mode of teaching does not engage students and does not allow students to reach their potential. Computers are expected to transform teachers into student-centered learning facilitators rather than the sole source of knowledge in the classroom(Blau, Peled, & Nusan, 2016; Hockly, 2017; Tatnall, 2015; Williams, 2016; Zheng, Warschauer, Lin, & Chang, 2016). Advocates claim these computers will "contribute to teaching and learning…in a way that would not be possible" without each student having his or her own Internet connected computer device(Hoffman, Petrosky, Eskander, Selby, & Kulaylat, 2015; Shapley, Sheehan, Maloney, & Caranikas-Walker, 2009).

The theme in the generational divide literature discusses how people from the Millennial generation have melded technology into their everyday lives. The Internet is the most comfortable means of communication and the primary source of both information and entertainment for the Millennial generation. Prensky argues that the brains of the Millennials have been reshaped by technology, that "a really big discontinuity has taken place. One might even call it a singularity— an event which changes things so fundamentally that there is absolutely no going back" (Prensky, 2001). Because of this singularity, a divide exists between the three generations in the workplace today; between the younger workers, "digital natives", and older generations who are termed "digital immigrants" (Prensky, 2001). This research is mainly focused around social lives, in a traditional office workplace, and communication. In schooling, the focus seems to be centered more around how digital natives want to learn, and not how the teachers of this generation are integrating technology differently than older generations.

This is a study to determine if the integration of computer technology in the classroom is related to the generational divide between digital natives and digital immigrants. This connection is determined by evaluating the way in which teachers use technology in the classroom and differentiates through the lens of generation. If generation is a large reason for the differentiation of technology use between teachers, this study could be helpful in determining the training and professional development to help teachers utilize technology in the classroom.

This study shows there is a split between digital natives and digital immigrants, and how the educational community can use this information to determine how to best train teachers, differentiate professional development, and how to educate the teachers the implementation of technology in specific ways in their individual classrooms. Because "some US school districts invest more than $1 billion in classroom computers and infrastructure" (Falck, Mang, & Woessmann, 2017), there is clearly a need to ensure the resources are being used productively to ensure teachers have the knowledge and ability to effectively implement technology in their classrooms.

Previous studies suggest that technology has become as common as paper and pencils in education. Therefore, the more interesting and relevant question to ask regarding technology is how are teachers integrating technology? If there is a generational divide, the research suggests that school districts need to ensure that younger teachers are supported in their creative use of technology in order to support student learning goals and that districts should provide additional resources for teachers of previous generations to learn, adapt and innovate their lessons to include technology their students have access to from the school district.

Data was gathered through interviews of teachers from different generations. Initial questions were asked to determine the teachers' ages and personal experience with educational technology. Further questions determined teachers' acceptance of technology and the extent to which they have integrated technology into their teaching practice. The interviews were semi-structured to allow the researcher to develop probing questions during the individual conversations to ensure the teachers were able to express their personal preferences and opinions regarding technology. As there are an infinite number of ways teachers judge, access, utilize and implement technology, the interview protocol was designed to allow for rich discussions where the teachers' beliefs and thoughts were able to be expressed.

The teachers in this study all work for a large suburban school district in the Midwestern United States. This district implemented a 1:1 program in 2013 with the stated intent of boosting student motivation, enhancing the materials being taught and adapting to the diverse learning styles of students. The school district implemented 1:1 computing as a way to enhance resources in the classroom and expand the ways in which students learn. The district goal was for teachers to utilize technology in order to personalize learning for students, increase collaboration and allow for project-based learning (District Website).

This interview study was designed for this district in order to learn: the teachers' valuation of technology, how teachers use technology and the teachers' personal, educational and professional experience of technology. The results will add to the body of research available into the ways in which teachers use technology, applying the lens of generational differences to this

research. As there is currently very little information on how generational differences affect teachers' valuation and utilization of technology, this study illuminates this area and directs educational researchers to what teachers want and need in order to effectively use computer technology in their classrooms.

The questions in this study were built around the will, skill, tool (WST) framework. The WST framework is used in many studies that report on how teachers integrate technology into their classrooms. The three components of this model are defined as: 1. will, the teachers' attitude about how effective computers are in helping them achieve their classroom goals, 2. skill, the teachers' ability to use the technology and 3. tools, the accessibility teachers have to the technology they need to use in their classrooms (Agyei & Voogt, 2011; Christensen, 2008; Ertmer, 2005a). The questions were designed to reveal the individual teacher beliefs and practices regarding the use of technology in their classrooms using this framework. Then, the responses were organized into generational groups.

Chapter 2 <u>Summary of Findings</u>

The results of this study indicate that there are some generational differences in the way teachers integrate technology into their classrooms. Millennial teachers have used technology in an educational setting since they have been in elementary school, which may underscore why they are the group to agree the most that technology is necessary for teaching. The Millennial group understands that computer technology has the ability to expand and enhance information and connect their students to real-world examples of their content. The older generations also made similar claims that technology is a tool to help their students achieve the goals of the teacher in

the classroom. The biggest contrast for Millennials is that they were the group most likely to use technology to make their own jobs easier by utilizing systems, applications and programs to facilitate the organization and management of their classrooms. This finding is important as it contradicts the prediction of generational research; Millennial teachers will use technology to transform education for their students. Instead, this group of Millennial teachers primarily uses technology to improve the efficiency of their work and manage the organizational needs of themselves and their students.

When it comes to the skill teachers have in using technology, the youngest and the oldest groups, Millennials and Baby Boomers, were equally likely to explore and implement new technology in their classroom. This finding is surprising, as the generational research predicts the older generation would be the most unlikely to research and implement technology in their classrooms. The difference is the Millennials find technology is useful to them in running the class and the Baby Boomers find technology is useful to their students' ability to learn. It is the middle group, Generation X, that is the least likely to research and implement technology, as many in this group do not believe the time spent learning new technology and teaching it to their students is worthwhile. Even when this group learns an application in professional development, they are unlikely to use it in class, as they do not see it beneficial enough to risk the time it takes to implement it and teach their students how to use it.

Questions surrounding the unreliability of technology brought out another result that is contrary to the generational research. Not surprisingly, the Millennial teachers did not let the threat of technology failure stop them from using technology in their classes. To this group, the incidence of failure of the tool was not a risk or problem great enough to interfere with their planning. The

other group that was willing to accept the risk of technology failing was the Baby Boomers who reported being capable of replacing their computer-based lessons with pen and paper as needed. The Generation X group were the group most negatively affected by the unreliability of technology. This group believes it is too risky to invest time in learning and implementing a technology-driven lesson that is not going to work when they need it. They have experienced failure of technology that has required them to re-do their work, costs them time they don't feel they have and deepened inequity for students who do not have technology support at home.

In the discussions with the three groups, there were overlapping concerns and accolades for technology in education. However, the fundamental conclusion of this study is that the youngest group of teachers in this study, the Millennial generation, have fully accepted that technology is as much part of teaching as books, pens, whiteboards and paper. This group grew up with technology in their classrooms as students, studied how to use technology as teachers in their university education programs, has the most confidence with using technology to manage and organize their classrooms, sees how computers can help their students gain information and examples to augment their knowledge, and are the most likely to report their job depending on technology. This supports the notion that while technology is here to stay in education, it may be used to save time, create efficiencies and better organize their classes, rather than transforming instruction as many advocates of computers in education have predicted (Ruggiero & Mong, 2015).

Another interesting finding of this study is that the group least enthusiastic about technology in the classrooms was not the oldest group. It was the middle group, Generation X, that had the most resistance to using technology in their classrooms. Although 100% of the teachers in the

study are using computers in their classrooms in various ways, the Generation X group of

teachers are the most resistant and critical of the three groups. This finding does seem contrary

to the assumption of generational research that the oldest group would be the least receptive to

using technology in their work.

Chapter 3 Literature Review

3.1 Ed Tech Review

There is an enduring debate on the effect of computers on teaching practices. The key problems the literature focuses on is how the beliefs and skills held by teachers about computers and the access teachers have to computers affect the integration of technology into pedagogical practices. Many in this debate argue that computers will enable teachers to transform their practices (Hoffman et al., 2015; Shapley et al., 2009). These researchers seek to understand how to encourage teachers to utilize 1:1 computing technology by developing their ability, providing access to resources and cultivating a desire in them to incorporate technology in the classroom.

Advocates of computer-based learning reflect a similar view of past educational reformers, that traditional teaching does not engage students, nor does it allow students to reach their potential. Progressive education reformers have worked to change teaching practices and schooling since 1900 with the "conviction that children had different abilities, interests and destinies in life" (Cuban, 2013; Tyack, 1995). For example, in the 1920s, Helen Parkhurst developed the Dalton Plan which sought to liberate students from "irrational relics of the past" such as graded classrooms and replace them with student and teacher created contracts that gave students control over their own learning. The teachers were no longer responsible for ownership of their class, but the facilitation of student-led learning (Tyack, 1995). The processes of her reform were different than computer-aided learning, but the rationale is similar, when students are in charge of their own education, they will be more engaged and have better outcomes.

The Dalton Plan did not persist. While the idea and policy talk of implementing radical reforms to the traditional school was widespread, it was only implemented in 2% of schools by 1930. By 1949, the number had dropped to one school, which was founded by the originator of the idea, Helen Parkhurst. The failure of this reform can be linked to the extra work it created for teachers, inability of students to capably direct their own education and the radical changes it proposed in the structure and appearance of schools under this plan(Tyack, 1995). Computer assisted education, on the other hand, has persisted since the 1960s in K-12 education and continues to grow as more schools adopt 1:1 devices. It has been implemented in schools across the United States and beyond(U.S. Department of Education, 2016; Zheng et al., 2016). The question remains, however, how effective is this reform at attaining its goal of transforming teaching?

The use of computers in education dates back to the early days of computing itself. In the 1940s, universities were at the forefront of developing modern computers. College instructors in the field of computer science and engineering were intrinsically motivated to teach their students all they knew about computers and technology in order to further their own research and improve the capacity of the technology ("Computers: Timeline of Computer History," 2016; Tatnall, 2015). Some of these university math and science students became high school teachers who, by the 1970s, sought access to computers in order to instruct their own students in computer science and programming. The introduction of computers to secondary schools, at this time, was only implemented by teachers who were dedicated to the development of computer science, was scattered across schools and was not seen as a reform to radically change teaching (Price, 1989; Tatnall, 2015).

With the advent of microcomputers in the 1980s and 1990s, computers began to be promoted as a tool to transform teaching across the curriculum(Dwyer, 1990).   Instead of focusing on computer science itself, teachers in every subject were encouraged to integrate new educational hardware and software into their classrooms. At this time, most educators were hesitant to integrate technology into daily practice because they did not believe the computers or software were of high quality or relevant to their subject matter. Teachers were also concerned by the notion that "computers in schools caused a rethink of how teaching should be handled and the role of the teacher"(Tatnall, 2015). Many teachers felt unprepared to use the new technology and the professional development programs offered by school districts were lacking in quality and quantity. Due to the concerns of the technology itself, the reluctance teachers had to radically transform their role in the classroom, and the lack of professional development available, many teachers rejected computers in the classroom.   Because of these technological and pedagogical concerns, widespread adoption of computers in the classroom came to a standstill in the late 1990s (Charp, 1997; Poore, 1984; Tatnall, 2015).

One of the newest iterations in the long history of educational technology is the one-to-one initiative. This reform is taking place across the globe as schools take advantage of the reduced costs of hardware, the increased capabilities of Internet-connected computers and tablets, and in response to the idea that technology will improve learning in the classroom (Blau et al., 2016; Hockly, 2017; Tatnall, 2015; Williams, 2016; Zheng et al., 2016). This reform gives every student in a certain grade, school or district access to his or her own, school-provided, Internet-connected laptop or tablet computer. Schools that implement a one-to-one initiative believe the

increased functionality and versatility the Internet provides in the classroom setting will give

teachers the tools they need to transform their teaching and engage students in a way that was not

possible prior to the technology available today (Tatnall, 2015).

Advocates of computer-based learning reflect a similar view of past educational reformers, that

traditional teaching, which is defined as

> a common form of instruction where teachers generally teach to the whole group
> of students in a class, show high concern for whether students are listening,
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Zheng et al., 2016). Advocates claim these computers will "contribute to teaching and

learning…in a way that would not be possible" without each student having his or her own

Internet connected computer device(Hoffman et al., 2015; Shapley et al., 2009).

The constructivist model of teaching puts "the students' own efforts to understand at the center of

the educational enterprise" (Prawat, 1992). Some researchers claim that through technology,

teachers will lead classrooms in which students create their own individualized learning path and

their own virtual learning communities (Hoffman et al., 2015; Shapley et al., 2009; Williams,

2016). In classrooms with computers for every student, advocates claim that "teachers'

traditional text-based curriculum … is first strengthened through the use of technology and then

gradually replaced by far more dynamic learning experiences for students"(Dwyer, 1990).

Technology is seen as a way to stimulate a constructivist model by stimulating "dramatic change

in the focus of teaching, putting the students' own efforts to understand at the center of the educational enterprise" and creating "major changes in the teachers' role"(Prawat, 1992).

Schools in the United States have been quickly increasing the number of Internet-connected computers. In 1995, there were 447,000 Internet connected computers available for instructional purposes in public schools. By 2008, that number had grown by over thirty times to 15,162,000 Internet connected computers (U.S. Department of Education, 2016). Teachers today are expected to use technology to transform their teaching practices, but others are still resistant (Cuban, Kirkpatrick, & Peck, 2001; Donnelly, McGarr, & O'Reilly, 2011; Ertmer, 2005a; Griffiths & Goddard, 2015). While many studies attempt to explain that teachers do not use computers because of their own skill or beliefs, others claim the structure of schooling does not allow this type of radical change.

In a 2015 study, Griffiths and Goddard found that teachers did not adopt an educational application past the pilot stage. While the teachers were engaged and interested in using the tested application during the pilot phase, during the implementation, the computer application "did not fit with how teachers did things in the classroom nor with institutional requirements," therefore the teachers did not use the technology as expected in the classroom (Griffiths & Goddard, 2015). This study will attempt to see if the new generations of teachers, termed "digital natives," (Prensky, 2001) will end this debate and eventually all teachers will consider a room without student laptops anathema to a classroom.

3.2 The Big Elephant in the Room: Does the generational divide matter?

Some students who graduated from high school in 2001 are now teachers in their 30s today. A 22-year-old, first year teacher could be a 2013 high school graduate. As more Millennial teachers begin their teaching careers, consideration should be given to the idea that these teachers may be able to integrate technology, regardless of their teaching philosophy or the structure of schooling.   Over time, these Millennials will become the bulk of the teaching force. There is a large body of research that compares how the Millennial generation uses and values technology differently, suggesting that teachers who belong in this generation are more likely to use technology in different ways than older generations. Because Millennials "are often more Internet savvy than their teachers, parents, grandparents, and even older siblings," (Herring, 2008) an argument could be made that these Millennial teachers use technology more often or in a more innovative manner than teachers who were born before 1980.

The theme in the generational divide literature discusses how people from the Millennial generation have melded technology into their everyday lives.   The Internet is the most comfortable means of communication and the primary source of both information and entertainment for the Millennial generation.   Prensky argues that the brains of the Millennials have been reshaped by technology, that "a really big discontinuity has taken place. One might even call it a singularity— an event which changes things so fundamentally that there is absolutely no going back" (Prensky, 2001). Because of this singularity, a divide exists between the four generations in the workplace between the younger workers, "digital natives", and older generations who are termed "digital immigrants" (Prensky, 2001). Generational research is focused on technology used to support social lives, traditional office workplaces, and

communication. In education, the focus seems to center around how digital natives want to learn, and not how Millennials are integrating teaching with technology.

There are a few studies that have attempted to discover Millennial teachers' ability to integrate technology into the classroom. One such study found that the Millennial teachers were no more adept at using a Learning Management System than their colleagues from older generations (Pegler, Kollewyn, & Crichton, 2010). This finding does not automatically dismiss the notion that teachers from the digital generation are unable to use technology in the workplace. It could be argued that a Learning Management System is an extension of traditional teaching practice, not truly a transformation of education (Ottenbreit-Leftwich, Glazewski, Newby, & Ertmer, 2010). Additionally, research emphasizes that even when teachers understand how to use technology and can think of many was of implementing these ideas in the classroom, when it came time for the teachers to use this technology they did not, due to the institutional pressures of schooling and the fact that the program did not conform to the teachers' needs during instruction (Griffiths & Goddard, 2015).

There are some powerful findings in the current educational technology literature that may explain the power of peer influence on technology integration by many teachers. Ertmer asserts that "change in teacher beliefs regarding the value of computers was more likely to occur when teachers were socialized by their peers to think differently about technology use" as well as the fact that "other teachers' tech attitudes and beliefs were the strongest barrier to the integration of tech within the schools" (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012) (Ertmer, 2005a). As older generations retire, and the teaching force is made up of a higher percentage of digital natives, the socialization effect could be a strong influence on Generation X

teachers and other less tech-receptive Millennials to integrate technology into their teaching practices.   As digital natives become the bulk of the teaching force, Prensky would argue the overall value placed on technology by teachers is likely to increase, resulting in schools where teachers are encouraged to use technology in innovative ways by their peers.

If Millennial teachers are accepting of technology in schools, the new normal in teaching practice could change to include the integration of technology by teachers and change the notion of what instruction could and should be. Many suggestions in the current literature surrounding tech integration hinge on the fact that teachers' values and beliefs surrounding the value of technology, along with their ability to use the technology will lead to this transformation of teaching. As more Millennials enter the teaching profession, with their innate understanding of technology, this could be the factor that finally allows schools to see traditional teaching transformed by the integration of technology.

This study seeks to show a connection between how Millennial teachers value technology and their integration of technology into classrooms.   If the literature about digital natives is accurate, as Millennials become teachers, they will have no option but to use technology in their teaching, as they are a part of a new way of thinking and living that has been ushered in with the use of technology as an inseparable part of their social and personal lives.

Another positive indicator toward more technology use is that younger teachers are more likely to have used computers in their own classrooms as students.   When the teaching force is comprised mostly of these digital natives, school systems may not struggle in order to train

teachers to use and value technology, the educational system will transform itself. As digital natives, these newer generations of teachers will already hold the value of computers and the skills necessary to utilize technology in ways that could transform teaching from our traditional notions of the work of teachers toward a new constructionist view of teaching.

 If Millennial teachers are able to integrate the technology available to them in ways that radically transform teaching, the argument can be that when these Millennials and Generation Z generations "grow older and replace present day adults as decision makers" (Herring, 2008), traditional teaching as we know it today will be replaced by digital, interactive, student-centered teaching. Prensky states, "today's students are no longer the people our educational system was designed to teach" (Prensky, 2001). Could it also be true that today's teachers no longer fit our educational system? The generational literature posits that Millennials are more comfortable and knowledgeable with computer technology. If this finding is true, it will be interesting to see if Millennial teachers are using effective and integrated technology practices in the classroom.

3.3 The "null effect" of computers on student outcomes

The counterpoint to the literature which argues for the transformation of teaching through the integration of technology asserts that computers "haven't brought schools any closer to realizing the promising path of building students' intrinsic motivation thru student-centered learning"(Christensen, 2008). In fact, most studies that analyze the effect of using computers in the classroom has not had the promising results which advocates of early computing had hoped. A meta-analysis of the effect of 1:1 laptop programs shows a small positive impact on standardized test scores in English, reading, writing math and science (Falck et al., 2017; Zheng et al., 2016). A 1:1 pilot program for middle school students across the state of Texas showed a

slight advantage for students based on their math scores but outcomes for reading were not significantly different(Shapley et al., 2009). A statewide project in Maine resulted in similar findings. There were small improvements in reading, but no significant differences in other state assessments (Silvernail, 2007).

Christensen argues that schools are currently too structurally interdependent to truly disrupt business as usual in a typical classroom. He identifies four interdependencies that limit schools' ability to transform instruction:

1. Temporal: The vertical alignment of curriculum between grades

2. Lateral: Pedagogical and curricular pressures from other teachers and subject areas

3. Physical: The design of classrooms and schools is not supportive of student-centered instruction

4. Hierarchical: State and local government mandates, such as high-stakes testing, state or nationally developed curriculum

Many researchers do not believe computers have the capacity to change teaching because educators cannot overcome the complexity created by these interdependencies and other external pressures on schools. Traditional, standardized instruction is the product of the structure of schooling itself (Cuban, 1982), and this structure is what affects teachers' ability to integrate technology in a constructivist manner, not the philosophy or the ability of individual teachers. Many teachers have thus far responded to technology in schools by using computers to save time, create efficiencies and better organize their classes (Ruggiero & Mong, 2015). If this is true across generations, computers will remain in classes, but not as a way of transforming instruction. They will be used by teachers to supplement and reinforce the methods that align with teachers' long-standing goals for their students.

Technology is incorporated most frequently into activities that correspond to traditional teaching practices, such as communication with students to give directions, assigning homework and classwork as well as supporting classroom management (Donnelly et al., 2011; Hinostroza, Ibieta, Claro, & Labbé, 2016). A 2015 study revealed that the most commonly used technologies in the classroom were PowerPoint, film, video, and games (Ruggiero & Mong, 2015). These tools may allow for an improvement on older methods of presenting information, but they do not allow for the transformation of the classroom that many advocates of technology have predicted.

The idea that technology can unencumber teachers from the school bureaucracy and allow them to become student-centered, for these researchers, is the "equivalent of re-building an airplane mid-flight" (Christensen, 2008).   Teacher-centered pedagogy is reinforced in education due to the structure of the educational system. The idea that teachers are the center of information in the classroom persists due to "the lack of time, a rigid schedule of classes and examination requirements" on to which both teachers and students are held (Tondeur, van Braak, Ertmer, & Ottenbreit-Leftwich, 2017). When technology is made available to teachers, many tend to use the new tool to reinforce the traditional techniques they to which they have been bound. While research shows that the presence of technology can result in a more student-centered classroom, the system itself will need to be more flexible before teachers will be willing to forgo their traditional role and beliefs (Cuban, 2001, 2013; Tyack, 1995).

The bureaucracy and structure of schooling is seen as the block to truly reforming schools. (Cuban et al., 2001; Tyack, 1995). Cuban explains that "how a school is organized into grade levels, subject matter for each grade, schedules that allot time for certain activities and rules that establish routines for monitoring behavior and evaluating performance of adults and large

numbers of students"(Cuban, 1982). Without a change in the structure of schooling, teachers are not able to adapt the technology to become student-centered educators while still maintaining these structural norms in their classrooms. While teachers now have access to more computers, the work of teaching, as measured by standardized tests and prescriptive curriculum, has remained static, leaving teachers to use technology in a way that reinforces their existing practices and the structure of the school itself (Christensen, 2008; Cuban, 2001). Is it possible that the views Millennial teachers have about the usefulness of technology actually produce a change in the structure of school?

Another limit on integrating technology into classrooms is the characteristics of many teachers. While Ertmer argues that teachers who are student-centered are more likely to use technology as a transformative pedagogical tool, Cuban claims the underlying "occupational ethos of teaching generates innate conservatism and resistance to change in institutional practices" (Cuban, 1982). Many studies, including Ertmer, show that teachers are using computers to create efficiencies and methods to support the traditional, teacher-centered classroom (Christensen, 2008; Ertmer, 2005a; Ertmer et al., 2012). In over 100 years of educational reform "few of the changes targeted at changing teacher practice got past the classroom door" (Cuban, 1982). However, if Prensky's ideas about the Millennial generation has a spill-over effect into their teaching practices, a change in how technology is utilized in the classrooms could be present today.

While "many corporate leaders, academics, and practitioners believe that traditional forms of teaching… reliance on textbooks, whole-class instruction, lecturing, and multiple-choice tests are

obsolete in the information age"(Cuban, 2001) teachers themselves believe "that certain information needs to be learned" (Cuban, 1982). Thus, when technology is presented as a new method of teaching, "teachers make value judgments about whether that approach or tool is relevant to their goals" (Ottenbreit-Leftwich et al., 2010). If the tool does not meet their needs or the perceived needs of their students, they are unlikely to embrace the technology in a transformative way, but will simply use it to "supplement and reinforce the existing teaching model" (Christensen, 2008).

The push to improve teaching through technology has much in common with other reforms proposed in public education. It has been implemented without much thought to the teachers. As Cuban notes about educational reform, "few of these reforms noted the workplaces within which teachers labored, involved teachers in the design itself, or allocated sufficient resources to develop teachers' capacity to implement the desired changes (Cuban et al., 2001). The developers of classroom technology often do not understand the needs of classroom teachers. If the technology changes the role of the teacher or does not accomplish the goals of the teacher, it may go unused by the teacher (Griffiths & Goddard, 2015).

While the developers understand the potential benefits of the program, the teachers perceive the reform as counter to their role in the classroom and the goals they have for their students. Not since the early days of computer science and programming in schools have teachers been at the forefront of bringing computing into the classroom. Cuban argues that because teachers are responding to a reform thrust upon them, without regard to or change in the structure of the school itself, there will be minimal change to the teaching practices due to technology.

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There are some suggestions in the research as to how to make more effective reforms regarding technology in teaching. Many indicate the "need to examine teachers themselves and the beliefs they hold about teaching, learning, and technology (Ertmer, 2005a) because "the integration of an ICT-based resource is a complex change process that needs careful consideration of the people it affects most: teachers" (Donnelly et al., 2011). If teachers "lack opportunities to provide input into these conversations and the decisions resulting from those conversations" (Ottenbreit-Leftwich et al., 2010) these researchers suggest a smaller chance of transformative pedagogical change through technology. When digital natives constitute a majority of teachers, will this theory be proven wrong? The newer generation of teachers could have the potential to unlock the power of computing to create the transformation of the classroom that advocates of computers in classrooms have claimed.

3.4 <u>How can technology be used to improve instruction?</u>
Advocates for integration of computers in teaching practices share the belief that technology can and should be used in order to transform teaching from a traditional model to a more constructivist, student-centered approach(Becker, 2000; Christensen, 2008; Prawat, 1992). The goal of these researchers is to discover what the differences are between teachers who successfully integrate technology and those who are unable or unwilling to do so. Many researchers attempt to discover how and why teachers do or do not integrate. There is a belief that if more teachers integrate technology into the classroom, they will become more student-centered in their practices (Becker, 2000; Christensen, 2008). However, there have not been

many studies that address how younger generations of teachers may be different from the traditional model.

Technology in schools has become commonplace. As the numbers of computers and money spent on educational technology increases (U.S. Department of Education, 2016), many teachers use them as an "additional tool to use in their customary repertoire of teaching practices," (Cuban et al., 2001) and "they have catered to the intelligence type that has been historically privileged in each subject" (Christensen, 2008). Although teachers are using technology, most are not using them in a transformative way as predicted by the advocates, instead they are using them to reinforce their current, traditional method of instruction. As Millennials have had more experience with technology as students themselves, it will be interesting to see if this trend will shift.

In order for computers to transform teaching, technology in classrooms should not be used to "teach students in the same ways that subjects have always been taught"(Christensen, 2008). Instead, teachers should put technology "in the hands of students who are encouraged and enabled to utilize it in the same ways and for the same purposes that professionals do— to communicate, collaborate and solve problems"(Ottenbreit-Leftwich et al., 2010). Many studies have shown that "the most common and frequent uses of technology have resulted in only incremental, or first-order, changes in teaching style and remain far removed from the best practices advocated in the literature"(Ertmer, 2005a).

In the past few years, research has started to emerge that pinpoints the type of computer-based

lessons that can improve learning outcomes for students when they are used in particular ways.

Several types of lesson-designs have been shown to transform lesson design in a way that early

advocates hoped: flipped classrooms, additional practice outside of the school day or class

period, using computers for research, as well as communicating with other students and teachers

(Falck et al., 2017; Lai et al., 2015; Peterson, 2016). The way in which computers are used in

the classroom is important, rather than the number of minutes or tasks are accomplished on the

computer. The tool itself does not matter as much as the pedagogy behind the decision to use the

technology. While research is beginning to demonstrate which computer teaching methods are

most able to transform teaching practices, there needs to be more information about which

teachers are using these methods and the reasons they have for implementing these practices in

their classrooms.

There is an opportunity cost of time to use a computer in the classroom. It takes time away from

other teaching methods or interventions, which can sometimes result in teachers avoiding using

technology and relying on more traditional task. (Falck et al., 2017). When a teacher plans his or

her lesson design, it is important that the teacher have evidence that the time is well-spent and

addresses the goals the teacher has for the students. If the computer can allow a student to

complete a task in less time, the teacher will have justification for using the technology. For

instance, research using the Internet is a more efficient use of time than traditional modes of

research, which are less efficient and have less breadth than using the Internet. (Falck et al.,

2017). The success of 1:1 implementation will not rely on the computers being in the

classrooms, but teachers' understanding of how to use technology, and their willingness to use it to meet the goals they have for their students.

Flipped classrooms are another example of a computer-based lesson design that teachers have used in lesson design in order to meet the needs of their students and can lead to gains in student achievement, deepen student learning and increase student enjoyment of a course. This approach "repurposes class time to focus on application and discussion; the acquisition of basic concepts and principles is done on the students' own time before class" (McLean, 2015). The studies reported here acknowledge there is much time investment by the teacher in preparing a flipped classroom design, but the benefits reported by the students are numerous. Students were willing and able to adapt their learning strategies, one reporting "I feel like it shows me that I need to be able to discuss and apply information to prove that I've really learned it" (McLean, 2015).

Students in both studies praised this model of instruction. In the Peterson study, a direct comparison was done between a traditional and a flipped course. In the end of course evaluation, the flipped classroom received the highest rating that this particular class had received in the existence of the course, with students reporting more interaction and better feedback from the instructor than in the traditional classroom setting (Peterson, 2016). In the McLean study, the students commented on "the interactive and collaborative nature of the course (both with classmates and with the instructor) as being particularly important in their enjoyment of the class" (McLean, 2015). Instead of using a computer to replace the teacher, it allows the teacher to disseminate information in a dynamic manner outside of class time which resulted in student gains in "independent learning skills, improvement in time management and deep learning strategies when completing OLM prework" (McLean, 2015). In class, the students had more

time to ask questions, work with classmates and engage in activities with the support of the teacher. These aspects of the flipped classroom were in the opinion of the teachers, worth "the investment of time and effort in the design of a flipped classroom" as the time spent met the goals the teachers set for her students (McLean, 2015).

Studies on the effects of computer assisted learning have shown that computers can help teachers meet the goals they set for students with different needs. While flipped classrooms, using computers for research and for communication had the greatest effect on students with a higher socioeconomic status, lower income students were helped more by using computers for additional practice and skill outside the classroom (Falck et al., 2017). In a study conducted in India, the net effect of computers was positive when students had computers outside of the school day. Instead of replacing traditional instruction for these students, it increased the amount of instructional time they had in order to learn and practice necessary skills (Lai et al., 2015). As teachers work to differentiate instructional goals for the individual needs of their students, using the computer can assist in this work. It will be interesting to find if Millennial teachers understanding of computing extends to this extent. Are they already using computers to individualize goals for their students, or do they need to be specifically taught this skill along with their digital immigrant peers?

The way in which computers are implemented in a school must reflect the needs of the community the school serves in order to gain the most benefit from the technology. Computer assisted learning can help students from disadvantaged backgrounds when used a supplemental learning tool. Schools that serve migrant children in Beijing were used to how effective

computers are at assisting students in developing countries "where schools are plagued with poor facilities and unqualified teachers" (Lai et al., 2015). Computer technology can help high needs students in communities with few resources by supplementing and enhancing, not replacing traditional teaching.

In ten or twenty years, the debate over whether computers will transform teaching could be as relevant as asking if the automobile will change transportation. If technology is entering the classroom via the experiences of Millennial and younger generation teachers, there is little debate if computers will change teaching, but how they will change it. To date, many researchers have seen few changes in the outcomes of students in classrooms that use technology, but it is becoming clear that there are certain methods of computer use that are helpful in helping teachers reach the goals they have set for their students. If Millennials have an innate understanding of how to use the technology to achieve these goals, computers can be of real help to teachers in the work they find important in the classroom. Through an examination of the teaching and technology practices of digital natives it can be understood if the valuation of technology that spills over from these natives' personal and social lives into their teaching practice.

3.5 To be or not to be: Why do teachers use or avoid computers?

One of the more common frameworks the research on computers utilizes to explain the acceptance or rejection of technology into teaching practice is called the will, skill, tool (WST) model. The three components of this model are defined as: 1. will, the teachers' attitude about how effective computers are in helping them achieve their classroom goals, 2. skill, the teachers'

ability to use the technology and 3. tools, the accessibility teachers have to the technology they need to use in their classrooms (Agyei & Voogt, 2011; Christensen, 2008; Ertmer, 2005a). Christensen and Knezek, in their 1999 study of teachers in Dallas Ft. Worth determined that 40% of technology integration is determined by teacher will, 79% is determined by will and skill combined and a full 87% of tech integration can be determined by all three together. The main conclusion of the WST model is that "a positive attitude on the part of the teacher toward the use of computer technology in the classroom, good skills in working with the technology and its fields of application, and finally, sufficient access to the devices" (Petko, 2012) informs an individual teacher's decision to integrate technology into his or her teaching practice. As Millennial teachers are expected by the literature to have more experience with technology, it will be interesting how their will and skill compare to teachers of other generations.

The integration of computer technology in schools would be described by Rogers as a diffusion, "a process by which alteration occurs in the structure and function of a social system" (Rogers, 1995). Introducing computers in education has met resistance from teachers who do not want to see a change in their professional role. Griffiths and Goddard state that "if technology constitutes an unwelcome rhetorical repositioning of a teacher in the teacher pupil relationship, then the conversation will be rejected by the teacher" (Griffiths & Goddard, 2015). Marzano and Waters have a framework for evaluating the difficulty of change into either first or second-order changes. First-order changes are described as "an extension of the past, consistent with prevailing values and norms and implemented with existing knowledge and skills" (T. Waters, Marzano, & McNulty, 2003). According to the WST framework, some teachers experience computers in the classroom as a first-order change. This group of teachers see integration of

technology as an instructional practice that can help meet the goals they set for their students. There is an acceptance of computers in the classroom by these teachers because they see computers as an improvement to education and the idea of integrating computers into their classroom is compatible with these teachers pre-existing values and needs (Rogers, 1995).

However, other teachers see the integration of computers in their classroom as a second-order change, one that is "a break with the past, conflicted with prevailing values and norms and requiring new skills and knowledge to implement" (T. M. Waters, Robert J.; McNulty, Brian, 2003). Some teachers do not accept technology as a benefit to education. While the computers will require teachers to attain new skills in order to use the technology, it is not obvious to this group how the computers will improve their ability to teach. Because computers in education "has first order implications for one person or group, yet has second order implications for another person or group, the latter group may view the change as a problem rather than a solution" (T. Waters et al., 2003). If the group that accepts technology as a first order-change is made of Millennials, while the resistant group is older generations, while creating a break now, this conflict within the profession itself will dissipate over time as teachers from older generations retire and Millennials become the dominant presence in the teaching profession.

Researchers from the WST framework argue that teachers' values and abilities about technology make the change easier for some than for others and has made the widespread integration of computers into teacher practices quite difficult. Due to the fact that many Millennials have used technology in their own education and are more accustomed to it in their personal and social

lives, this transformation of teaching is a first order change for them; whereas older generations of teachers are less likely to have used technology as students and do not have the same familiarity with technology, this change will be a more difficult, second order change.

In the WST model, Ertmer proposes a structure similar to first and second order change described by Marzano and Waters. She asserts there are first-order barriers to technology integration, those that are external to the teacher. These barriers are "described in terms of the types of resources: equipment, time training, support, that are either missing or inadequately provided to teachers" (Ertmer, 1999), as well as pressures from high stakes assessments and even the subject matter of the teacher(Ertmer et al., 2012). While the availability of computers has increased since 1999, (U.S. Department of Education, 2016) there are still many teachers unable to successfully integrate technology into their teaching practices. Since computers in education are now ubiquitous, Ertmer and her fellow WST researchers have largely dismissed external barriers as a reason for lack of integration of technology, even though many of these other external barriers i.e. absence of training, presence of high stakes assessments, remain commonplace in schools today.

Many WST researchers dismiss external barriers as a cause for lack of integration due to the fact that a shortage of support and resources from school systems does not significantly hamper all teachers' efforts to include technology in their classrooms. Some teachers have been able to integrate technology into their practice, although computers have not always been readily available in classrooms (U.S. Department of Education, 2016). An example of this argument is when Ertmer relates a story of one teacher who "continued to obtain new hardware and software

through shareware, hand-me-downs, grants and private donations"(Ertmer, 1999). As computers have become more abundant in public schools (U.S. Department of Education, 2016), there are many teachers who continue to avoid integrating technology, while some have always embraced technology, even when it was not provided to them by their schools or districts.

Will: Tech use is shaped by philosophy of or utility to the teacher
Because the first-order barriers mentioned above have not been a deterrent to all teachers, some researchers have concluded that it is the second-order, internal barriers that are more important to address to promote the integration of technology into teaching practices (Agyei & Voogt, 2011; Ertmer, 1999; Ertmer et al., 2012). The beliefs of teachers about the value of technology are represented by the "will," in the WST framework. These "second-order barriers… are typically rooted in teachers' core beliefs and are therefore the most significant and resistant to change. These beliefs revolve around issues relating to teacher–student roles, teaching methods, organizational and management styles and assessment type"(Donnelly et al., 2011). Many researchers suggest the best way to transform teaching through technology is through changing the "will" or philosophy of the teacher and suggest that school systems should primarily focus on convincing their teachers of the value of computing. If the generational literature on technology use is accurate, the values required to integrate technology into education already exist with Millennial teachers.

In order to understand the motivations of teachers who have successfully integrated technology into their teaching practice, in spite of first-order barriers, some researchers have focused on teachers who have been recognized by their peers and outside organizations as exemplary technology integrators. These teachers have strong beliefs in the power of technology.   It is

argued that these beliefs are what have allowed these educators to successfully integrate

technology into their teaching practices (Agyei & Voogt, 2011; Becker, 2000; Ertmer, 2005a;

Ertmer et al., 2012). To these advocates of educational technology, the "best way to bring more

teachers onboard is not by eliminating more first-order barriers, but by increasing knowledge and

skills, which in turn have the potential to change attitudes and beliefs"(Ertmer et al., 2012) of

teachers regarding their willingness to utilize technology in a transformative manner. If

Millennial teachers already have a positive attitude regarding the power of technology to

transform teaching school systems will need to leverage this enthusiasm in order to increase

technology integration.

There are two threads to describe the "will" component of the WST framework. The first is that

teachers integrate technology based on their constructivist teaching philosophy. Articles in this

literature argue that teachers with constructivist, student-centered, pedagogical beliefs use the

computers to create a classroom that aligns with their philosophy (Ertmer et al., 2012). In order

to successfully integrate technology in schools, "we need to examine teachers themselves and the

beliefs they hold about teaching, learning, and technology"(Ertmer, 2005a). This question is

much deeper than do teachers use technology or not, but that a real shift in the perception of the

role of teachers is necessary in order to use technology in transformative ways.

These researchers believe in the ability of technology to accomplish the task of changing

teachers' pedagogical philosophy Ertmer states that, "technology adds value to the curriculum

not by affecting quantitative changes, doing more of the same in less time, but by facilitating

qualitative ones, accomplishing more authentic and complex goals"(Ertmer, 1999). There is a

strong push by these researchers to integrate technology in order to enable "schools move to a student-centric classroom thru the adoption of computer based learning"(Christensen, 2008). In order to achieve this goal of constructivist practices through technology, "many of the professional development and teacher education programs were focused on changing teachers' pedagogies and technology uses to reflect a student-centered approach,"(Ottenbreit-Leftwich et al., 2010).

Rather than teaching how to use the technology as a means to an end, these researchers wish to transform the core beliefs of educators through the use of technology. The WST research calls upon school systems to support teacher skills regarding technology and create a culture that values the use of technology in education as a way to promote student-centered, constructivist teaching. If school systems can leverage the younger generation of teachers, who may have a different philosophy from older generations due to their personal experiences with technology, it could mean that the transformation of teacher philosophy is a natural process that will gradually spread through systems and become the new normal, accepted practice. Instead of threatening to replace the teacher, technology will be seen as a way to transform their role to one of learning guides as advocates of computers in education have expected.

In order to change the will of teachers to accept and use technology teachers must see technology as useful. These researchers veer away from the philosophy argument, and claim "it is clear that when teachers perceive technology to be useful, and that using technology would increase their productivity, their intention to use will be significantly increased," (Teo, 2011). Instead of trying to change teachers' fundamental beliefs, technology should be used to "target a specific purpose that aligns with teachers' values and beliefs"(Ottenbreit-Leftwich et al., 2010). A 2015 study

comparing the pilot phase of computer-assisted learning pilot project with the implementation phase led the researchers to the conclusion that teachers did not use the computers in their classrooms past the pilot phase because it "did not fit with how teachers did things in the classroom nor with institutional requirements, despite the enthusiasm of teachers and schools for the system" (Griffiths & Goddard, 2015).   In order to encourage teachers to utilize computers in classrooms, systems should "trust teachers to make good pedagogical decisions about how and why to use technology in order to enhance teaching and learning" (Ottenbreit-Leftwich et al., 2010). As more Millennial teachers enter the field, their expertise as digital natives could bridge this gap between the available technology and what is useful and usable for classroom teachers.

When researchers discover that "teachers have implemented computers in the most common sense way— to sustain their existing practices and pedagogies rather than displace them" (Christensen, 2008), there is an argument to be made that systems should develop ways to "influence teachers' acceptance of computer usefulness" in order to gain more integration of computers into teaching practices(Agyei & Voogt, 2011). The claim has been made that when schools fail "to obtain teachers' input on the use of technology in the classroom, professional development and training programs may not align with teachers' value beliefs, thus decreasing the likelihood that those uses will transfer to teacher practices"(Ottenbreit-Leftwich et al., 2010). As Millennials enter the teaching force in greater numbers, it may be important for schools to understand their unique view of technology in order to attain true integration of technology into the classroom.

These researchers want to prove the utility of technology to teachers. Because teachers have many strategies to choose from in their teaching, "when a new pedagogical approach or tool is presented, teachers make value judgments about whether that approach or tool is relevant to their goals. The more valuable they judge an approach or tool to be, the more likely they are to use it" (Ottenbreit-Leftwich et al., 2010). If they are able to use the technology to reinforce what they value in teaching, bolster their ability to teach their content, or increase their productivity, teachers are more likely to use technology in their teaching practices.(Ottenbreit-Leftwich et al., 2010; Teo, 2011)

Skill: Technology, Pedagogy, Content

Whether philosophy or utility drive a teacher's decision to integrate technology, he or she must have the capacity, or skill as defined in the WST model, to use the technology before he or she can employ it in the classroom. Seven years ago, Donnelly asserted the "skill level of most teachers is fairly low at ICT…They've no model. None of their teachers in their time ever had this so they've never seen any of them do it" (Donnelly et al., 2011). Today, an increasing number of teachers entering the profession have had experience with technology as students. It will be interesting to see if these student experiences will affect their instructional practice.

Many of the WST researchers categorize skill as a first order change, and claim that is easier to provide teachers with skill through professional development and less important to technology integration than teacher attitudes and beliefs.(Ertmer, 1999) However, some make the point that teaching itself is a complex process that draws on many different pedagogical and content knowledge and skills. Technology must be integrated into the framework of teacher knowledge

created by Shulman in 1986. The original model overlapped the two dimensions of pedagogy and content knowledge in order to give some understanding that teaching "includes knowing what teaching approaches fit the content, and likewise, knowing how elements of the content can be arranged for better teaching"(Mishra, 2006; Shulman, 2013). Mishra expands this framework to include technological knowledge. He has developed four types of technical knowledge that should be understood by teachers:

1. Technology Knowledge: The ability to use technology, from books to software.

2. Technological Content Knowledge: An understanding of how the content taught can be transformed with the available technology.

3. Technological Pedagogical Knowledge: Knowledge of the tools that are available to complete a variety of tasks from maintaining student records to using social media in instruction.

4. Technological Pedagogical Content Knowledge: An understanding of what tools to use, when to use them and for what purposes. The teacher can use these tools to personalize and deepen instruction for their students (Mishra, 2006)

Teachers cannot be handed a laptop and told to integrate the computer into their practices. Effective use of technology in the classroom requires that teachers know how to enrich the content and the method of teaching by applying the right technology in the right context at the right time (Mishra, 2006). Although the technical knowledge must be integrated with content and pedagogical knowledge, it can be argued that the newer generation of teachers will have an

advantage regarding technical knowledge which will enable them to integrate technology more easily than teachers of older generations.

Tool: More than just a laptop
The final component of the WST model, tool, is also categorized by Ertmer as a first order barrier to change in technology integration (Ertmer, 2005b). Again, many WST researchers believe that first order, external barriers are seen as easier to overcome for teachers than the internal, second order barrier of will. However, in a discussion of teachers access to technology, there is more in question than just if teachers have a computer or not. Necessary to full implementation includes "time, training, and support" that are not always sufficiently available to teachers (Ertmer, 1999). Although it is clear from the data that more computers are available as tools to the teachers, if those tools are not adequately supported by the school or district, teachers will have a difficult time overcoming the "tool" component and fully integrate technology into the classroom. It will be interesting to discover the perspective that Millennial teachers have on district supported technology and training.

When discussing the effect accessibility to tools has on teachers' willingness to integrate technology, it is not just the availability but the reliability that can affect a teachers' likelihood to integrate computers into their classrooms. In the early 2000's some teachers reported that "technology itself is unreliable…many teachers prepare a back-up lesson just in case"(Cuban et al., 2001). In a more recent study, teachers report that while they want to use technology, many applications they want for their students have not been installed, the technology does not work at the time it is needed and finding technical support in the moment of need can be difficult. While external barriers are not as great for the implementation of computer technology in the classroom

as they once were, they are still an impediment for teachers who have the will and skill to use technology (Liu, Lin, Zhang, & Sheng, 2017). When teachers discover the tool to be unreliable, the effect on teachers' value for it is diminished. While tool is counted as a first order change, the reliability and "accessibility of tech tends to affect attitudes and competencies and has a positive relationship with the level of tech use" (Agyei & Voogt, 2011).

3.6 "Grammar of Schooling"

School reform literature also offers some explanation as to why teachers can be resistant to the adoption of computer technology. One finding indicates that the ritual of school, especially the relationship between student and teachers, is disrupted by the introduction of computer technology in the classroom (Griffiths & Goddard, 2015). If the technology interferes in teacher's ability to conduct the business of the classroom, which has traditionally included "maintaining order and seeing that students learn the standard curriculum," the teacher may well be disinclined to implement computing in the classroom (Tyak & Cuban, 1995).   The technology does serve a goal, but it may run counter to the goals of the both the teacher and of the structure of school itself (Griffiths & Goddard, 2015).

This structure is referred to as the "Grammar of Schooling" by Tyak and Cuban in their 1995 book *Tinkering Toward Utopia*. Some examples of this grammar include age-based elementary schools, subject specific classrooms in secondary schools and the awarding of credits for classes in order to pass and eventually graduate from high school. This structure of schooling has been formed by history and shaped by reformers' interactions with education professionals, students

and families. The idea of what school is and what it should be has become engrained in the culture itself. Teachers, students, and the parents of students have accepted what their roles in the process of education are and what they should continue to be. When educational reform calls for "departure from customary school practice" resistance to this reform may develop from one or all groups involved. In many cases, this resistance can cause the proposed change to fail but in some, the reform is adapted and adopted by the educational professionals to fit their needs in how they view their job as a teacher to "enable teachers to discharge their duties in a predictable fashion and to cope with the tasks that school boards, principals and parents expect them to perform" (Tyak & Cuban, 1995).

Technology has long been promoted as the best way to improve teaching and revolutionize the classroom environment for teachers and learners. Some of this technology has become a part of the grammar of schooling as described above. For example, in 1841 a technological system was touted by Josiah F. Bumstead as "among the best contributors to learning and science, if not among the greatest benefactors of mankind." The publication was *The Blackboard in the Primary Schools*, and the technology described in this manner was the blackboard. While generations of teachers have successfully used the blackboard to improve communication in their classroom practice, its promise to transform education was overblown. The blackboard earns a place in the grammar of schooling along with paper, pens, and textbooks because teachers have been able to adapt these technologies to "fit familiar routines and classroom procedures" (Tyak & Cuban, 1995). Cuban argues that computers fall into this category, a useful tool to enhance the teacher's ability to fulfill his or her traditional role in the classroom. The way in which

Millennials see technology could change overthrow this view if they do see technology as a familiar classroom practice.

3.7 <u>Weaknesses</u>

There is a poor way of reporting technology integration and use in the classroom. In many studies, teachers self-report their computer competencies and what integration means for themselves and their students. While the advocates for 1:1 computer access for students claim that the availability of computers in the classroom will revolutionize and transform teaching, many teachers have not been using technology in transformative ways. One study exploring the use of computer technology by literacy teachers who, according to the self-report, put value in computer skills found that these same teachers perceive integration of technology to be more about "using technology for its own sake as opposed to adopting new instructional goals involving new activities"(Hutchison, 2011). In their own practice, the teachers report mostly using computers as word processors and presentation tools rather than the a means to introduce real-world scenarios or to enhance communication and collaboration within the classroom (Hutchison, 2011).

There is some reporting on teachers' usage of the internet to communicate with peers and parents, their ability to use basic applications, work with LMS and use the Internet, but these capacities do not clearly indicate the teacher is using the computer to redefine the task. Without a defined understanding of a model, the definition of tech integration is weak and is difficult to measure.

3.8 <u>Mind the Gap</u>

The gap this study attempts to address is how teachers who belong in the Millennial generation use computers in their teaching and if it is different than digital immigrant groups. While research has been done that suggests younger teachers are more comfortable with technology, there has been little done that shows how they actually change their teaching strategies with the use of computers. For example, younger teachers may be more apt to use PowerPoint to replace or enhance a traditional lecture but not significantly transform the lesson itself. The goal here is to determine if teachers are using technology in the classroom and evaluate if these differences are based on generation, adding to the literature on the generational effect of teaching with technology.

There are not many studies which directly connect the generational divide with technology integration of teachers. As members of the older generations retire, and more teachers from Millennials, and Gen Z in another 5 years, enter the teaching force, it will add to the research a current snapshot of how teachers who have the same resources and administrative supports differ in their classroom usage of technology. Studies in the future could compare with this one in order to study the effect of tech integration or instruction as the faculty of a school district becomes more Millennial and less Boomer.

Chapter 4 Methodology

Empirical context

The goal of this study is to discover if there are differences in the way teachers of different

generations integrate technology into their teaching practice. This study takes place in a large

Midwestern suburban school district. This district has approximately 27,000 students enrolled in

a combination of 5 traditional high schools, one alternative high school, 5 middle schools, 33

elementary schools, an early education center and a therapeutic day school. In school year 2017,

36.1% of the student population is a member of a minority group, with 8.8% of students

identifying as African-American, 18.7% as Hispanic and 8.6% in an unspecified category.

Students identified as economically disadvantaged make up 35.87% of the student population.

[Building Report Card]

The digital learning initiative in this district began in early 2014 with the school board's approval

of a one to one initiative, in which every student receives his or her own personal computer. In

the Spring of 2014, all teachers received a MacBook Air and iPad. In the fall of 2014, all

students in grades 9-12 were provided with their own MacBook, students in grades 7-8 received

an iPad to use in school and to take home. While every secondary student received a device in

the initial year, there was a two-step process for elementary students.   Students from ten of the

district's K-6 schools in phase one received one to one iPads, while students in the other 23

elementary schools had iPads available on carts in their classrooms. In the fall of 2015, all

students from grads 3-6 received their own iPad, while K-2 students continue to have access to

their own iPad in the classroom. Another change in the program in the 2015 school year was

that all students in 7th and 8th grades received a MacBook instead of an iPad.

The stated intent of the district for this 1:1 implementation is to change the learning experience for its students. The goal stated on the district website is for the technology to "personalize learning for students, increase collaboration and allow for project-based learning." If the district's goals for the students change, it follows that teachers' goals for students must also change. The tool provided by the district to enable this change is technology. Each student in the district received his or her own device in order to enable students to engage in a more personalized learning experience. The implication in this district policy is that teachers must transform their traditional practices and the goals they had previously for their students in order to match with the district's new idea of student learning.

During the summer of 2014, all teachers and administrators in the district were provided many opportunities for professional learning. Ensuring that teachers have the skills necessary to use the technology was a major part of the district's initial plan to integrate technology into the classroom. In addition to training from Apple for all teachers, all library media specialists were trained to be the building technology leader. In order to ensure teachers had timely individualized support, in the first year of implementation a group of teachers at each building was recruited to receive additional training and serve as mentors and guides for other teachers.

The money, time and effort to enhance teachers' skill regarding technology reflects the recommendations in the Will Skill Tool literature that emphasizes providing the computer is not enough to successfully integrate technology. A well-planned initiative should provide for costs and time associated with developing technological infrastructure to support the tool as well as cultivating the skill of teachers to successfully integrate technology in the classroom (Ertmer, 1999; Ottenbreit-Leftwich et al., 2010). The district recognized the need for infrastructure and

other technical upgrades in order to provide technology that is workable in order for the initiative to be successful. Importantly, training for teachers was also a priority, as almost $900,000 from the Apple proposal was specifically professional development for teachers. The initial costs approved by the school board are noted in the following table.

Table 1: Approved Cost for 1:1 Initiative

Vendor and/or Products	Total Cost
Apple Inc.: Hardware, Peripherals, Professional Development	$18,780,776
BlueCoat: Security Software and Hardware	$289,956
	$479,022
Network Infrastructure	$96,033
Software Subscription, Training and Implementation of JAMF	$75,630
Upgrade Direct Internet Access Service	$25,000/month
Network Switches and Internet Router	$400,000
Total First Year Approved Cost	**$20,421,417**

Although money was dedicated to professional development regarding the use of the device itself, the district did not follow with research-proven practices that ensure success of a school reform. While teachers were paid to attend training on how to use the devices themselves, there was no training provided that gave concrete examples to content areas as to how to use the devices to support their curriculum. Although the district spent many resources of time and money, the teachers, whose "job is to make work in the classroom" were not consulted about the implementation itself (Tyak & Cuban, 1995). For these reasons, the rollout of this district reform did not follow the path of successful reforms in the past, leaving it open to failing to create the changes in teaching it was meant to create.

As this study seeks to determine the difference in technology use between the generations of teachers, the context of this district must be addressed. The interview protocol includes questions that address the way in which the district implemented the reform as well as how it has and is supporting the teachers. Most of these questions will fall into the "tool" category of the WST model. Ertmer and other researchers contend that tool, as a first order change, is easier to overcome as a barrier to technology integration in teaching (Ertmer, 2005a). This study seeks to understand if all teachers see the district implementation and support as a barrier to integration or if Digital Natives' understanding of tech allows them to overcome these problems easily, or perhaps they do not perceive a problem with the "tool" as they use technology in the classroom.

<u>Plan</u>

There is an assumption in this study that teachers will be using technology in different ways and to different degrees in the classroom. The research question seeks to explain this differentiation in terms of generational differences between teachers.

Independent Variable	Mechanism	Dependent Variable
Generation	Because Millennial teachers have more experience with technology in their personal lives, and in their educational history, they will be more likely to integrate technology in their own teaching.	Technology Integration

Many researchers purport that younger generations value and incorporate technology into their lives differently than older ones(Prensky, 2001) [Tapscott]. This study attempts to find data to apply this supposition to how Millennial teachers use technology in the classroom compared to older generations. Because this school district has been equal in the distribution of tools and training between all schools and levels in its implementation of technology, all teachers have similar access to the district tools and training that would enable them to similarly integrate technology into their teaching practices(Agyei & Voogt, 2011; Ertmer, 1999) The differences in the ways teachers have chosen to use the technology will most likely be based on the "W" of the WST mode. The personal and professional differences in belief of how valuable technology is to their teaching will be a significant factor in how individuals have adopted technology as a part of their teaching (Ertmer et al., 2012; Ottenbreit-Leftwich et al., 2010; Pegler et al., 2010).

<u>Procedure</u>

In order to fully understand the extent of technology integration, a qualitative study was conducted, enabling "the researcher to look for the complexity of views rather than narrowing meanings into a few categories or ideas" (Creswell, 2003). By using direct information from the subjects, the researcher was able to "rely as much as possible on the participants' views of the situation being studied"(Creswell, 2003). By putting the teachers at the center of the study and allowing their actions, attitudes and perceptions to be the data, the researcher garnered direct and unfiltered information regarding how teachers are using technology, why they choose to use it and how it may relate to their experiences outside of the classroom. The research is in the form of a case study in order to gain in-depth knowledge of the teachers' use of technology in the time since 1:1 laptops have been adopted by the school district in this study (Creswell, 2003).

The goal of the interviews was to determine the scope of teachers' valuation and use of technology in their teaching and determine if there is a correlation between generation and technology use in the classroom. In order to gather this information, the interview protocol included questions about the teachers' experiences with technology in their own schooling, their exposure during teacher training as well as in their personal lives. This information could help illuminate the idea that Millennials have more of the "will" and "skill" to use technology, and fewer problems with the "tool" provided by the district. A qualitative method is useful in this study due to the individual perspectives and history regarding teachers' personal and professional experience with technology.

One of the key issues in this study is the definition of technology integration. It is probable that many teachers have a different idea of what this concept looks like in practice. Advocates for technology in education have long argued that the use of computers in education should not just

replace textbook, paper and pens. Computers should transform classrooms from teacher to student-centered, from students working in isolation to collaboration and from a standardized to a personalized curriculum (Ertmer, 1999) (Christensen, 2008).   Teachers who are using research-proven practices that meet the goals they have for their students will have successfully integrated computers into their classroom for the purposes of this study. Although Cuban refutes the idea that technology is a necessary component of a student-centered classroom, he would agree that in order for computer technology to truly be integrated, the students should be using it in a constructivist, rather than a traditional manner (Cuban et al., 2001). In order to get at this specific meaning of integration, it was necessary to create questions that not only ask if computers are in use, but how they are used in the classroom.

3.   Select interviewees: Thirty teachers were interviewed in order to gain insight into why teachers choose or refuse to use educational technology in their classrooms. Although there are many factors that have been postulated regarding the use of technology, this study focuses on generational uses of technology. Therefore, the subjects were selected based on their generation alone. Ten of the subjects are Millennials, ten are from Generation X and ten are from the Baby Boomer generation.

Table 2: Generations Defined

Generation	Age at time of Study
Millennial	23 to 37 years old
Generation X	40 to 54
Baby Boomer	59 to 64

For the teachers who use technology the most, the interview consisted of questions regarding what types of technology are used and how they are used in their classrooms. There is such a wide range of possibilities in educational technology, it was helpful to investigate individual teacher practices and experiences to better understand how the most prolific teachers use technology. It was interesting to discover if their practices align with uses that have been shown to increase student outcomes, create a more student-focused classroom, reinforce traditional classroom practices, or a mixture of these.

For teachers who use technology the least, the questions attempted to understand what their reasoning is to avoid educational technology. It was interesting to investigate the reasons and compare these personal narratives with the research in the WST model. The data from these interviews may be useful to schools and districts who are searching for methods to train the most hesitant teachers on how to incorporate technology into their teaching.

Conduct Interviews: The data gathered from interviews is used to provide rich data from teachers on the young, middle and older end of the spectrum. The data provided information on the experiences teachers have had in the past and how it can affect their current values and practices regarding technology.

The interviews were conducted in person at the teachers' home school when possible. If a teacher is unable to meet in person, an online conference call via Facetime was used. Either in person or via conference call, the interviews were, on average, one hour in length. Each interview was recorded, coded and partially transcribed in order to understand how each teacher's own generational experience with technology has influenced his or her use of technology.

4. Transcribe Data

The data was either fully or partially transcribed.

5. Code data

The transcription was coded according to generational category as well as will, skill, tool.

6. Analyze

The data will be analyzed in order to determine commonalities between generation and the different components of teacher to determine if, in the context of this school district, there is a difference in the implementation of technology between generations of teachers.

7. Measures/Protocols/Observations

The interview questions are designed around the WST framework. The main purpose of the question design is to understand each teacher's will and skill regarding technology and its

application to their teaching. Additionally, there are questions that will assess the district-provided tools from the perspective of the teacher.   This protocol is semi-structured in that the researcher may let the subject expand on his or her thoughts and allow for sub-questions to be created in order to attain detailed and valuable data in this process.

Table 3: Interview Protocol

Demographic Questions: Age, Sex, Level of Education, Years of Experience, Subjects and Grades Taught
Will: philosophy, utility of the teacher
1.   When did you first use a computer in a school setting? Was it as a teacher or a student?
2.   When did you first use a computer at home? How old were you?
3.   When did you first have a mobile device?
4.   What types of technology do you use to communicate with your friends and family?
5.   Does technology help students be more creative?
6.   Does technology help students learn, read, write, problem solve?
7.   Is technology ever a hinderance to your lesson design?
8.   What is the primary use for technology in your classroom?
9.   How does technology help or improve your teaching?
10. In what other ways do you use technology in the classroom? Is it mainly the teacher using or the students?
Teacher: Efficiency, lesson planning, communication, writing, data analysis
Student: games, practice, assessments research, writing, presentation, communication
11. How has technology changed your teaching?
12. Do you explore applications and technology on your own for use in the classroom?
13. How likely are you to share technology you found with other teachers?
Skill: tech knowledge, tech content knowledge, tech pedagogical knowledge, tech pedagogical content knowledge
14. What technology are you most comfortable with in the classroom?
15. Do you ever help other teachers understand how to use tech?
16. When you learn a new technology in training, how likely are you or how often have you implemented it in your classroom?
17. What are the websites or applications that best fit your content area?

18. How is technology helpful for your specific subject area?
Tool: Time, Training and Support
19. Can you speak to the quality of the technology the school has supplied with you?
20. What are the biggest shortfalls of the technology?
21. What are the best features of the tech?
22. How helpful is tech support?
23. How does the reliability of technology affect your lesson design surrounding tech?
24. What professional training have you had with using technology to supplement your lesson design?
25. How useful to your teaching is the technology provided by the school? What is the most/ least useful?

The stated goals of the district are to boost student motivation, enhance the materials and resources for teachers and students, promoting differentiation of learning, support project-based learning and increase collaboration between students. These goals align with the rationale of advocates for computers in education (Agyei & Voogt, 2011; Donnelly et al., 2011; Ertmer et al., 2012; Pegler et al., 2010; Tatnall, 2015). Thus, the results of this part of the survey will be used to see how well the teachers in the district are achieving the stated goals not only of the district, but of advocates for technology integration in the classroom through this 1:1 initiative.

Analytical Plans

In order to answer the question posed in this study, the interview data was coded, sorted and analyzed in order to compare the ages of the respondents with the measures of how they value and integrate technology. The data gathered from interviews was used to provide rich data from the Millennial group, the Generation X group and the Baby Boomer group of teachers. The data provides information on the teachers' experiences regarding technology in the past, as well as

their current practice. This information is used to report the current state of technology use by teachers in this district and how it is informed by their past experience and affected by their current values and practices regarding technology.

Summary
The school district in this study provided an interesting population for this study, as it was four years into a program of 1:1 technology integration when the interviews were conducted. The district itself is the initiator of this program and has provided both financial and administrative support. The interviewees were chosen based on their generation, and the data is sufficient to to draw some conclusions about how and why teacher the integration of technology varies from teacher to teacher based on their generation.

Chapter 5 Analysis of the Data

<u>Research Questions</u>
The focus of the research in this study seeks to determine if the generation of the teacher

determine the way computers are utilized in the classroom. The secondary questions that

emerged from the main question are

- What do these differences look like between generations?

- Are Millennials able to transform education through their understanding of

  technology?

- Do Millennials have an innate understanding of what are the efficient and

  productive uses of computing in education?

<u>Research Methodology and Study Sample</u>
The research was conducted in a large suburban school district where one to one computing for

students and teachers had been in place for five years at the time of the study. This district was

selected due to the longevity of the program and the way in which the policy was applied. All

schools became one to one at the same time. There was no pilot or roll-out of the policy, thus all

teachers have had the same amount of time and experienced the same training across the district,

regardless of individual school, grade level or subject matter taught. This "fresh-start" of using

technology in classrooms presents as a baseline. All teachers in the study have the same

professional experience with one-to-one computing, so the difference will likely not be attributed

to varied experience with computers and instruction in a professional setting.

The same semi-structured interview protocol was used with all interviewees. All the interviews

were recorded and partially transcribed. Detailed notes were also conducted during the

interviews. The transcriptions and notes were used to analyze the data and determine what differences exist between the three generations of teachers represented in the study.

The interview protocol is organized by the Will, Skill, Tool (WST) framework. This sample is made of 30 teachers who span three generations of teachers with experience ranging from one year to 42 years, aged 23 to 64 years with college graduation years between 1977 to 2017. Ten of the subjects are Millennials, between the ages of 23 and 37; ten of the subjects are members of Generation X, between the ages of 40 and 54; ten of the subjects are Baby Boomers, between the ages of 59 and 64. In the sample there are two elementary teachers who respectively teach kindergarten and fourth grade. There are two middle school teachers, one of whom teaches math, the other teaches a combination of creative writing, drama and journalism.

The rest of the sample is comprised of high school teachers from a variety of subject areas. Out of twenty-six high school teachers, fourteen teach the core subjects of math, social studies, ELA (English Language Arts), and math. Ten of the twenty-six teach elective courses, including band, world languages, journalism, FACS (Family and Consumer Sciences), woods, and CTE (Career and Technical Education). Two of the high school teachers are in the special education department, where their roles vary from co-teaching core classes to instructing intellectually disabled students in a sheltered classroom.

Analysis of the Data
As I began to organize the data from the study, I formed categories in a spreadsheet based on the

WST framework and organized by generation. In doing this, I was able to detect if there were

any major differences that emerged from the data that could be aligned with the generation of the

teacher. It became clear that the most obvious difference between the generations of teachers is

the experience the generations have in both their personal and academic histories with using

computer technology. Out of this observation, I created the sub-categories of personal will vs.

professional will regarding technology in the classroom.

Description of the Data

Personal Will
All teachers in this study found ways of integrating technology into their classrooms, and all had

something good to say about using technology in the classroom. There are also problems

teachers have with using technology in their classrooms. There were qualitative distinctions in

the conversations along generational lines, regarding teacher will to use technology.

Table 4: Summary of Findings-- Will Questions

Millennials
• accept and appreciate technology as necessary for their work
• used technology as students and have an expectation to use it in their teaching jobs
• main use of technology is to manage and organize their own work as teachers
• see technology as a way to enhance and expand knowledge for their students and to give students access to real-world examples and applications
• believe technology has shifted the role of the teacher, but human connection and the teacher remains vital to learning
• criticize the unreliability of technology and its potential to distract students from learning
Generation X
• sees technology as a tool to help achieve student and teacher goals
• uses technology to provide examples and to replace the library
• believe the role of the teacher has shifted, but remains important in education
• criticizes technology for taking away individual thought from students and for being a significant distraction to learning
Baby Boomers
• believe technology is a tool to make learning more fun for students

- can replace technology with paper and pencil, is not necessary for students
- have less confidence with technology than the other two groups
- worry administrators will try to replace teachers with technology
- allow students to explore with technology
- are critical of technology as a tool for students to cheat and distract themselves from learning

First Use of Technology in Educational Setting
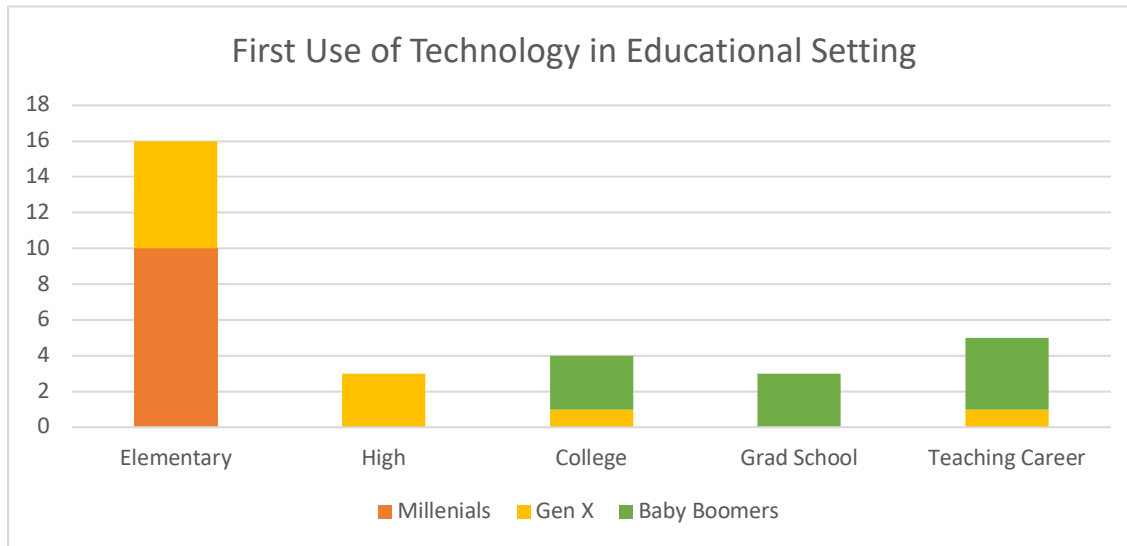
For Millennials, all interviewees had used computers in school in early elementary grades and all of them had home computers and mobile phones by high school. Nine out of ten subjects are currently connected on social media. Because they have all used computers as a student, they have had personal opinions on the value of computers to students. Eight out of ten have an overall favorable impression of using computers as a student. The subjects mentioned most often typing, writing and organization as the main benefit they found in using computer technology as a student. Two mentioned notetaking and one other research. Three of the eight who valued the computer as a student also mentioned distractions and social media pressure as downsides to using computers as students.

Like the Millennials, 9 out of 10 subjects from Generation X all used computers as students. The difference is that only one of them used computers in elementary school, while 5 used computers

in high school and 2 of them did not use computers until college. The variation in data for

Generation X reflects the availability of computers being quite sporadic during the time most

were in school, with the youngest of this group graduating from university in 2001 and the oldest

in 1985. Another difference is how the teachers in this group used computers as students. These

teachers only spoke of computer programming and word processing being available to them as

students. They did not have experience with using them to take notes or do research. There was

also no mention of being distracted or social media pressure, as those concerns did not exist for

this group while they were high school students.

For Baby Boomers, there is quite a shift in the first use of computers in an educational setting.

None of this generation used technology with the grades they currently teach, only three used

computers in college, two in graduate school and four used computer technology for the first

time as a teacher themselves. These differences in the first time use of technology are a drastic

difference between the generations, as illustrated in the chart below. It sets up a major difference

in the experience with technology, especially between the Millennials and Baby Boomers.

Generation X has a varied experience with educational technology. It will be interesting to see if

the differences in experience correlate with attitudes and use of computers by teachers across the

generations.

Professional Will

A teacher's professional will to use technology is based on how teachers believe the use of

computers will promote the goals they have for their students. In order to understand if teachers

are using technology to further their goals, I first had to ascertain what are the specific goals the teachers I interviewed have for their students. The responses I received led me to develop four categories of teacher-specific goals: content specific, academic, career readiness and life skills.

Content specific goals are observed when a teacher specifically mentions growth in their content area. For example, a band teacher I interviewed commented that he wants his students to "learn to love music, play and create music on their own." A world language teacher expressed his goal for "students acquire enough enjoyment of language that they continue to study outside of the classroom… They want to travel and study abroad." These goals relate specifically to the content in the classroom and were most common in the elective classes such as these examples from band and Spanish.

Academic goals reference skills that are important across curricula but are focused on students having academic success. A high school English teacher shared the goal, "I want my students to think critically and to know the purpose of study." One of the CTE teachers described her goal as the students should "be their own learner… they should be in the process as much as I am." The ELL teacher I interviewed shared her goal that the students can "express themselves, speak and write correctly." While these goals are academic in nature, they do not emphasize a specific content, but overall skills that will make their students better learners in general.

The third broad category of teacher goals is career-readiness. These are goals that focus on the need to acquire specific skills, not for the sake of the curriculum as content goals do, but to apply these skills toward a future career. For instance, the journalism teacher is focused on the

production of news stories and stated her goal as "my students need to be able to function, write and report digitally… how to turn in a story w/out going to the newsroom." The woodshop and digital design teacher explained his goals align with "very specific skills needed in CAD (Computer Aided Design) and woodshop. Students need to set and follow plans, be detail-oriented… skills that are transferrable to jobs in the industry." I have also included goals in this category that, based on the context of the interview, the teacher was expressing the need for this skill beyond the academic arena of high school or college. For instance, an 11th grade ELA teacher shared that he wants his students to "be better critical thinkers and communicators… articulate complex thoughts… question assumptions." The context of this conversation applies to life beyond high school and college, into their careers and professions, thus was included in the career-readiness category.

The last category of teacher goals is life skills. These are skills that are necessary for having a successful life, now and in the future. There is a wide range of goals in this category, depending on the students, subjects and levels taught, but they are focused on students having an overall successful, productive life. These goals imply the students will be able to provide for themselves, have good relationships and contribute positively to society. The self-contained special education teacher shared she wants her students to be as "independent as possible: cook a meal, go to the store, (take care of) hygiene, grooming…live independently as possible." A middle school math teacher stated her goal that students "be successful… with good character, good people… see diversity as a blessing." The fourth-grade teacher I interviewed shared his goals that his students "have a safe place to learn… they will learn skills to make a good citizen." A high school math teacher stated her goal is students have a "work ethic… (understand their)

treatment of others and conduct themselves well." These are all goals that supersede academic life and are focused on the overall quality of their students' lives now and in the future.

Computers Aid in Achieving Teacher Goals
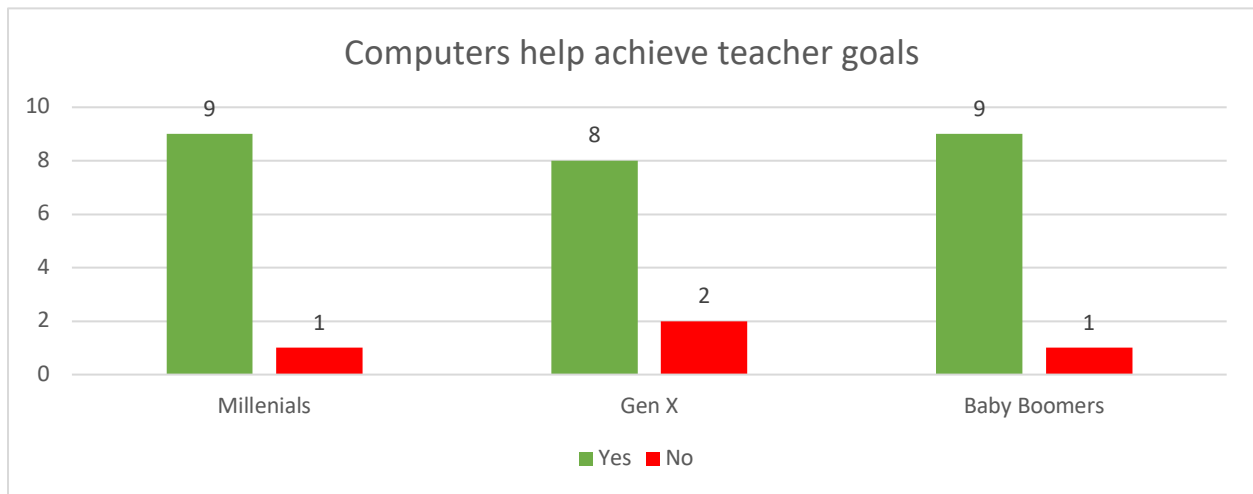
Across generations and types of goals, teachers expressed how computer technology helps their students achieve the goals they have for their students. What is interesting is that while almost equal numbers of teachers across generations said that technology does help in achieving goals, the comments from each generation varied. Millennial comments were extremely enthusiastic about the way tech helps their individual goals; however, the Gen X and Baby Boomer teachers were more reserved in their approval of computers in their classrooms. Their comments were either focused on the computer as a tool or had mixed reviews of computers as a part of their classroom.

The following comments were typical of Millennial teachers when asked how technology helps students attain the personal goals teachers have for students in the classroom. One Millennial teacher shared the computers make it "easy to see outside your own personal scope…the entire

world's knowledge is available… not restricted to what the people around you know." Another

Millennial teacher shared, "students can check their grades, have autonomy and practice skills."

Still another shared "they can better research and vet sources online… figure out what is

credible… basement blog vs. museum." One more comment from a Millennial teacher says it

"makes life easier. Skills that would take a whole week now are gained more quickly…

Communication is improved."

Positive comments from older teachers, from both Generation X and Baby Boomers, regarding

computer technology were a bit different from my conversations with the Millennial teachers.

While most teachers agreed that technology was useful, their comments were more reserved. For

example, one teacher noted that "computers are a tool, not a driving force of the classroom," and

that "computers are one source to help achieve goals." The belief that technology is a resource,

or a tool, was echoed by 12 of the twenty teachers in the older generation.   The other positive

comments were also more limited in nature, for example, computers "make learning more fun for

students." The most negative comment from a teacher who believes computers aid in achieving

their goals is that computers are a "necessary evil… and they have become an expectation."

These comments are helpful in understanding the difference between generations, as the total

number of teachers who said yes when asked if computers help aid in their goals, is almost the

same across generation, 9 out of 10 for Millennials, 8 of 10 Generation X and 9 of 10 from the

Baby Boomer generation. The quotes from the teachers speak to a gap in the professional will

between generations. While 26 of the 30 teachers in the study agree that technology helps them

attain their individual classroom goals, the actual meaning of how that happens and what the

mental picture of exactly how computers are helping is quite different generationally. The Millennials see technology as a way to create personal goal setting, responsibility and individualized knowledge for their students, but the other two generations see technology as another tool to assist their students in achieving the goals they have for their students.

Removing Computers Harms Instruction
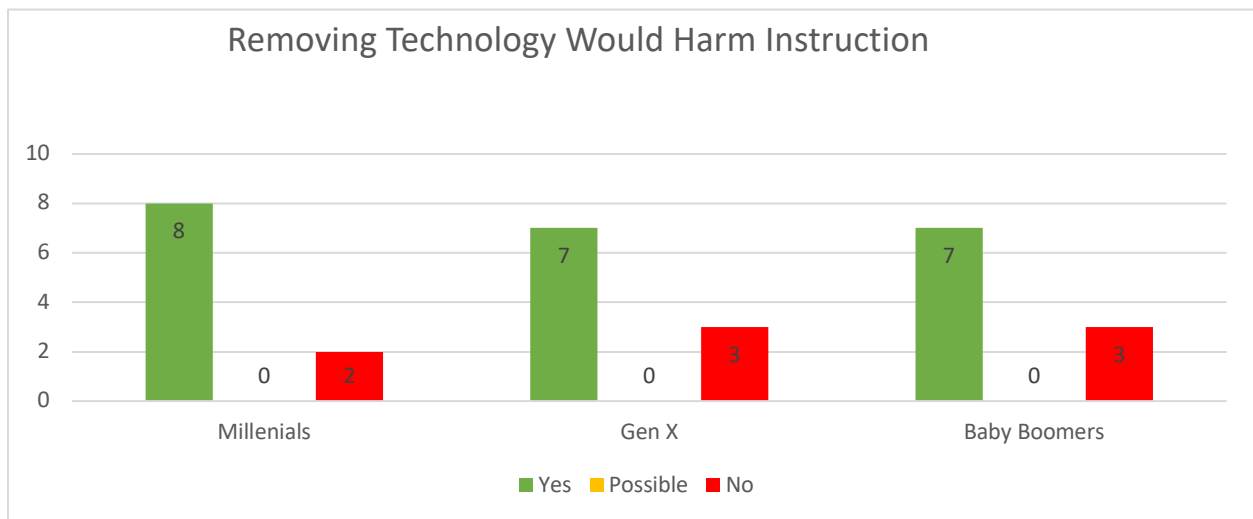
The next set of questions dealt with how teachers would react to computers being removed from the classroom. Across all generations of teachers interviewed, the majority stated that removing technology will harm instruction. The overall numbers for this question are very similar to the previous question, "do computers help you achieve your classroom goals?". The vast majority of teachers and a similar number across generations agree that removing the computers from the classroom will harm their ability to teach. This time, however, there is no common thread of extreme positivity or reluctant acceptance in any of the generations. Instead, the difference seems to be related to the subject matter and/or grade level of the teacher's class.

Some of the comments from teachers across the generations highlight this difference. For

example, one Millennial teacher reported, "I couldn't do my job, I couldn't organize all the

placements" her students have in her community service class. A Generation X teacher reported,

"I couldn't teach… have to go back to T-squares and triangles… all hand-drawing until the mid

2000s." in his CAD classroom. In a similar vein, a Baby Boomer teacher commented if

computers were taken away, her class "would cease to exist as it is now" in her journalism class.

She continued, "we would slow down, design would be far less detailed… I can't imagine going

back to film (cameras)." This commentary on computers in classrooms across generations of

teachers is interesting because it gives evidence that the individual goals of a teacher in his or her

classroom is an important criterion in whether or not a teacher will use computers. It also points

to a difference between teachers of more traditional, academic classes and those who teach

career-related subjects.

In looking at the academic teachers across the generations, the Millennial generation definitely

wants to keep computers in the classroom. The youngest teacher I interviewed, is a math teacher

who said, "I do not think I could survive being a teacher 15 years ago." While this was the

strongest statement from an academic teacher in the study, many other Millennials expressed

how the computers help them find resources, be more efficient graders and communicators,

engage their students and simply make their job less difficult. One teacher spoke of a scenario in

her experience. As a discipline issue, some students have their laptops taken away. This teacher

said "a kid who gets his laptop taken away cannot do the work. The lesson cannot be replaced

by a paper copy or one book." This comment indicates there is a shift in 1:1 the classroom that

is qualitatively different to Millennials than a more traditional, paper and pencil-based classroom.

The academic teachers of Generation X are more lukewarm in their reactions to having computers taken away. The strongest comment from this group of teachers about having computers removed from the classroom was that to take away computers would require her to "restructure…it would take away resources and communication." Similarly, another teacher commented "it would be more difficult to research and do lesson planning." There were two Generation X teachers who simply said "no" to the question: Would removing computers affect instruction? A third said "no, I would increase the use of paper." There were no strong comments in this group that indicated technology was more than a useful tool to them in their teaching. While there were seven who said it would affect their instruction, none of this group would have to radically transform their classrooms if their computers were removed.

The Baby Boomer group of academic teachers had a more varied response to this question. Three teachers said their instruction would not be affected, "I would adapt… more pen and paper and go to the library," and "I'm not 100% dependent on the computer… can use the book and discuss," were a sample of the responses these teachers gave. There was a middle ground whose voice is represented best by the comments "teaching is totally different…would have to re-think before going back" and "now… hard to take away" regarding computers in the classroom. The last group of these Baby Boomers is represented by the comments, "it would be a detriment (to take the computers away) … for all the negatives, the positives outweigh" and "it would slow things down. While I could still do my job… don't recommend we go back. Things are better

now." The wide variety of these comments allude to the fact that there is a great variety of personal acceptance of technology as tool for instruction, regardless of the generation of the teacher.

Technology Enables Authentic Learning

Technology Enables Authentic Learning
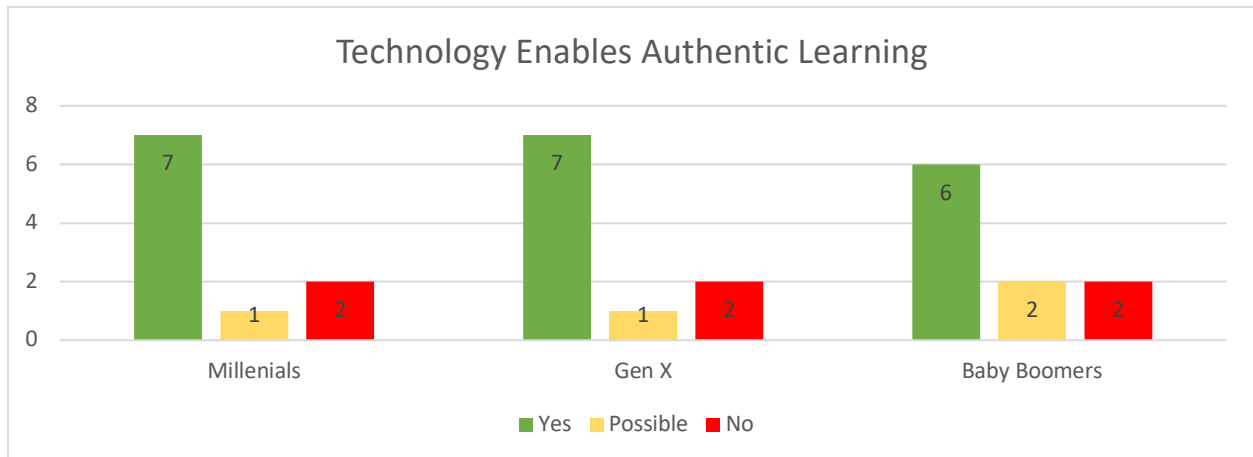
Across the generations of teachers in this study, there is strong agreement that technology enables authentic learning to take place in the classroom. A strong theme across the generations is that technology provides students with access to updated, relevant information or real-world simulators via the Internet.

All the Millennial teachers who believe technology enables authentic learning to happen in the classroom mention one or both of these aspects of using technology in their classrooms that enable authentic learning. A science teacher mentioned that her students can "watch labs, see ecology things actually happening… listen to TED Talks by incredible scientists… sparks creativity," while a math teacher discussed how students can "build their own equations and quickly have the computer graph it and use that to see if their equation matches the problem. An

ELA teacher commented "the sheer amount of contemporary voices makes relevant connection with students." Across core academic subjects, Millennial teachers are using the technology to help their students make connections with the outside world in two ways. One is exposing them to contemporary work and the other is showing the students how they can apply their ideas and problems to real-world situations.

Very similar remarks were made by the digital immigrant generations who embraced computers as a means to authentic learning. A Generation X teacher responded, "yes, because I can give them a real-world problem and they have to design a solution." There were multiple comments such as this one, "can show how math is used… real-world examples." Many Generation X teachers stated comments like, "information is relevant and updated… students can do rigorous, in-depth research." Baby Boomer teachers gave examples of using "the actual rise and fall of stock prices," and "doing the same thing as actual journalists" to describe how computers can allow students to have an real-world experience via the computer in the classroom. Others commented on the ease and accessibility of finding the information via the computer. For example, "More interesting for the students to use the computer…. Visual, colorful and not time consuming. Can do it anywhere instead of having to go to the library." For these teachers, computers either enable or enhance authentic learning in their classroom.

Of the teachers who said no to the question, "does instruction enable authentic learning experiences?" there was interesting difference between the generations. The two Millennials who responded "no" were both in performance classes, one a band instructor and the other

teaches leadership and community service classes. Their comments were neutral and simply referred to the design of the class itself, "it's a performance class," said one while the other said, "computers are convenient, but class is designed to be hands-on."

 However, the Generation X teachers who responded "no" were more negative in their reaction to the question. One Gen X teacher said, "no, I'm okay with being old. I may be stubborn and ignorant. To learn Shakespeare, I did the reading on my own and then had a discussion with people and direction from the teacher. (There is) no better way to learn." Another commented, "to pretend you're somewhere else is not being there." Finally, the Baby Boomer teachers tended to blame themselves for not using the computers correctly. One said, "I'm not that good at it. There is the possibility… I haven't done it" while another shared, "we need to figure out how to do that." While the mentality of the "yes" teachers was similar across generations, the "no" teachers had very different reasoning for rejecting computers as a means to authentic learning.

Technology Hinders Instruction
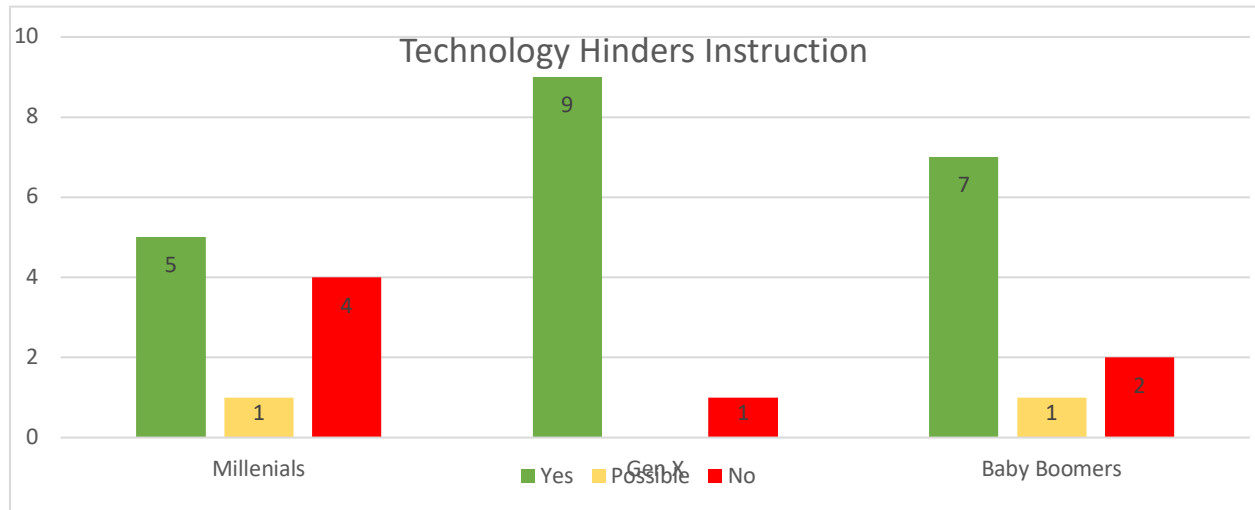
When asked the question, "Does technology hinder instruction?" the response seemed somewhat

contradictory to the responses gained from the previous question, "Does technology enable

authentic instruction?" While 20 of the 30 teachers across the generations answered, yes,

technology enables authentic instruction, 21 of the 30 teachers also answered, yes, technology

hinders instruction. When broken down by generation, the most negative response came from

Generation X, followed by Baby Boomers. The least negative response was from the group of

Millennial teachers. It is interesting that teachers to see that teachers have mixed feelings about

using computers in the classroom. On the one hand, they see them as a tool to enhance

instruction but are also aware that it can be a negative influence on learning.

Of the ten Millennial teachers, five see computers as a definite hinderance to learning and one

sees it as a possible problem. The teachers who see computers as a hinderance are either

regarding the unreliability of the technology, "students can't reliably connect at home… when it

doesn't work I have to scrap the entire plan" and that it is "an avenue of disruption and off task

behavior if the technology fails." Many also commented on the distraction from the work the

computer provides, "it is a distraction… if taking notes on Google classroom, the students are more distracted… on paper they are more locked in… doing work they are supposed to without the laptop. Just substitution is sometimes not worth it." This comment is telling in that it shows teacher discernment of when computers are appropriate and helpful in instruction as opposed to when they can be a distraction from the work for students. The major complaint with distraction is that "the same kids, every day want to watch Netflix or play games," and the observation by teachers that "students misuse their computers… (lesson) takes more time because students distract themselves." This misuse of the computer led one Millennial teacher to comment on the technology causes problems building relationships with students and cause classroom management problems for teachers, "kids are possessive over phone and computer… not that easy to maintain relationships and not be aggressive." Combined with the previous comment that it is "the same kids" who misuse the technology reveals that using computers in instruction can be a frustration point for teachers.

All but one of the Generation X teachers said that teaching is hindered by computers. The one teacher who said it doesn't hinder instruction, says "but I don't use it for its own sake… ask what is the best way? If the laptop is needed, I use it." One teacher itemized a list of how computers are a hinderance in teaching,

> 1.When you count on it and it doesn't work. 2. When the information is not curated, kids are easily distracted… social media. Teachers have to be vigilant. 3. Time spent outside of class… As a student, bombarded by distractions and no one is there to help them.

"Student use and habits," "lack of self-discipline," "kids can't disconnect… they get mad," "it is a constant battle to keep students' attention," "disengaged" are all phrases from Generation X teachers who find technology to be a hinderance to teaching. For these teachers, who

importantly also agreed that technology is an asset to authentic learning, the distractions provided by the computer, and their students' struggle to maintain focus and control over these distractions, is a hinderance to learning.

Seven of the ten Baby Boomer teachers said yes, technology hinders instruction. Their comments are split into two major complaints. The first is similar to the Millennial complaint that computers are distracting to students and can harm teacher-student relationships. For example, one Baby Boomer teacher said, "games, Netflix… makes me a police officer," while another commented "Netflix should not be allowed. How do you monitor 30 students? So much more complicated to manage class, have them stay with me." The second complaint from the Baby Boomer teachers involves the students who use computers to shortcut the lesson, "students have a difficult time creating their own ideas without 'Googling it'," or "by cheating… students try to find a website to speed things up," and "some students have learned ways to cheat using technology." When "students just want the outcome, not the process," teacher goals are subverted, and most of the Baby Boomer teachers interviewed for this study believe that technology can and does undermine their goals.

Fear of Replacing Teachers
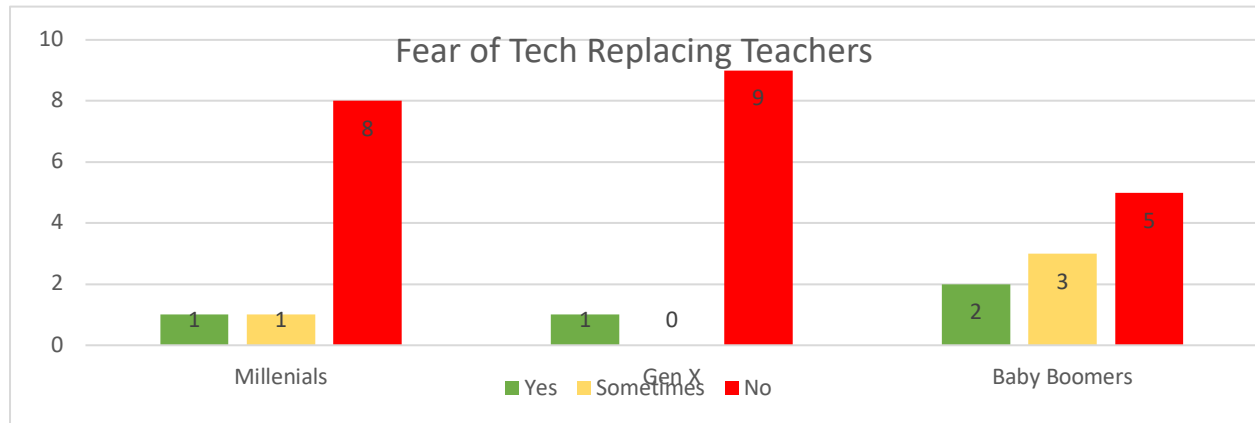
Out of the 30 teachers interviewed, only 4 were a strong "yes" in their answer to the question, "do you have a fear that technology will replace teachers as the primary source of information in the classroom?" while 22 teachers were a firm no. Across the generations, the Baby Boomers were the group who were most likely to say that technology could be used in place of teachers. However, in the conversation that followed, many teachers across all generations agreed that computers have changed the role of the teacher in the classroom.

For Millennial teachers, only one said yes, this shift "has already occurred. We are the guide on the side… become the facilitator. This was true before computers in schools… (we can) be a facilitator without always being online." In this teacher's case, the question was less about replacing the teacher in the room and more about shifting roles of the teacher. Many of the no's actually are more like her comment, "we need facilitators for learning," and we are "more like learning managers." Some of the other Millennial teachers who answered no, there is no fear in being replaced by computers pointed to the need for interaction and discussion on a personal level. "The main purpose of school is human connection… to talk to one another," "while we
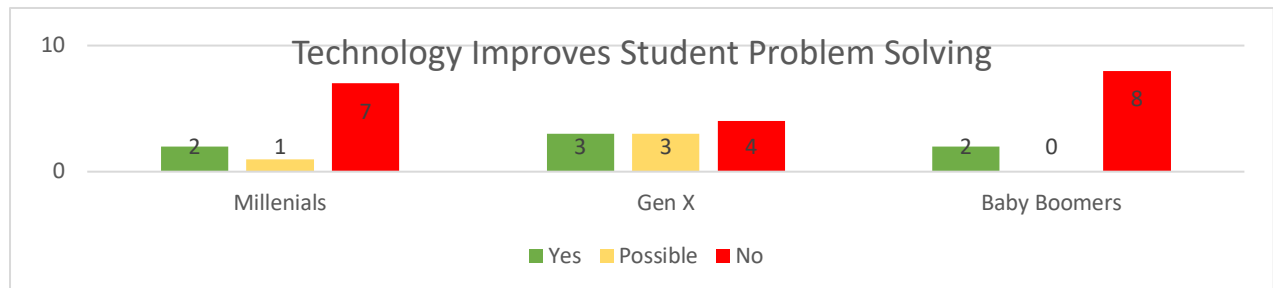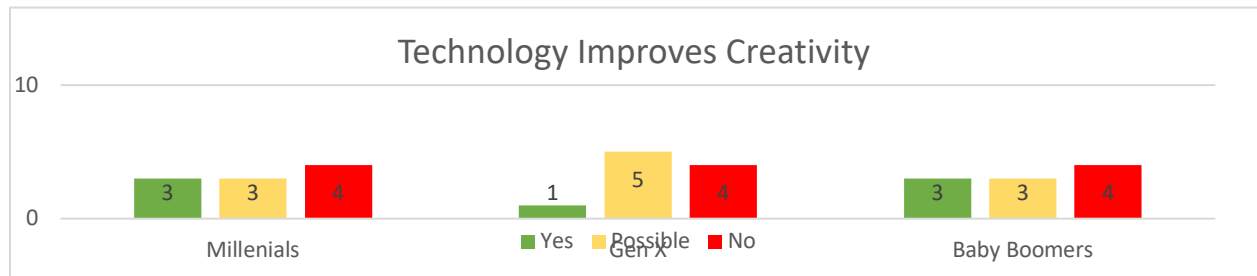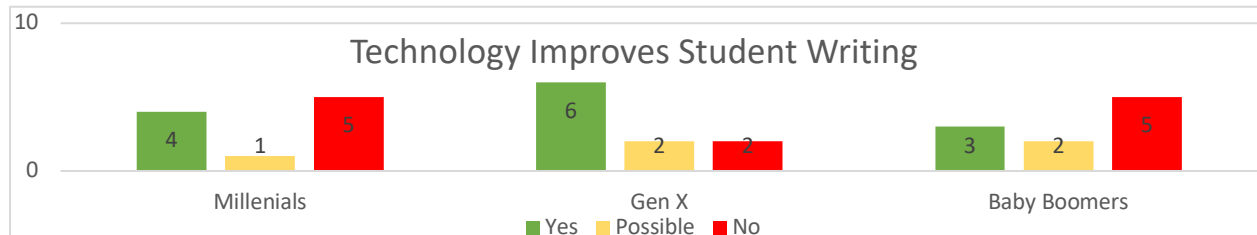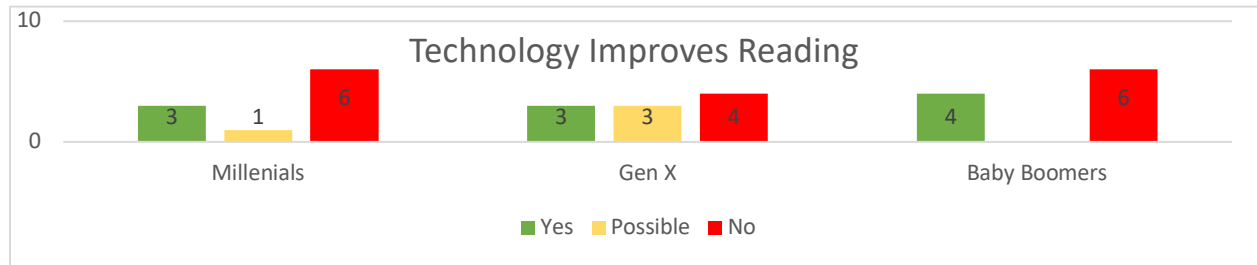
see more online students, there are too many soft skills to be learned, students lose the benefit of class discussion," and "kids like the human explanation."

Of the ten Generation X teachers interviewed, nine have no fear of being replaced as the primary source of information in the classroom. However, like the Millennials, some conversations alluded to an understanding that technology has caused teachers to "totally shift our roles. Students get information from computers, we put it into context… we are educational coaches." An understanding that students need teachers is reflected in the comment, "if the students did it on their own, they would skip stuff in the process… the beauty is in the process." Another area of conversation similar to the Millennial teachers' comments was "students need human connection…kids get bombarded and need a human to make sense of the thing" and "twenty-five 8 year-olds still need a human to guide them." Interestingly in this vein, two teachers mentioned how "parents need child-care," which implies that these teachers understand children need guidance that a computer cannot provide.

The Baby Boomer generation was split, five saying no, teachers will not be replaced with two saying yes and three saying it is possible that teachers could be replaced in the classroom. Several of the five who see this situation as a possibility made comments about current and past attempts at using technology in place of teachers. One teacher said, "I think people who run the schools are going to try to do just that…" regarding replacing teachers with computers. His comment was about the attempt in the 1980s and 1990s to do long-distance learning via television. Other teachers mentioned "online learning…education studies will be different. I hope it doesn't happen… will lose discussion. We should learn to use technology without taking

away from the student relationship." This concern was echoed by other teachers who say education "needs a human being… Where is the direction? There are unintended consequences, attention span is not what it us. Tech is re-wiring brains. Students expect more entertainment (than learning)." This group of teachers also believe in the value of human connection. One teacher noted, "I see blended classes, but feeling of being connected helps the teacher and the student. Too many students are still happy to work with a teacher." Almost all teachers in the study agree that while technology may have changed the role of the teacher in the classroom, they are not fearful of being replaced by computers due to the nature of the job and the needs of the students.

Technology Improves Skills Related to Teacher Goals

Technology Improves Reading

Millenials: Yes 3, Possible 1, No 6
Gen X: Yes 3, Possible 3, No 4
Baby Boomers: Yes 4, No 6

■ Yes ■ Possible ■ No

Technology Improves Student Writing

Millenials: Yes 4, Possible 1, No 5
Gen X: Yes 6, Possible 2, No 2
Baby Boomers: Yes 3, Possible 2, No 5

■ Yes ■ Possible ■ No

Technology Improves Creativity

Millenials: Yes 3, Possible 3, No 4
Gen X: Yes 1, Possible 5, No 4
Baby Boomers: Yes 3, Possible 3, No 4

■ Yes ■ Possible ■ No

Technology Improves Student Problem Solving

Millenials: Yes 2, Possible 1, No 7
Gen X: Yes 3, Possible 3, No 4
Baby Boomers: Yes 2, Possible 0, No 8

■ Yes ■ Possible ■ No

A series of questions in the interview process asked if the teacher believed computers improved basic skills that are at the core of most teachers' goals in the classroom: reading, writing, creativity and problem solving. Across the board, teachers were unconvinced that technology helped with these basic goals. This is a puzzling finding, since most teachers in the study responded that technology helps teachers achieve their goals, enables authentic instruction and

that removing them would harm education. However, compiled with the strong response

especially from the Millennial and Generation X teachers, that teachers are not fearful of being

replaced by technology, the responses to this question may point to the reality teachers know;

that the computer on its own is not a teacher, but a helpful tool teachers use to further their own

goals.

There was a tie for the strongest negative responses on these four questions between the

questions regarding technology improving problem solving and the separate question of

technology improving creativity.

There was a tie for the most positive response to these four questions came from the question

about technology improving writing and reading.

Primary Use of Computers in the Classroom
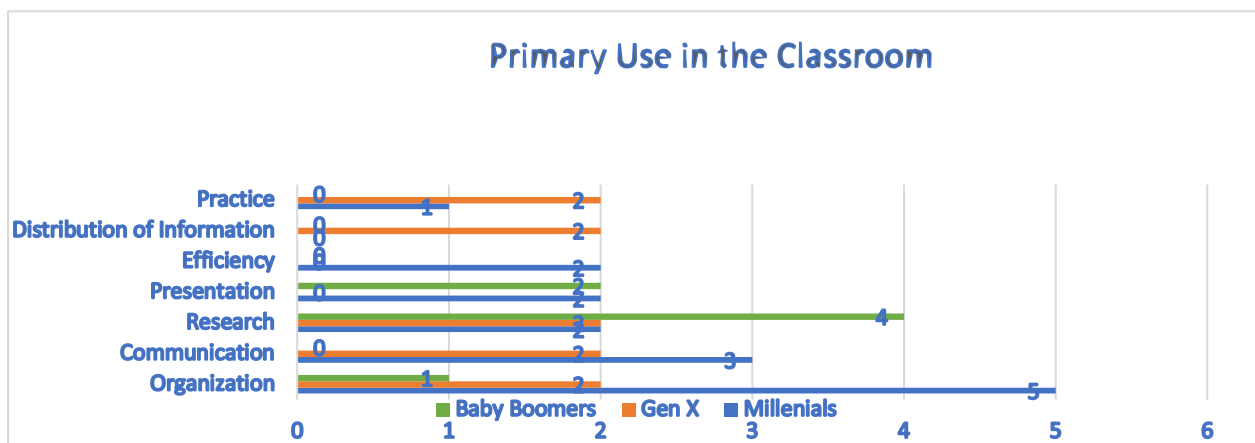
To further explore this idea, that teachers see technology as a tool to be used, teachers were

asked, what is their primary use of the computer in the classroom? There were, in total, 26

different responses to this open-ended question with many teachers unable to limit themselves to

just a "primary" use. In total, there were 43 unique responses in a sample size of 30 teachers, which shows there is much variability within how technology is being used in the classroom.

The group with the greatest commonality of responses was the Millennial teachers. Five of the 10 teachers picked organization as their primary use of technology; three mentioned communication, two efficiency, research, and presentation; while the uses of assessment, notes, disseminating information, writing and practice were each mentioned by one teacher of the Millennial group. The majority of responses from this group, organization and communication, along with the responses of efficiency, presentation, giving notes, and distributing information have less to do with content or skill building and more with management of information and the class itself. Only 5 out of nineteen separate responses were student-driven uses of technology. The vast majority of the teachers in this group chose a primary use that is teacher-directed, not student-driven.

 The idea that Millennial teachers primarily use technology to manage and organize their classes are supported by several comments made by the Millennial teachers. One teacher of this generation that they "only use tech if it helps the goal of the lesson, because the second they get their laptop out, they seem to tune out the teacher." This quote points to how teachers must decide when and why to use the laptop and that students need guidance from the teacher to stay focused on the business of the classroom.   Another theme with Millennial teachers is regarding student ability to use the computer for its intended purpose. One teacher commented the students "need specific classes to teach students how to use" the technology, while another shared, "kids can be overwhelmed by technology. (They) have not way to discern the difference between

good and bad." Because Millennial teachers recognize the students need guidance are choosing to use the computers to manage their classroom instead of having students explore content on their own without guidance from the teacher.

Generation X teachers had no clear common primary use of technology in the classroom. While there were 10 teachers in this group, there were 15 primary uses shared, again showing that it is difficult for many teachers to narrow one "primary use" when discussing how they use technology in the classroom. There was a 5-way tie for 1ˢᵗ place with two teachers each saying research, practice, communication, organization and distribution of information is the primary way they use technology in their classroom. Five teachers also said assessments, games, projects, writing and data keeping were the primary way they use computers in instruction. This mixed bag of results makes it difficult to make any connection between this generation of teachers and their preference on technology use.

In order to better understand a pattern in the Generation X group, it is helpful to divide these tasks into teacher-directed and student-directed. For teacher-directed tasks, there are communication, organization, distribution of information and data keeping. These are all things which gives the teacher control of the instruction. Seven teachers chose one of these teacher-directed tasks as their primary use of technology in the classroom. For student-directed tasks, teachers shared research, practice, assessment, games, projects and writing. Eight teachers chose one of these, student-directed tasks as the primary way they use computers in their classroom. The Gen X group is different from the Millennial group in that they do allow their students more

access to using the computer to direct their own learning, while similar in that they utilize the computer to organize and manage their classrooms.

For the Baby Boomer Group, there were only six unique answers given to this open-ended question. In first place is research, with 4 votes, followed by presentations with 2 votes. With 1 vote each, the rest of the uses were production, writing, online textbook and organization. This group of teachers put the emphasis on student-directed usage of the computer, in stark contrast to the Millennial group of teachers who, out of 19 separate responses chose a teacher-directed function for primary use in the classroom. While the Gen X teachers were more student-focused than the Millennials, the Baby Boomer teachers are the most student focused. As the teachers' ages increased, the main way they use technology changes from being driven by managing the classroom with technology to putting the students in charge of using the technology. This finding is a strong correlation with teacher generation to teacher primary use and is quite an interesting finding.

Skill

Millennial teachers entered the teaching profession with a set of skills garnered in their K-12 and university training, so they are the most skillful group of teachers in this study regarding technical computer knowledge. The most resistant group to acquiring more skill regarding educational technology is Generation X. This group is the least likely to see technology as valuable enough to risk investing time in learning, implementing and teaching the applications or programs to their students.

The following chart is a summary of findings, based on generation.

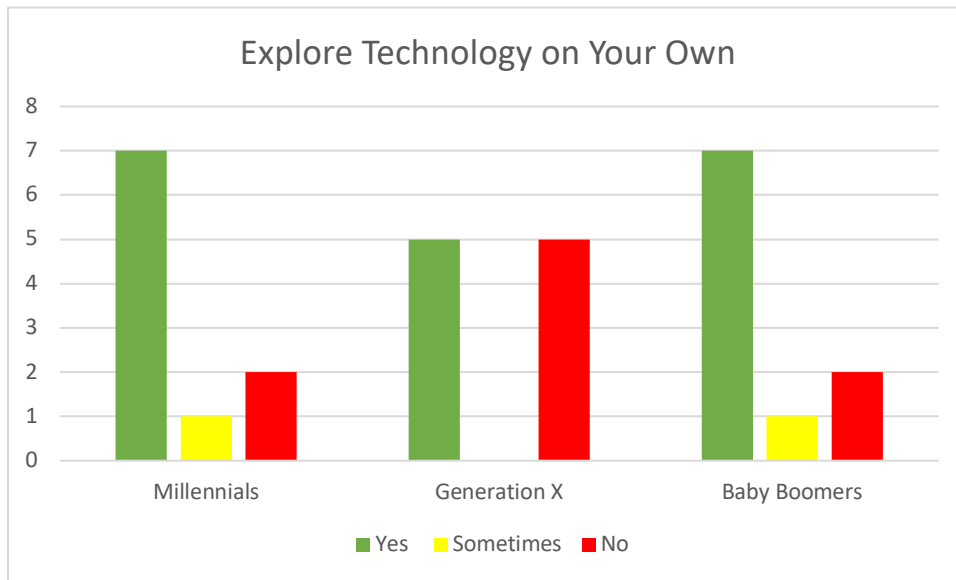| Millennials |
| --- |
| • are likely to test out new applications and explore EdTech on their own time |
| • seem to find technology helpful in running their classes |
| • use district provided time and resources to share technology with their colleagues |
| • help other teachers with technology concerns |
| • have the most confidence of all teachers regarding technology in the classroom |
| • can use technology to differentiate instruction and work against inequity among students |
| **Generation X** |
| • are the group least likely to explore technology on their own time, to share technology with their colleagues, or to implement technology they learn in professional training |
| • have a high threshold of what technology they deem as useful to their teaching |
| • want more district-led training on required programs and applications |
| **Baby Boomers** |
| • explore and implement new technology as much as Millennials |
| • focus on learning applications their students can use in class |
| • least likely to help colleagues with questions regarding technology |
| • least confident group regarding their own ability to solve problems with technology |
| • do not trust technology to differentiate instruction or assessment for students |

Many of the WST researchers categorize skill as a first order change, and claim that is easy to provide teachers with skill through professional development and less important to technology integration than teacher attitudes and beliefs.(Ertmer, 1999) However, some make the point that teaching itself is a complex process that draws on many different pedagogical and content knowledge and skills. Technology must be integrated into the framework of teacher knowledge. The original model, created by Shulman in 1986, overlapped the two dimensions of pedagogy and content knowledge in order to give some understanding that teaching "includes knowing what teaching approaches fit the content, and likewise, knowing how elements of the content can be arranged for better teaching"(Mishra, 2006; Shulman, 2013). Mishra expands this framework to include technological knowledge. He has developed four types of technical knowledge that should be understood by teachers:

1. Technology Knowledge: The ability to use technology, from books to software.

2. Technological Content Knowledge: An understanding of how the content taught can be transformed with the available technology.

3. Technological Pedagogical Knowledge: Knowledge of the tools that are available to complete a variety of tasks from maintaining student records to using social media in instruction.

4. Technological Pedagogical Content Knowledge: An understanding of what tools to use, when to use them and for what purposes. This includes the ability of the teacher to use these tools to personalize and deepen instruction for their students (Mishra, 2006)

According to this research, teachers cannot be handed a laptop and told to integrate the computer into their practices. Effective use of technology in the classroom requires that teachers know how to enrich the content and the method of teaching by applying the right technology in the right context at the right time (Mishra, 2006). Although the technical knowledge must be integrated with content and pedagogical knowledge, it can be argued that the newer generation of teachers will have an advantage regarding technical knowledge which will enable them to integrate technology more easily than teachers of older generations. This study attempts to determine if the generation of the teacher is related to the skill of the teacher in how to use technology and to integrate it into their classroom.

In order to tap into the suggestions from the current research, the questions in this study were designed to investigate all four aspects of the skill, as defined by the WST model. As a proxy for

basic technology knowledge, teachers were asked questions about how often they explore technology on their own, share what they find with others and are able to help others. The answers given to these questions indicate how comfortable the teachers are with using technology by analyzing their capacity to use computer technology own their own, as well as their willingness to share what they find and help their colleagues with issues regarding technology.

Explore Technology on Your Own

A bar chart titled "Explore Technology on Your Own" with a vertical axis from 0 to 8. For Millennials: Yes = 7, Sometimes = 1, No = 2. For Generation X: Yes = 5, Sometimes = 0, No = 5. For Baby Boomers: Yes = 7, Sometimes = 1, No = 2. Legend: Yes (green), Sometimes (yellow), No (red).

In this question, about exploring technology on your own, the Millennials and Baby Boomers had the exact same responses, seven yes, one sometimes and two no. The conversations with both groups were also similar. Many in these groups are looking for ways to enhance instruction with technology, which indicates that many of them are comfortable with and know how to use the technology provided by the school district. Two Millennial teachers summed up this desire to explore applications through "online tools from curricular web searches and educational blogs" or "find new ways to present information." Baby Boomer teachers shared they are looking for ways "to show different possibilities" to use technology and they are now "more aware of Twitter chats" as a way of finding information to improve his teaching. Lastly, a Baby Boomer

teacher shared that she "researches new areas, finds new data and updated information," to share with her classes. Through their comments, these teachers communicated an understanding of how to use technology in ways that are beneficial to them and their students.

Generation X teachers were split in half, with five saying yes and the other five saying no. The teachers who said "yes" gave similar reasons for their exploration as the other two groups of teachers. For example, "I need to stay ahead of the kids" indicates the teacher needing to stay updated with the newest information available, and the technology as the way he is able to do this. Another teacher reported, "I spend lots of time on FB groups finding what I want." The main difference with this group of teachers is that as one teacher reported, "I try... I want to understand but it is a time issue," while another says, "I have wasted too many hours." These comments explain why this group of teacher avoids exploring technology to improve their teaching. They know how to use the technology, but do not have the time to use it or the exploration is not worth their time.

Implement Learned Applications in Classrooms
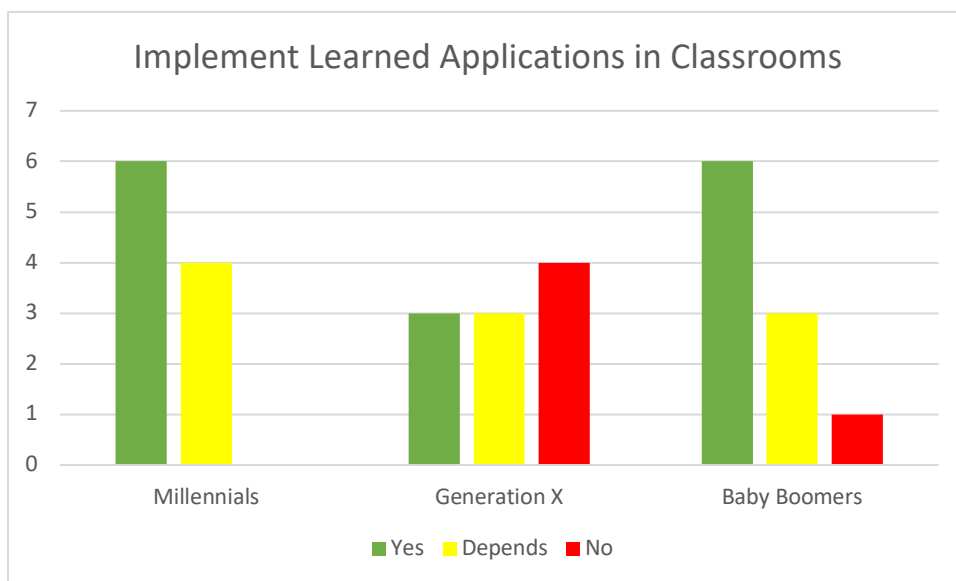
The responses to this question are similar to the above question regarding exploring technology on the teacher's own time. The Millennial and Baby Boomer teachers are more likely to implement technology they have learned than the Generation X group of teachers. This is an interesting response rate, as it counters the conclusions of the generational research, which suggests that the older generation would be the least likely of the groups to willingly implement technology in the classroom.

Every Millennial teacher said they use technology learned from others. While some of them said "it depends, can I use this now?" they were all open to the idea that "if I can see the relevance or it would make my life easier… I am likely to test it out." The comments from this group of teachers suggests they believe technology can help them with their classroom goals. One teacher commented, "I like to try new things… I'll pick a test class and go from there." Although the comment "I have tried some and not used again," could suggest this teacher was not open to technology. However, he gave several examples of websites and apps that he does use: "Newsela, commonlit.org, procon.org and Goodreads" are all used in his classroom to further this teacher's goals. The attitude from the Millennial group is summed up by this teacher, who said, "It depends if it fits what I'm doing… if it applies, I'll use it." Every teacher in this group was willing to try new technology to see if it was a good fit for their classroom and helped them achieve their individual goals.

Interestingly, the Baby Boomer group had several teachers with the same attitude as the Millennial teachers. The most positive comments from this group were in alignment with that of the Millennials, that technology can and does help students and teachers. One teacher

commented, "I usually can't resist trying something new… I want a magic pill to solve all my problems, so I can't stop trying new things." Another teacher said she will use it, "I want to expose my students to different ways and different learning styles." Most of the teachers in this group want to use it but keep the needs of their students in mind. A good example of this concern for the students is the comment, "I have to keep in mind the 14-year-old SPED student; I might think it's great, but will the student be better off for it?"

The Generation X group of teachers were the group least likely to implement learned technology in their classroom. The most positive comment from this group came from the CAD teacher, because "it is essential for Cad and wood lab." This teacher has been using technology in his curriculum due to his subject matter, not the 1:1 initiative from the district. Besides two teacher who simply replied "yes" to this question, the commentary was quite negative regarding implementing technology in the classroom. The overall implication from this group is that trying out technology is a waste of time. One teacher said "I will use new technology if it is something to use daily. It has to be used every single day," in order to be worth the time of rolling it out in his classroom. Another teacher said it is "rare that anything matters to my classroom. I want more training in Skyward. Programs get pushed (by the district) but I don't have cause to use it." These comments allude to a frustration that they do not have access to training on things they are required to use, such as the online gradebook.
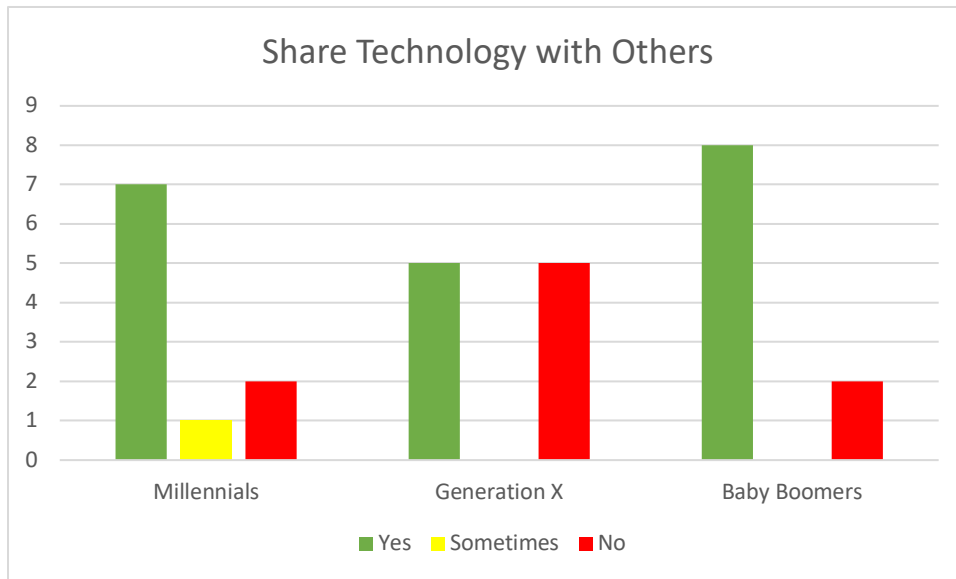
Two additional questions in the interview protocol that sought to understand if and how teachers use technology in their classrooms to achieve their goals were: "What are the websites or applications that best fit your content area?" and "How is technology helpful for your specific

subject area?" Across the generations, 100% of the interviewees found something useful about technology to use in their classrooms. The most popular tool across the generations was Google Classroom and every single teacher in the study was able to name or discuss other technological resources and how they are able to utilize them in their classroom.

The positivity about technology was reflected in the conversations across all three generations. The quote that exemplifies the Millennial generation mentioned benefits for both students and teachers. For the students, it gives them access to "different voices and perspectives… give kids choice in their learning… audience is more public and authentic." For the teachers, one Millennial teacher reports it gives teachers a way "to give feedback to students, check for plagiarism, finding resources for the classroom." This quote is an example of how, in the conversation with this group, the teachers mentioned how technology benefits both teacher and students to achieve classroom goals.

In the Generation X and Baby Boomer groups, the focus was on how technology helps the students, without much focus on how it helps the teacher. For example, a Generation X teacher shared that technology "shows them (students) a final project to which they can aspire… watching performances and poetry readings are so powerful." A Baby Boomer teacher shared how "computers are great for students to see stock prices change in front of their eyes, research legal cases" showing how it allows students quick, up to date access to real world information. Another Baby Boomer teacher commented that "students are close to tech. It's how they grew up. Kids are not the same as they were… we must follow the way they learn." The two older generations have a sense of difference between how they learned and how the students who grew

up with technology have an expectation of immediate access to current information and real-world application of what is learned in the classroom. While not one teacher out of the older two generations mentioned how it helped them as teachers, they did recognize the expectation their students have and how computer technology does have the potential to help their students.

Share Technology with Others

A bar chart titled "Share Technology with Others" with a vertical axis from 0 to 9. For Millennials: Yes = 7, Sometimes = 1, No = 2. For Generation X: Yes = 5, No = 5. For Baby Boomers: Yes = 8, No = 2. Legend: Yes (green), Sometimes (yellow), No (red).

The next question that is a proxy for how well teachers understand technology itself was, do you share technology you find with others? The answers to these questions are strikingly similar to those to the previous question, "do you explore technology on your own?" The Generation X teachers were the group less likely to share with five saying yes and five no. The Millennial group was in the middle, with seven yes, one sometimes and two saying no. Surprisingly, the group most likely to share is the Baby Boomer group. Eight said yes to the question do you share technology and two said no. This result seems to flip on its head the research that suggests older teachers are less amenable to technology than the younger generations.

In the conversations with these teachers, many who reported sharing technology mentioned how and when they were able to share with their colleagues. For the Millennial sharers, some teachers mentioned a structured environment created by the district allowed them to share what they personally learned. For example, "it is very easy to share, both here and at other schools, during curriculum mapping." Other teachers mentioned PLC (Professional Learning Community) time as a place where they share technology with teachers. Another avenue for sharing for many teachers was the instructional coach. One Millennial teacher mentioned, "I let the iCoach know what I'm doing… we worked to create a tech and treats program for teachers to learn… it is a matter of time for teachers… the iCoach packs as much in as possible during PD days." Interestingly, none of these district-sponsored activities, from the curriculum mapping to the iCoach are designed as a way for teachers to share technology in and of itself, but to share practices, curriculum, goals and methods with each other. The teachers are incorporating the use of technology into these everyday practices and district-provided times and opportunities without being specifically instructed to do so.

Fewer Generation X teachers reported sharing technology, and as opposed to the Millennial group who found district-sponsored ways in which to share technology, only one Generation X teacher used district-provided time or resources to do so. In short, Generation X teachers do not think the district provides sufficient time to share technology with colleagues and this group does not see sharing technology with others as a valuable way to spend their time.

Help Others with Technology
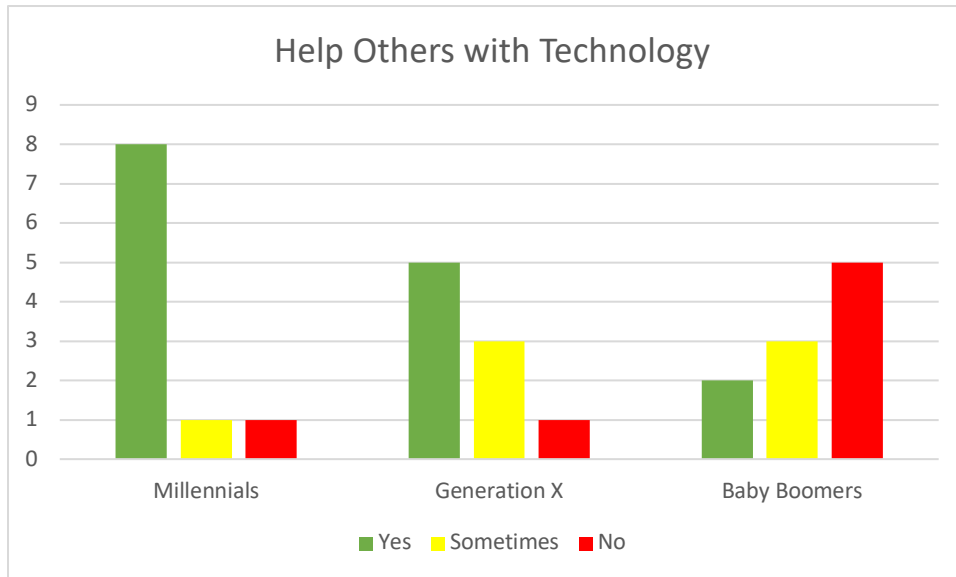
The answers to the question, "Do you help other teachers with technology?" fits the pattern that would be predicted by the generational research. The digital natives, the Millennials, are most likely to help others. Eight of the ten interviewees responded yes, one responded sometimes and only one said she did not help others with technology. The comments from this group of teachers support the research that says people of the Millennial generation instinctively understand technology. One teacher commented, "I am a younger teacher, so I have more experience," while another states, "especially during the first year of the roll-out younger teachers could navigate the ins and outs." Another teacher exclaimed, "I had to hide my first year!" to express how much she was sought out during the first year of the 1:1 initiative. That year was her first year of teaching, but ironically, she was the person in her school who had the most experience with using technology. These comments also reflect the findings in this study that show that all the Millennial teachers interviewed have been using technology in education since they were in elementary school.

The Generation X teachers' responses to this question were not as strong as the Millennials, both in number and in comments. Although five Generation X teachers said yes, they help and three said they sometimes help, the comments show this group is not as confident in their knowledge. For instance, the comments, "yes, we all help each other" along with "I helped in the past, with older teachers on the team," as well as, "they come to me if they have questions," have a different feel to them than the comments from the Millennial teachers. Instead of "hiding" from the other teachers, this group is more resigned to the fact that technology is a part of the job and they are willing to take it on and help out as they can. There is a lack of confidence in their answers when compared to the Millennial group, reinforced with the comment from one teacher, "the teachers who need help are growing fewer and fewer." However, there is an acceptance of the technology and a willingness to do what they can, combined with the realization that "younger teachers don't need me. They had Facebook pages in middle school."

The Baby Boomer group only had two teachers of answered a definite yes, with three who said they sometimes help others, while half of the group said they do not help others. These "no" teachers' comments align with both the generational research that would put these teachers solidly in the digital immigrant category. One teacher simply said that technology "is not in my wheelhouse," another said "each year gets worse about what I know… I ask the students, they teach me." The teachers in this group who said sometimes followed up with "more often I ask," "I'm not the guru" and "when we had IG Pro," which is a computer based gradebook teachers in the district used before the 1:1 initiative, six years ago. The comments from this group of teachers illustrate the vast difference between the generations of teachers in the confidence regarding the skill they have with technology.

Use Technology to Differentiate Instruction
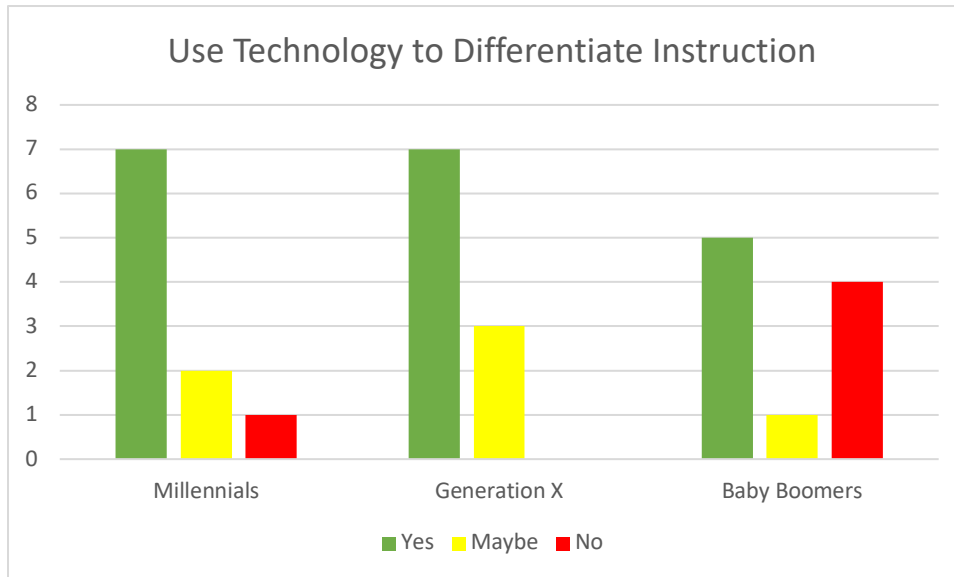
The last question in this part of the interview asked if teachers used technology to differentiate instruction for their students. The majority of teachers responded yes to this question, but there are some notable differences between the generations. All of the Generation X teachers reported they definitely or sometimes use technology to differentiate, and only one Millennial teacher saying he does not differentiate instruction with technology and that is because of his subject matter as a music teacher. However, four of the Baby Boomer teachers reported they would not rely on technology for differentiation of instruction, and the comments of many of these teachers seem to indicate that they do not trust technology to be a reliable method of differentiation.

Comments from the Millennial teachers demonstrate this group's overall trust in technology as a way to differentiate instruction for their students. One teacher says, "Amazing! With technology, disability doesn't define you as a student." Another comments that technology, "creates a growth mindset… (students) can pick and choose questions, get individualized feedback." According to this group of teachers, students of all abilities can benefit from differentiation via technology. One teacher says, "The computer allows for flexibility. Students

get things done quicker when they see it online… It allows faster-paced kids to work ahead on both content and skill. They have video and written sources to work from… a variety of ways to submit a project… can do a movie, presentation or paper." Another teacher points out that assigning tests in an online program in groups, "allows students to keep their dignity," as it enables teachers to easily keep student grouping confidential.

Tool
There were generational differences in the discussions regarding the usefulness, reliability and functionality of the technology tools provided by the school district. Many conversations centered around the reliability of technology, training and the time spent learning the tool, as well as how the computers help in student learning. Millennial teachers and Baby Boomers were not affected in their planning by the unreliability of technology, albeit for different reasons while Generation X teachers had difficulty implementing technology due to the risk of it failing during class or for their students at home.

 Across all generations, there was disappointment in the training provided by the district regarding technology. Addittionaly, all generations were unhappy with the district's communication regarding the implementation of the 1:1 initiative. Teachers also felt unsupported by the district. The overall impression is that the district created a plan without input from teachers on what they needed or wanted for their classrooms. In all groups, teachers felt the district did not truly want input or feedback regarding the technology initiative.

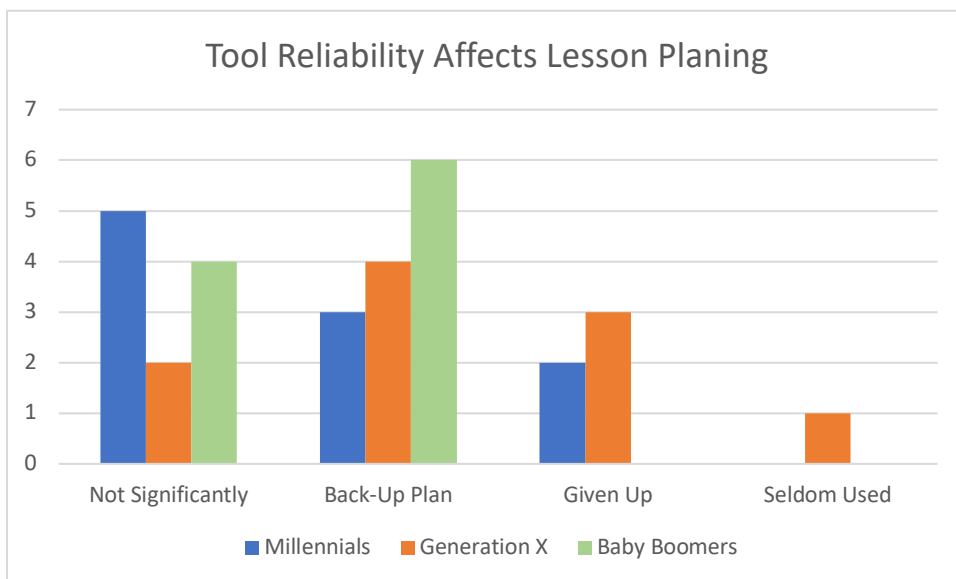The following chart is a summary of findings, based on generation.

Millennials
•   are not deterred by the fear of technology failure
•   believe technology does allow students to take charge of their own learning
•   received most of their training from their university programs
•   are not as reliant on colleauges for technological help
Generation X
•   are the group most negatively affected by technology failure
•   have fear of loosing instructional and planning time if technology does not work as expected
•   believes technology does not solve inequity in education; the same students who struggle with school as a whole also tend to struggle with the technology
•   received most of their training from the school district
•   found the training offered by the district inadequate
Baby Boomers
•   are accepting of risk when planning with technology
•   believe students benefit from having access to additional information through technology
•   received most of their training from colleagues

In the discussion of "tool" in the WST framework, there is more in question than just if teachers have a computer or not. Necessary to full implementation includes "time, training, and support" that are not always sufficiently available to teachers (Ertmer, 1999). Although it is clear from the data that more computers are available as tools to the teachers, if those tools are not adequately supported by the school or district, teachers will have a difficult time overcoming the "tool" component and fully integrate technology into the classroom.

Another factor that affects how willing teachers are to integrate technology besides availability and support, is the reliability of the tool and the infrastructure to support that tool. In this district, it extends to the wireless Internet connection as well as the Virtual Private Network (VPN) utilized by this school district. If a teacher cannot count on the tools to function for the students as they should on a consistent basis, the teacher is less likely to implement technology

in his or her classroom, even if they have the will and skill to use technology in their teaching practice.   Based on the WST framework, when teachers discover the tool to be unreliable, the effect on teachers' value for it is diminished (Liu, Lin, Zhang, & Sheng, 2017). This study asked several questions that alluded to the reliability of the technology itself, as well as the quality and reliability of the technology support provided by the district to address problems.

According to the responses from the subjects of this study, the unreliability of technology does have an effect on how teachers plan to use technology, and this effect does vary across generational lines. The perception of the reliability of technology in this district varies from teacher to teacher. For some, it is adequate while others find it lacking. Reliability issues cause a range of behaviors in teachers, from avoiding technology altogether in their planning, to creating a pencil and paper back up plan, to planning without concern of technology failure. For the most part, the possibility of technology failure is a risk worth taking for most teachers.

Tool Reliability Affects Lesson Planing

A bar chart titled "Tool Reliability Affects Lesson Planing" with a vertical axis from 0 to 7. The horizontal axis categories are Not Significantly, Back-Up Plan, Given Up, and Seldom Used. Legend: Millennials (blue), Generation X (orange), Baby Boomers (green).

- Not Significantly: Millennials 5, Generation X 2, Baby Boomers 4
- Back-Up Plan: Millennials 3, Generation X 4, Baby Boomers 6
- Given Up: Millennials 2, Generation X 3
- Seldom Used: Generation X 1

Generation X teachers were the group most negatively affected by the reliability of technology. The comments from the Generation X teachers reveal a frustration that technology has

disappointed them and cost them time and created uncertainty in the success of their lessons.

One teacher reported, "yes, you need a backup plan, which is often busy work and punitive,"

another reiterates this point with the comment, "you never know when you need a backup plan."

A middle school teacher lamented, "I tried to use the online textbook. With all the VPN issues, I

had to change, go back and re-do with paper which created double the work. I am now scared to

try it. I had enough, so I just quit." A high school teacher commented, "the unreliability of

technology costs one week of instruction. You cannot simply make copies or create back-ups for

many lessons on the computer." This last comment points to the fact that technology is not

something that can easily be swapped out for paper and pencil work. Before committing time

preparing a lesson that is reliant on the computer, some teachers remain "very paper reliant," in

order to avoid "throwing wrenches into the calendar."

Reliability for students also was a factor in discussion with the Generation X group of teachers.

The unequal access students have to the technological support they need, especially at home, is a

factor that dissuades some teachers in Generation X from using technology in their lessons.

"Tech is a barrier to student learning." This was reiterated by another teacher who stated, "the

Director of Technology (for the district) admits his students have VPN issues at home. This

disruption hits the least-prepared students the hardest. When kids have tech problems and don't

have a back-up computer at home, they suffer." Another Generation X teacher commented that

technology "hasn't leveled the playing field… (technology) does a disservice to lower SES and

we're not talking about it." A similar comment came from a Baby Boomer teacher, "brighter

kids can work around, less savvy students have more problems," regarding the reliability of

technology. These teachers have a problem with the "tool", in that it is not accessible to all

students at the same level. In the experience of these teachers, many students do not have the resources at home to make computing consistently available, increasing the inequity in the system, and causing teachers to hesitate or avoid making plans that are reliant on technology.

Across generations, teachers whose lesson plans were not significantly affected by the reliability of technology had similar comments.   One Millennial teacher commented, "I'm not worried about it," when discussing if she lets the fear of technology failure affect her lesson planning. Those are the exact same words from the mouths of two of the Baby Boomer teachers who do not let their concern of technology failure affect their lesson plans. Another comment shared by teachers in all generational groups is their plans are "occasionally disrupted… at the beginning of the year, couldn't count on computer working." These teachers understand there is some risk in counting on technology in their planning, but not enough to stop them from integrating computers into their daily plans.

A separation between Millennial teachers and Generation X teachers is indicated by what the Millennial teachers did not say about how the reliability of technology affects student learning. A Millennial teacher reported, "it has gotten better. I can run to the copy machine for two or three copies. A few students without computers don't get to engage as much," but largely the lesson plans are done without much thought to technology failing. Another teacher commented, "computers work except for the first two weeks of school." These comments suggest that while Millennial teachers do acknowledge a limited problem regarding the reliability of technology, they do not see it as a barrier to student learning when compared to Generation X.

The Baby Boomer group is generally accepting of risk when planning with technology. None of the teachers in this group reported giving up on using technology in their lessons. One teacher's answer to this question regarding how the reliability of technology affects planning is indicative of this group's attitude, "It has, but not frequently. I'm not relying on tech 100% of the time… the more you use it… more likelihood of things going wrong; however, I can switch gears… easy to overcome." The biggest concern these teachers have is "when I can't access the Internet." Some comments that indicate this group of teachers are not affected by the unreliability of technology to "have a trick or two up my sleeve," "hardwiring in," or "I have a plan B and C." Reliability issues do not stop the Baby Boomer generation teachers in this study from incorporating technology in their lessons.

Technology Allows for Student-Centered Instruction
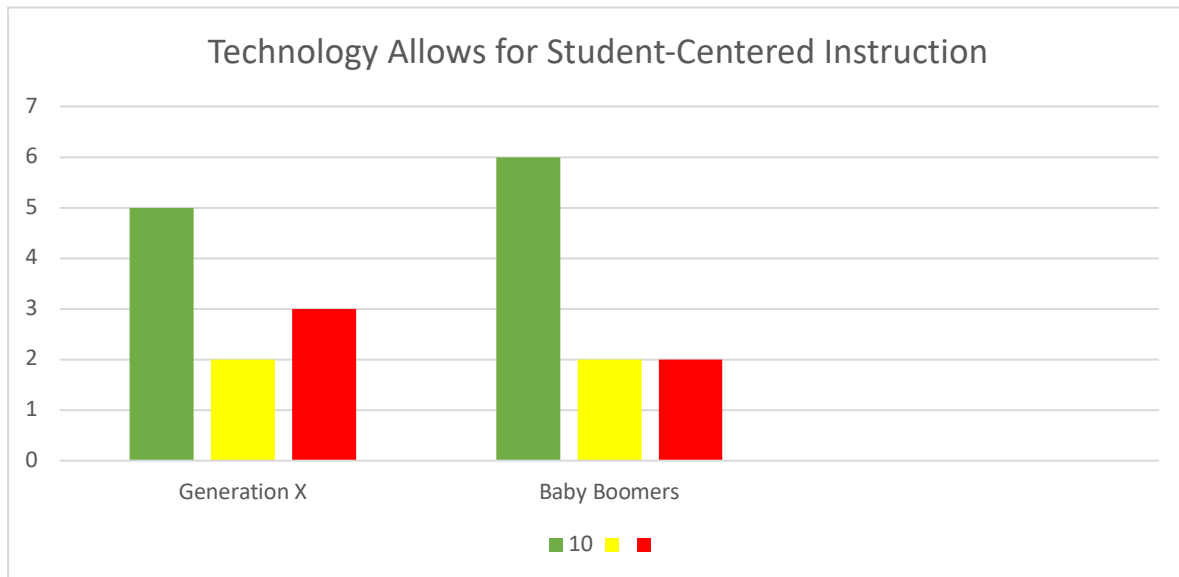
Millennial teachers in this study were all in agreement that technology allows for student-centered instruction. In conversations with Millennial teachers there was an overall understanding that technology allows students to have ownership of their learning. This idea is best stated by the teacher who said, "Yes, students can find information on their own instead of

relying on the teacher." One teacher commented that she could "move away from direct instruction with technology," emphasizing it was easier to do inquiry based and project-based learning with the computer. Another point made by Millennial teachers was that "tech levels the playing field… you don't have to buy art supplies for projects." This is an interesting argument on how technology can actually level the playing field for students across socioeconomic groups, as many creative tools are either provided by the district on the computer or are accessible for free online.

Generation X teachers were not as enthusiastic about the ability of technology to enable student-centered learning as the Millennial group. Although half of them answered something similar to "yes, (computers) can be used to their (student's) benefit," there were some reservations about using technology in the classroom. For instance, one teacher replied, "helps students become more of what they intend to become as adults… they can cut corners or be creative." This response alludes to the fact that not all students use the technology appropriately. As mentioned before by participants in earlier responses, teachers are wary that students sometimes use the technology to "cut corners" through cheating and plagiarism. One teacher answered that student-centered learning is "based on the teacher, not the technology." While this group of teachers sees technology as a tool for teaching and learning, they are not convinced that technology is the answer to putting students in charge of their own learning.

By the numbers, the Baby Boomer group of teachers was slightly more positive than the Generation X group regarding the question of technology improving student-centered instruction. Several of these teachers commented on how "students can find resources that solve

problems," and "can see examples" in order to further their understanding of what they are learning in class. Another positive comment is that the students "do more research and presentation" with technology resources than they were able to without them. However, this group of teachers have an understanding that student-centered instruction "depends on the teacher." "Students don't have the wherewithal to do things on their own…They need a guide." In addition, they believe it also depends on the "motivation and skills" of the students. There are "different needs for AP and IB students… SPED needs more hands-on." As student-centered instruction is dependent on addressing individual student needs, these comments are in line with this style of instruction. They indicate an understanding by these teachers that technology is not a one size fits all solution for every student but should be adjusted according to teacher and student needs and abilities.
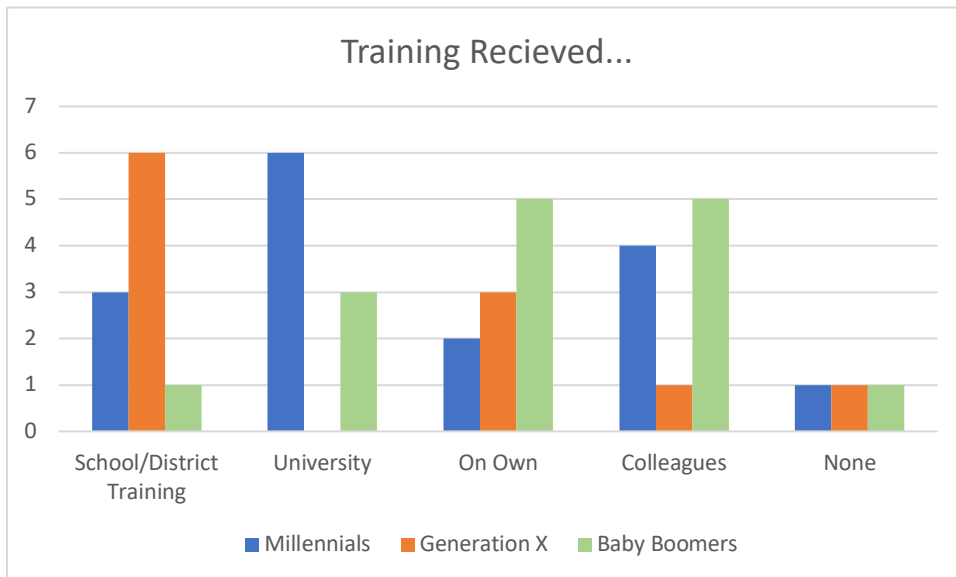
Most teachers in this study responded with more than one answer regarding how they received training on the technology and how to integrate it into their lesson planning. The answers are categorized into six groups that represent the conversations regarding this topic. The responses were varied across the generations. The categories broke down into no training, learning from

other teachers, learning on the teachers own time and initiative, university training, and training provided by the teachers' schools and/or training provided by the district.

While three of the Millennial teachers said they had received training from the school district, they all made comments that indicated they could have used more training. For example, one teacher whose second year in the district was the first year of the 1:1 initiative commented, "we had PD (professional development) at school, especially at the beginning (of the initiative) … might have been better to train before 1:1 rollout began." A second teacher who came into the district the same year as the initiative began said regarding the training, "not very much… Skyward (online gradebook) training… mini- lessons as a PD day… We went from class to class and learned from other teachers." A different experience was indicated by a teacher whose first year was two years into the initiative said of the training, "almost none from the district… not useful," due to the fact that the district did not offer much in the way of training on the computer or the required software after the first year it was adopted.

Teachers in Generation X were most likely of all generations to attribute their training to formal professional development presented by the school or the district. Of these six teachers, many were unsatisfied with the training provided either by their individual school or available to all district teachers. While one teacher had positive comments, "we got tons of PD on MacBook, Skyward and Google," a few comments were neutral, "PD was offered…," "some in-service training here and there." The more negative statements pointed to the fact that while there was training, it did not meet the wants or needs of the teachers in this group, much like the comments from the Millennial group. For example, one teacher commented "when we first got Macs,

training from the district was not useful or valuable." Other comments, such as "training on iBook author is not exactly what I want," and "the advice was to just play with it" points to the opinion of this group of teachers that the district did not understand what they wanted or needed in order to be prepared to use this technology in their teaching.

Across generations, the district-provided and individual school training was deemed inadequate by the teachers in this study, especially for teachers in the Baby Boomer generation. They did not attribute much of the training they received to the school district. Only one teacher commented in a neutral way, with the brief comment "training in PD." Another teacher's response embodies this group's opinion of the district training as "very little… I trained myself on Skyward, Google Classroom and Schoology. I had to figure it out and go from there. Colleagues always help," was reiterated in other teachers' responses. For example, district training was "not enough… I was self-taught, or by other teachers," and yet another who said "none… Done on my own, with my PLC (Professional Learning Community), or department members." While the training from the district was deemed inadequate across generational groups, the Baby Boomer group were the most vocal in their disappointment with this formal training.

There were as many teachers who reported learning about technology on their own and learning from colleagues as there were who cited formal training by the district. The quotes from the Baby Boomer teachers in the paragraph above regarding learning on their own or from colleagues were repeated in the younger two generations. For example, one Millennial teacher expressed, "I learned from other teachers and the instructional coach," while another said, "I

learn on my own, with other teachers." "We help each other out" is another comment from a Millennial teacher regarding training on professional instruction.

The difference in the Generation X teachers from Millennial and Baby Boomer teachers, as shown in the chart, is that they are less reliant on colleagues than the other groups. In fact, only one Generation X teacher mentioned "teachers trained other staff in the beginning of this" to give credit to other teachers. That comment was as close as the Generation X group came to credit their learning to fellow teachers. This group was disappointed in the district training and, outside of this formal training, was largely self-reliant on learning what they need to for their classes. One teacher commented he has to do "training on new versions of software whenever they come out… (He) must keep ahead of students." Another remark that indicated the opinion of this group of teachers is "little skill is self-taught." Unlike the Millennial and Baby Boomer group, the Generation X group made little mention of department, grade-level, or PLC sharing or teaching that helped them learn how to integrate technology into the classroom.

The teachers who cited the university as the main source of their technological information were comprised of two groups: six of the younger Millennials, all but one in their twenties, and three Baby Boomers who have gotten their master's degrees in recent years. The youngest teacher of the group remarked, "none since high school," when asked about formal training on technology. It should be noted that this teacher did not follow a traditional certification route, so she did not have the same four-year university teacher's curriculum as did her peers. As noted earlier, the educational experiences of the generational groups with respect to technology are quite varied due to the age of the groups and the technology available to them at the time. Based on this

information, as new teachers enter the field and older teachers retire, almost every teacher who goes through a traditional four-year university teaching program will have formal training on using technology in their classrooms.

Feedback Requested by the District
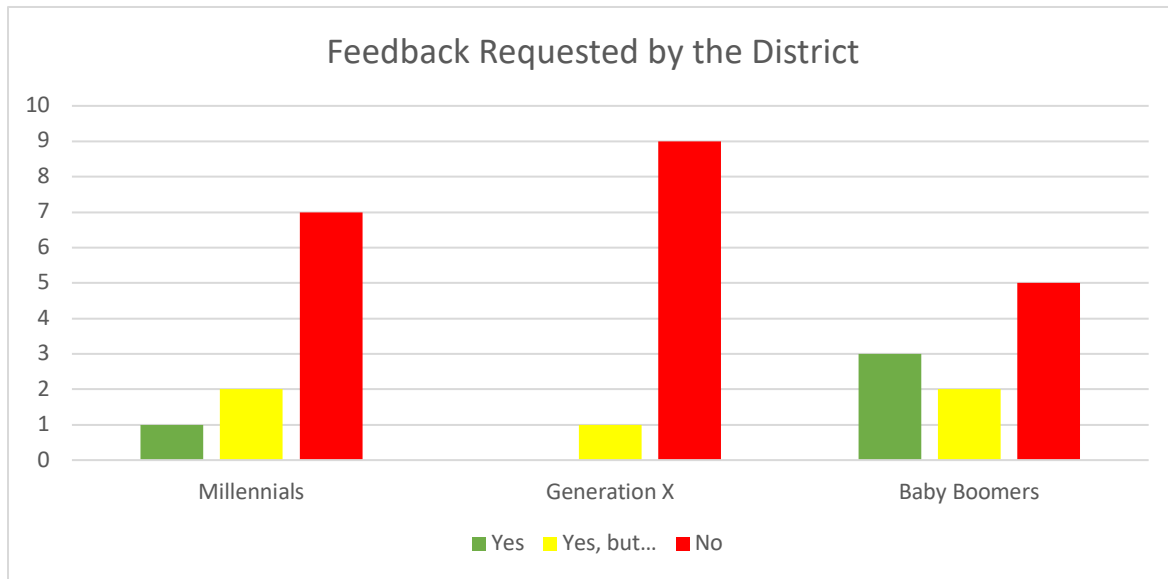
Across all generations, there was a negative response to whether the school district was interested feedback from teachers regarding computers and technology in the classroom. Only four teachers from the sample of 30 responded in the affirmative to this question without much reservation. The one Millennial teacher who answered yes was the most positive of the entire group. She commented, "we took a survey and the district is responsive to us." The three Baby Boomers who responded yes were not as certain that the district was interested with the comments. Their comments sounded a bit uncertain, for example, "Maybe a survey. They should get feedback and revamp the program," "both the district and building have requested to know what I think… They listened to a degree," and finally, "Occasionally, with surveys. (The district) just now started looking for volunteers for a committee due to parent concerns… They

are more responsive to parents than to teachers." While the one Millennial teacher group seemed to have confidence that the district would listen, the most positive teachers of the Baby Boomer group were unsure what would happen with their input.

The teachers who are in the "yes, but…" category had similar responses across the generational groups. They all acknowledged the district had asked for input in some way, but these teachers saw no response to the feedback they gave. A Millennial teacher in this category reported, "If we take a survey it doesn't make a difference. We want them to block Netflix, need a tech guy… teachers for years have asked for things with no response." The one Generation X teacher who is in this category said, the district's message was "They requested no feedback that I recall except when the superintendent at the time asked what we thought on a listening tour. The district's attitude is the info is out there. Find it. Good luck." An example of Baby Boomer thought in this category is,

> They did, but don't anymore. Just before 1:1, all journalism teachers met with the district and discussed specs and programs. Now, they don't want to meet. That's why we don't have what we need now. Personnel changed at the district level. They are not doing the necessary research and they don't listen.

While the teachers who answered in this category remember the district asking for input or feedback regarding how the technology should be implemented or adjusted, they were either unhappy with the response or did not see a response at all.

Twenty-one teachers out of thirty in this study replied the district did not elicit feedback during or after the implementation of the 1:1 initiative. All but one of the Generation X teachers fell into this group, while only half of the Baby Boomers were represented here. These teachers fell

into two groups: either they did not remember the surveys, or they were so dissatisfied with the response that they discounted any survey they may have been given. Five of the teachers are in the group that simply stated, "no" or, "not that I recall." These five were broken fairly evenly throughout the generational groups.

Eight of the teachers saw no response and gave a fairly mild critique of the school district's response. For example, "you haven't really been supported by the district" and "I've never been asked… the district should know what the teachers need." Another teacher indicates feedback so far into the 1:1 initiative is not useful or wanted by the district with the comment, "no, at this point we (teachers) adjusted to what we have. Could have been better with training, too late to change things now." On a more positive note another teacher states, "as we navigate, the district should listen to teachers and parents," indicating hope that the district policies regarding technology can change. There were more comments for change that teachers hoped to see. One teacher lamented "we are underutilizing technology," while another reported she "asked about Math 180 and an online textbook, but I never heard back." These teachers have opinions and specific requests for which they have not received answers.

The remainder of the teachers in this dissatisfied subgroup all had a unique story regarding what they wanted to tell the district about how their lack of communication has affected their ability to teach and has left them unheard. Each generation has a few teachers with a story to relate about a specific incident or problem regarding technology. From the Millennial teachers, one teacher remarked,

> No, they don't want to hear. They are not doing steps to guarantee success. We need to be a team. The district should have taken training more seriously if they want this to work. District threw these things at us with no direction. Do what you want, sink or swim. Messed up to the kids.

Another teacher reported her story of advocating for a software suite for the district and her

experience at her job interview,

> I petitioned the district that we should use Schoology (a Learning Management
> System). I was laughed at. The district should invest money where teachers
> want. At my interview I asked about the expectation of computer use in
> classroom. Their plan was to hand them out and say go.

There is a strong example from the Generation X group that shows how some special programs

needed something different from the rest of the group due to the unique requirements of their

curricula. Much like the journalism teacher noted above, this teacher was unheard and reported,

> I had no input five years ago. No one asked what would be the solution for
> woodshop. Now, kids don't have the same permissions so they can't use the tech
> like they should be able too. Teachers have to save the work and use a
> workaround given by the tech department. I don't think too many teachers would
> have gone for MacBooks to prepare kids for the business world… The most
> disappointing part is the district took printers. The kids would print out blueprints
> and plans. Now, they can no longer see their work on paper, only on the screen.
> Also, the district thought a pricey laser engraver was a printer and they took it and
> sold it at auction. Had to be replaced.

Another teacher lamented that her Special Education classroom suffered from the transition

because she believes while many students may have been helped by the transition to a 1:1

school, it causes her students more problems than it solves.

> Teachers did not ask for the change, we were told. I don't understand the reason
> for the change. The tech problems encountered by my students are magnified as
> the students themselves are unable to follow directions on how to reset passwords
> and remember usernames. We, in this room have to keep a book for all the
> passwords in order for the students to use their laptops.

One more Generation X teacher was passionate in his response to this question regarding the

school district's communication about the 1:1 initiative.

No, from the get-go they said it would be good for student learning. Please show us! Never did, have yet to see it. I have read and seen its bad for test scores, causation for bad mental health. Students need empathy. Student activity has declined… More and more people who won't care about other human beings. Coming to school at a deficiency, lower maturity… Less listening to others… None of it is useful. I learned to study by reading slowly and discussing it in a room. Tech cannot help students learn. It is best through discussion, face to face.

One of the Baby Boomer teachers has a similar complaint with the district's roll-out of the initiative and the lack of input and feedback it elicited from the teachers. He related,

Should have asked people who actually use it. We could be doing things better and cheaper. Other districts limit access and monitor computers. If a kid misuses, it gets taken away. District thinks 1:1 solves everything, but I think it introduces new ones (problems). All they (students) do is Google answers. I've got an eighteen-year-old who can't figure gas mileage in a car. They won't do simple division and don't need to know how to do anything.

It is interesting that the question which produced the longest and possibly most negative responses was the one regarding the district's attempt to garner feedback from the district.

When asked if they had anything more to share, there were more suggestions how to improve the technology used by the district. For the Millennials, two teachers mentioned they believed that technology is counter to building good student-teacher relationships. One teacher reported,

relationship-building and technology do not go together; I am pulling away from it. I grew up as a student using technology and taught with it. It is important as a tool, but I am dialing it back due to it damaging relationships, deep thoughts, critical thinking skills-based learning. The screen is a barrier to human connection.

A different Millennial teacher spoke along the same lines, that "The Internet does something to humanity… affects how our brains work, making us shallow regarding relationships, reading, and blocks interacting with different perspectives."

Across generations, teachers spoke of wanting different technology in their classroom to meet the needs of their students and curricula. For example, a band teacher "would like iPad pros to store music. It would be a waste of money for all to have, but good for some. I would constantly use the Pro if I had it," while one of the math teachers commented, "It would be cool if we had iPads for students, class sets." Another teacher commented about access to websites, "Netflix makes it so much harder to teach… while things that would be helpful (Pinterest) were taken away. I would use tech more if I had what I wanted." An interesting question to ask is how personalized can a large district be with a technology roll-out for all students and teachers?

The data in this study are varied.   In many cases they tend to vary as predicted across generation, while some entries seem to contradict the digital native and digital immigrant argument. Most teachers in this study are using technology on a daily basis, despite the complaints and pitfalls they may have suffered. The final quote which summarizes the majority of this data comes from the oldest Millennial teacher in the survey, who was 37 at the time of the interview: "Overall, I enjoy having tech as a teacher. It is crazy to think how I would have done this job without it. I wish students realized how lucky they are."

Chapter 6 Discussion

Overview

This study seeks to determine if teachers in the Millennial generation integrate technology more often, or differently, than teachers of previous generations. This study does show that there are generational differences in familiarity and value afforded to technology affect the way teachers utilize technology in their classrooms. In this study, all teachers regardless of generation were able to utilize technology in their teaching. When the data is viewed through the lens of the will, skill, tool (WST) framework, it becomes evident that the generations of teachers have different views, beliefs and uses for technology in their classrooms.

Research Questions:

Does generation determine the way teachers use technology in the classroom?

- What do these differences look like between generations?

- Are Millennials able to transform education through their understanding of technology?

- Do Millennials have an innate understanding of efficient and productive uses of computing in education?

Methodology

This study was conducted in a large, suburban school district located in the Midwestern United States. This district was in the fifth year of a 1:1 initiative during the interview phase of this study. The 1:1 initiative in this district put an Internet-connected computer or tablet in the hands of each student and teacher. Students grades 4-12 were allowed to take their devices home,

while Pre-K through 3rd grade kept them at school. Students in grades 7-12 had a MacBook, students in grades Pre-K to 6 had an iPad.

 To gather data in this study, thirty teachers participated in a semi-structured interview, ten from each generation of current teachers. At the time of the interviews, the Millennials were aged 23-37; Generation X ranged from 40 to 54; the Baby Boomers were between the ages of 59 and 64. High school teachers comprise the bulk of the study with some sampling from middle and elementary teachers. There was a wide variety of subject matter represented, including academic core teachers, special education teachers as well as teachers from various elective classes. Each teacher in this study participated in an interview that lasted, on average, one hour. The interview notes along with partial transcriptions of the actual interviews were used to sort and code the data, and to develop an understanding of how the generations differed in their thinking and use of technology in their teaching.

Summary of Findings
Based on the conversations with the teachers in this study, computers have not radically changed teaching for any group of teachers. While the older generations of teachers do use technology to give real-world examples and current resources to their students, their teaching style and the way they conduct their classes have radically changed.   Millennial teachers' classrooms are slightly different. In addition to using the computer-based resources, Millennial teachers rely on technology to organize and manage their classes. The ability to use the computer to structure their classrooms is invaluable to many of the Millennial teachers and cannot be as easily reproduced without technology as the older two groups' classes.

Contrary to generational researchers' predictions, in this study Generation X was the group most resistant to implementing and learning new technology. The Millennial and Baby Boomer groups report they enjoy exploring technology on their own and experimenting with the technology in class, but the Gen X group does not find new technology particularly useful or valuable to their teaching practice. Ultimately, the district's goals in this 1:1 initiative of personalizing learning, increasing collaboration and allowing for project-based learning was not achieved with the older generations in this study. While teachers of all generations use technology, and Millennial teachers integrate it more than the older generations, teaching practices remain largely unchanged. The computers have been adapted as a tool to achieve the goals teachers had for their students before the 1:1 initiative began.

Concluding Discussion

<u>Generational Commonalities</u>
The answer to the main research question, does generation affect how teachers use technology, is mixed. The generations do have different beliefs, attitudes and uses of technology in their classrooms. However, the way the different generations integrate technology may not always be what either advocates for computer education or generational researchers may have predicted. There are also some instances in the study where teachers across generation were in agreement. Most teachers regardless of generation, appreciate how technology helps them manage classes through the distribution of information and eases communication with students. They also value how technology improves access and availability to authentic, timely, real-world content for

teachers and students. Every group in this study was positive about computers providing more authentic learning opportunities.

While teachers across all generations were positive about technology allowing for authentic learning opportunities, they were negative in the ability of technology to teach skills. While the groups varied somewhat in their responses regarding the computer's ability to improve reading, writing, creativity, and problem solving, the overall response to this line of questioning is that it does not. These responses fall into alignment with the pervasive belief in technology as a resource, a tool that can enhance learning, not replace the teacher, especially when it comes to teaching skills crucial to student achievement and that underlie the goals teachers have for their students. None of the groups believe that computers can replace teachers in the classroom and that it is teacher skill more than educational technology is the most important to the success of their students.

There was some consistency across generations about concerns with computers in classrooms. All generational groups take issue with the distractions available on the computer and the ability for students to use computers to cheat. Another major commonality in the three generations was they felt unheard by the school district during the implementation and on-going support of the 1:1 initiative. Besides the lack of response by the district to inappropriate technology use by students mentioned above, teacher specific needs in elective and special-needs classrooms were not addressed in the initial adoption of technology, nor in the subsequent re-deployment of computers to students and teachers in 2018. Also, teachers across generations were critical of the technical problems that students encountered when using their computers at home.

Additionally, all teachers were dissatisfied with the amount and quality of training offered in the implementation of the 1:1 initiative. The perception of the teachers is that the district did not create a plan for training with input from the teachers, nor did the district elicit feedback from them during the initiation of the 1:1 program. The teachers did not have a voice in the implementation or training, which created resistance within the teaching staff. Almost every teacher felt unheard and inadequately prepared to use the technology. However, many were willing and able to utilize colleagues, professional networks and their own knowledge to integrate the technology into their teaching. Without the teachers' willingness to learn on their own, build professional networks and help out their colleagues, little learning or training on how to use technology in the classroom would have been achieved in this district, according to the research in this study.

Generational Differences
Millennials

Through conversations with Millennial teachers, it was apparent that this group embraced using technology in their teaching. Millennial teachers see tech as a useful tool with few drawbacks. If it helps them, they will use it, and most Millennial teachers in this study found ways to integrate technology into their classrooms.

The main way in which the Millennial group of teachers use technology in the classroom is teacher directed. They use the technology to organize and distribute materials, communicate with students and parents, and manage assignments and presentations they give to their classes. This group did not mind spending time searching for things or actually trying it out in the

classroom, as they believe the time they invest in researching, learning and teaching the technology will help them to achieve their personal goals in the classroom and be useful to many of their student's acquisition of skills and knowledge. While Millennial teachers, for the most part, have less experience teaching than the older generations of teachers, their experience with technology in education gives Millennial teachers confidence in themselves and clout with older generations of teachers. When asked if their teaching would be affected if technology was removed from the classroom, Millennial teachers had the strongest stance on keeping technology available to teachers and students.

The Millennials main concern was that technology could create disengaged students, who do not know how to interact with others face to face. Although some teachers in the older generations mentioned this concern, the potential for disconnection was particularly strong in the Millennial group of teachers. Three of the Millennial participants in the study spoke at length about how they wanted to make sure they had face to face discussions with their students and allow for discussions between groups of students in class, with the laptops closed, before allowing the students to use their laptops to conduct research, create individual projects, or start a group assignment. This concern over disconnection of students from other people could be one reason why Millennial teachers focus on how the technology can help them organize, communicate, and manage the class, rather than have their students work on computers themselves.

Generation X

Of all three groups, Generation X is the least positive about the 1:1 initiative in this study. Time is a big frustration point for this group of teachers. This group does not see the value in spending their plan time or class time on something that is not guaranteed to help them or their students.

Generation X has the highest threshold of usefulness of the three groups involved in this study. If the technology wasn't something they felt could be used on a regular basis, they were unlikely to risk the time and effort required to implement a new application or tool in their classroom. This group was the least likely to explore technology on their own or use technology tools they learn about in training. Generation X teachers have the skills to use technology in the classroom, but in practice, have not found computers to improve their teaching or their students learning enough to warrant extra time or attention. Additionally, Generation X teachers were the group that reported that their instruction would be least affected if technology were removed from the classroom.

Generation X teachers are cautious in deciding what technology to use with their students and have a higher bar for acceptance than either Millennials or Baby Boomers. They do see that some technology can be helpful to students. For example, eight of the ten believe that technology can improve writing, which was far more positive than the other two groups. The conversations in this study reveal that Generation X teachers believe that technology enhances individual student volition in school. Each individual student will use it or reject it as they do other educational tools and strategies. According to Generation X, computers do not have the ability to change student motivation to engage students who were not already successful in school. In fact, in the conversations with this group, there is a sense that technology can deepen inequity for students whose parents are not tech savvy or do not have other personal computer resources at home.

Baby Boomers

Baby Boomer teachers in this study are as likely as Millennial teachers to use technology in their classroom, explore it on their own, and share it with colleagues. Overall, they report having a positive relationship with technology in teaching and would see it as "a step backward" to remove technology from the classroom. Compared to the Millennial's use of technology to manage their classrooms, student-directed use is the most common with this generation of teachers. The Baby Boomer generation focuses on how technology resources can help their students learn. They use technology to allow students to research, find current real-world examples and enhance their content knowledge.

The biggest difference in the Baby Boomer generation is their confidence with technology. This generation reports being the least likely to help other teachers and the most likely to rely on younger teachers or their students for technology help. For this reason, they find ways for the students to use technology in ways that do not require much teacher intervention. Students in these classrooms work independently with technology. While resources are expanded online and give more access and independence of students, it is easy for Baby Boomer teachers to switch between online and offline instruction.   In these classrooms, technology is used as a replacement for more traditional resources, not a redefinition of schooling.

Will technology radically change teaching?

According to the teachers in this survey, technology alone will not radically transform education. While younger teachers appreciate and understand how to use technology to organize, manage, and communicate with students; and older generations use it to help build the skills of their

students and provide resources, the overall goals of teachers and the work done by students has not radically changed by technology. Over time, it is possible that schools will look quite different and technology will be used in new ways to teach and learn. As older generations retire and are replaced by Millennial teachers, Generation Z and beyond, the teaching force will be comprised of teachers who have had access to a myriad of new technology in the personal and school life, and most likely will have received formal university training on using technology in their teaching. While this could, over time, change teachers' and students' expectations and experiences of school, for now and for the teachers in this study, there has not been a computer-driven education revolution.

Do Millennials have an innate understanding of efficient and productive uses of computing in education?

Interestingly, the Baby Boomer teachers were the most likely to allow students free reign with technology. While Millennials understand the different programs and applications, and know more about the technology itself, not necessarily have a full understanding of how to utilize the tools to radically transform education. The Millennial generations preferred using technology to assist management of the classroom, distributing information and communicating with stakeholders, rather than having their students use technology to replace or redefine the work they do in class.

Limitations of the Study
The profile of my interviewees was limited in some ways. Twenty-six of the 30 interviewees in this study were high school teachers, and only two of the study participants were elementary teachers. While the elementary teachers interviewed for this study did not seem to be outliers

from their use of technology compared with the generational group to which they belong, this study should not be used at large to reflect the integration of technology into the elementary level. Another limitation to my interview pool is that the school district to which all of these teachers belong has a strong expectation that technology will be used in classrooms. This district does not allow teachers to opt-out of using technology, so while all the teachers do use technology, it may have more to do with the expectations of the district than their own experience with technology, regardless of generation.

The timing of this study is also a limitation. The interviews were conducted in 2019, before the COVID-19 pandemic created remote, online and virtual learning that has relied almost entirely of using computer technology. This pandemic has forced teachers of all generations to rely on technology in a way that no one has experienced in history. During this study, teachers had much more choice to use or not use technology, whereas now, almost every teacher is required to use it for all things in their classrooms. After this pandemic, many teachers could change the way they use technology in teaching, even if in-person, due to what they have been required to learn now.

Further Study
A retirement incentive offered by the school district one year into the implementation of the 1:1 initiative produced a wave of retirements which removed many teachers in the Baby Boomer generation from the classroom in this district. These Baby Boomer teachers may have left due to the financial incentive, but they also may have also left out of resistance to or frustration with using technology in the classroom. A study of the retired teachers could compare the opinions of retired teachers with the Baby Boomers left in the classroom. These interviews could further

explain why in this study, the Baby Boomer teachers were as positive as the Millennial teachers about many aspects of using technology in the classroom.

Another interesting study would be to compare teachers not on generation, but on subject matter. A comparison of core, elective and special education teachers could further show different levels of acceptance and integration of technology into the classroom. Many teachers of special education, performance-based classes, CTE classes, and specialized electives, such as journalism, either use or reject technology based on the expectations and requirements of the course content and curriculum, not on the generation of the teacher.

Another possibility for further study is to conduct a similar project with the same groups of teachers either during or after the conclusion of the COVID-19 pandemic. Due to the nature of remote, online and virtual teaching, all generations of teachers are being required to redefine their classes to online platforms that rely on computer technology. It would be quite interesting to see how these teachers react to technology as a requirement to even meet with their students, as opposed to their statements in this study, which relegated computers to an optional tool, to be used but only at their discretion. To discover the generational differences today may be different than what this study discovered with the 2019 interviews. It would also be interesting to discover if teachers are now using technology to continue traditional methods of teaching or if it will become more student-driven and personalized during this time of online learning.

Implications for Practice

Understanding teachers' needs and expectations in rolling out any reform, including this computer technology initiative, is important for the success of the program. The teachers in this study reported not being asked for input when it came to needed devices, initial training or ongoing support. This lack of communication prevented many teachers from using technology in the classroom as effectively as possible and in fact, harmed some programs. For example, some CTE teachers were using computer technology every day in their classrooms before the digital initiative. When the 1:1 initiative was instituted, it actually caused problems for these programs. The special technological needs and processes that were already in place were overwritten by the district's roll-out of technology for all students. Better communication from the district administration may have prevented these setbacks and provided for a better teacher experience and buy-in to the districts' goals.

The 1:1 initiative in this district put computers in the hands of all students and teachers. Across generational groups, teachers reported they relied on their own knowledge, their colleagues and outside training in order to implement technology in their classrooms. All generational groups reported they wanted more training, and more voice during this innovation. As school districts consider implementing district-wide reform, it is important that they consider the needs and hear the voices of the teachers whose classrooms and students they are affecting. Without input from the teachers before a reform is initiated, as well as their support and buy-in during the implementation, the goals of the district will be made more difficult, if not impossible, to achieve.

Bibliography

Agyei, D. D., & Voogt, J. M. (2011). Exploring the potential of the will, skill, tool model in Ghana: Predicting prospective and practicing teachers' use of technology. *Computers & Education, 56*(1), 91-100. doi:https://doi.org/10.1016/j.compedu.2010.08.017

Becker, H. J. (2000). Findings from the Teaching, Learning, and Computing Survey: Is Larry Cuban Right? *Education Policy Analysis Archives, 8*(51), 31.

Blau, I., Peled, Y., & Nusan, A. (2016). Technological, Pedagogical and Content Knowledge in One-to-One Classroom: Teachers Developing "Digital Wisdom". *Interactive Learning Environments, 24*(6), 1215-1230.

Charp, S. (1997). Some reflections. *T H E Journal, 24*(11), 8.

Christensen, C. M. H., Michael B.; Johnson, Curtis W. (2008). *Disrupting Class: How Disruptive Innovation Will Change the Way the World Learns*. USA: McGraw-Hill.

Computers: Timeline of Computer History. (2016).

Creswell, J. W. (2003). *Research Design: Qualitative, Quantitative, and Mixed Methods Appraches* (2nd ed.). Thousand Oaks, California: Sage Publications.

Cuban, L. (1982). Persistence of the Inevitable: The Teacher-Centered Classsroom. *Education and Urban Society, 15*(1).

Cuban, L. (2001). *Oversold and Underused*. Cambridge, Massachusetts: Harvard University Press.

Cuban, L. (2013). Why so many structural changes in schools and so little reform in teaching practice? *Journal of Educational Administration, 51*(2), 109-125. doi:10.1108/09578231311304661

Cuban, L., Kirkpatrick, H., & Peck, C. (2001). High Access and Low Use of Technologies in High School Classrooms: Explaining an Apparent Paradox. *American Educational Research Journal, 38*(4), 813-834. doi:10.3102/00028312038004813

Donnelly, D., McGarr, O., & O'Reilly, J. (2011). A framework for teachers' integration of ICT into their classroom practice. *Computers & Education, 57*(2), 1469-1483. doi:https://doi.org/10.1016/j.compedu.2011.02.014

Dwyer, D. C., Rignstaff, Cathy, Sandholtz, Judith Haymore. (1990). *Teacher Beliefs and Practices Part I: Patterns of Change*. Retrieved from

Ertmer, P. A. (1999). Addressing first- and second-order barriers to change: Strategies for technology integration. *Educational Technology, Research and Development, 47*(4), 47.

Ertmer, P. A. (2005a). Teacher pedagogical beliefs: The final frontier in our quest for technology integration? *Educational Technology Research & Development, 54*(4), 15.

Ertmer, P. A. (2005b). Teacher Pedagogical Beliefs: The final frontier in our quest for technology integration? *Edcuation Technology Research and Development, 53*(4), 25-39.

Ertmer, P. A., Ottenbreit-Leftwich, A. T., Sadik, O., Sendurur, E., & Sendurur, P. (2012). Teacher beliefs and technology integration practices: A critical relationship. *Computers & Education, 59*(2), 423-435. doi:https://doi.org/10.1016/j.compedu.2012.02.001

Falck, O., Mang, C., & Woessmann, L. (2017). Virtually No Effect? Different Uses of Classroom Computers and their Effect on Student Achievement. *Oxford Bulletin of Economics and Statistics, 80*(1), 38.

Griffiths, D., & Goddard, T. (2015). An explanatory framework for understanding teachers resistancew to adopting educational technology. *Kybernetes, 44*(8.9), 10.

Herring, S. C. (2008) Questioning the Generational Divide: Technological Exoticism and Adult Constructions of Online Youth Identity. In, *The John D. and CatherineT. MacArthur Foundation Series on Digital Media and Learning*. Cambridge, MA: The MIT Press.

Hinostroza, J. E., Ibieta, A. I., Claro, M., & Labbé, C. (2016). Characterisation of teachers' use of computers and Internet inside and outside the classroom: The need to focus on the quality. *Education and Information Technologies, 21*(6), 1595-1610. doi:10.1007/s10639-015-9404-6

Hockly, N. (2017). One-to-one computer initiatives. *ELT Journal, 71*(1), 80-86. doi:10.1093/elt/ccw077

Hoffman, R. L., Petrosky, J. A., Eskander, M. F., Selby, L. V., & Kulaylat, A. N. (2015). Feedback fundamentals in surgical education: Tips for success. *Bull Am Coll Surg, 100*(8), 35-39. doi:10.1111/j.1365-2729.2007.00227.x

Hutchison, A. (2011). Teachers' Perceptions of Integrating Information and Communication Technologies Into Literacy Instruction: A National Survey in the United States. *Reading research quarterly, 46*(4), 312-333. doi:10.1002/RRQ.002

Lai, F., Renfu, L., Linxiu, Z., Huang, X., & Rozelle, S. (2015). Does computer-assisted learning improve learning outcomes? Evidence from a randomized experiment in migrant schools in Beijing. *Economics of Education Review, 47*, 15.

Liu, H., Lin, C.-H., Zhang, D., & Sheng, B. (2017). Language Teachers' Perception of External and Internal Factors in Their Instructional (Non-) Use of Technology. In *Preparing Foreign Language Teachers for Next-Generation Education*. Hershey, PA: Information Science Reference.

McLean, S. (2015). Flipped classrooms and student learning: not just surface gains. *Advances in physiology education, 40*(1), 47-55. doi:10.1152/advan.00098.2015

Mishra, P. K., Matthew J. (2006). Tecnological Pedagogical Content Knowledge: A Framework for Teacher Knowledge. *Teachers College Record, 108*(6).

Ottenbreit-Leftwich, A. T., Glazewski, K. D., Newby, T. J., & Ertmer, P. A. (2010). Teacher value beliefs associated with using technology: Addressing professional and student needs. *Computers & Education, 55*(3), 1321-1335. doi:https://doi.org/10.1016/j.compedu.2010.06.002

Pegler, K., Kollewyn, J., & Crichton, S. (2010). Generational Attitudes and Teacher ICT Use. *Journal of Technology and Teacher Education, 18*(3), 443-458.

Peterson, D. J. (2016). The Flipped Classroom Improves Student Achievement and Course Satisfaction in a Statistics Course: A Quasi-Experimental Study. *Society for the Teaching of Psychology, 43*(1), 6.

Petko, D. (2012). Teachers' pedagogical beliefs and their use of digital media in classrooms: Sharpening the focus of the 'will, skill, tool' model and integrating teachers' constructivist orientations. *Computers & Education, 58*(4), 1351-1359. doi:https://doi.org/10.1016/j.compedu.2011.12.013

Poore, J. H., Hamblen, John W. (1984). Why Computer-Based Education is Making Slow Progress: An Analysis of Costs and Other Impediments. *AEDS Journal, 17*(3).

Prawat, R. S. (1992). Teachers' Beliefs about Teaching and Learning: A Constructivist Perspective. *American Journal of Education, 100*(3), 354-395.

Prensky, M. (2001). Digital Natives, Digital Immigrants Part 1. *On the Horizon, 9*(5), 6.

Price, R. (1989). An Historical Perspective on the Design of Computer-Assisted Instruction: Lesssons from the Past. *Computers in the Schools, 6*(1).

Rogers, E. M. (1995). *Diffusion of Innovations* (4th ed.). New York: The Free Press.

Ruggiero, D., & Mong, C. J. (2015). The Teacher TEchnology Integration experience: Practice and Reflection in the Classroom. *Journal of Information Technology Education: Research, 14*, 18.

Shapley, K., Sheehan, D., Maloney, C., & Caranikas-Walker, F. (2009). Evaluation of the Texas Technology Immersion Pilot: Final Outcomes for a Four-Year Study (2004-05 to 2007-08). In (pp. 168): Texas Center for Educational Research. P.O. Box 679002, Austin, TX 78767.

Shulman, L. S. (2013). Those Who Understand: Knowledge Growth in Teaching. In (Vol. 193, pp. 1-11): Journal of Education.

Silvernail, D. L. G. A. K. (2007). *Maine's middle school laptop program: Creating better writers*. Retrieved from Portland:

Tatnall, A. (2015). Computer education and societal change. *Information Technology & People, 28*(4), 742-757.

Teo, T. (2011). Factors influencing teachers' intention to use technology: Model development and test. *Computers & Education, 57*(4), 2432-2440. doi:https://doi.org/10.1016/j.compedu.2011.06.008

Tondeur, J., van Braak, J., Ertmer, P. A., & Ottenbreit-Leftwich, A. (2017). Understanding the relationship between teachers' pedagogical beliefs and technology use in education: a systematic review of qualitative evidence. *Educational Technology Research and Development, 65*(3), 555-575. doi:10.1007/s11423-016-9481-2

Tyack, D. C., Larry. (1995). *Tinkering Toward Utopica: A century of public school reform*. Cambridge, MA: Harvard University Press.

Tyak, D., & Cuban, L. (1995). *Tinkering Toward Utopia: A Century of Public School Reform*. Cambridge, Massachusetts: Harvard University Press.

U.S. Department of Education, N. C. f. E. S. (2016). Number and internet access of instructional computers and rooms in public schools, by selected school characteristics: Selected years, 1995 through 2008. In.

Waters, T., Marzano, R. J., & McNulty, B. (2003). *Balanced Leadership: What 30 Years of Research Tells Us about the Effect of Leadership on Student Achievemnt. A Working Paper*. Retrieved from Aurora, CO:

Waters, T. M., Robert J.; McNulty, Brian. (2003). *Balanced Leadership: What 30 Years of Research Tells Us about the Effect of Leadership on Student Achievement. A Working Paper*. Retrieved from Aurora, CO:

Williams, N. L. L., Karen H. (2016). One-to-one computing and student achievenent in Ohio high schools. *Journal of Research on Technology in Education, 48*(3).

Zheng, B., Warschauer, M., Lin, C.-H., & Chang, C. (2016). Learning in One-to-One Laptop Environments. *Review of Educational Research, 86*(4), 1052-1084. doi:10.3102/0034654316628645