2018

Barriers to Effective Technology Adoption and Integration

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BARRIERS TO EFFECTIVE TECHNOLOGY ADOPTION AND INTEGRATION

A MASTER'S THESIS

SUBMITTED TO THE FACULTY

OF BETHEL UNIVERSITY

BY

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IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE OF

MASTER OF ARTS IN TEACHING

MAY 2018

BETHEL UNIVERSITY

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May 2018

APPROVED

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Abstract

This study reviews the available literature to identify the barriers to technology adoption, which encompasses professional, efficiency-driven uses of technology by teachers and students, and to technology integration, which encompasses pedagogically sound, student-learning-driven uses of technology in the classroom. It also seeks to explore the relationship between the ongoing emphasis and pressure to adopt and integrate technology and occurrences of teacher burnout. Factors influencing technology adoption were determined to include demographic factors, teacher beliefs and attitudes toward technology, and self-efficacy. Technology integration was influenced by similar factors, as well as district-level policies and professional development. Technology adoption and integration efforts were connected to teacher burnout through three types of anxiety- anxiety about the changing nature of technology, anxiety about lack of abilities and low self-efficacy, and anxiety and frustration about poor professional development- and the increasing burden of those anxieties over time. Recommendations for future research and professional implications are also provided.

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CHAPTER I: INTRODUCTION

When I was student teaching in my high school placement, my cooperating teacher had all of his exams online, where they automatically graded themselves, leaving him only the short answer and essay questions to correct and provide feedback on. Despite the ease of this application of technology, I frequently heard his colleagues complaining about how many exams and quizzes they had to grade, and how much paper was being wasted when they had their students print out large papers. I was typically done grading exams by five minutes into the following class, so I could not understand why his colleagues would not take 30 minutes to load their exams into the online system. They cited concerns that the system might be changing soon, but even then, I felt sure that 30 minutes would be worth even one exam with time saved.

Why the Study of Educational Technology is Important

While it may be the case that saving time is enough of a reason for many overworked teachers to try to work with technology, efficiency is by no means the only reason an educator would look to these tools. For starters, research over the last three decades has shown that technology positively impacts learning. Ganguli (1992) found that computer-based learning is more joyful and motivating for students, pushing them to better learn concepts. While students today may not derive as much joy simply from the use of technology as those at the dawn of the digital age, research has repeatedly confirmed Ganguli's (1992) fundamental conclusions: technology helps learning (Mumtaz, 2000), and schools that properly integrate instructional technologies can elicit higher engagement from their students (Kay, Knaack, & Petrarca, 2009). This pattern of

discovery led to the Ertmer and Ottenbreit-Leftwich (2010) statement that effective teaching requires effective technology use.

One would certainly hope that the betterment of learning is enough of a reason for educators and education researchers to take an interest in technology, but as democratic citizens, it is important to examine this area because of the volume of spending that governments around the world have poured into bringing classrooms into the digital age (Hew & Brush, 2007). The Secretary of Education recently Tweeted a picture of a classroom set up with rows of students looking up at a teacher in front of a blackboard and claimed that despite billions and billions of dollars being poured into modernizing education, American education is largely where it was 100 years ago. She received pushback from teachers around the country, but it is essential that researchers examine how true that claim is after almost 30 years of federal spending on classroom technology.

It may be that constructivism has outmoded the traditional setup of a classroom with rows of desks facing the teacher, but there are reasons to be concerned that a blackboard is still the dominant form of educational technology being used. Study after study confirms that the use of instructional technologies is still rare in classrooms from the United States to Turkey (Ertmer, 2005; Yildirim, Kocak, & Kirazci, 2001; Mueller, Wood, Willoughby, Ross, & Specht, 2008; Srimshaw, 2004; Smeets; 2005; Tondeur, van Braak, & Valcke, 2007). The only conclusion that can be drawn from the literature is that the pushes to integrate instructional technologies in the classroom have fallen far short of expectations (Parsad & Jones, 2003; Swanson, 2006), and only a small number of

teachers are using technology effectively for student-centered learning (Culp, Honey, & Mandinach, 2005). Most of this research was conducted over a decade ago, however, so there is a need to reexamine our progress.

Again, though, there is reason to be skeptical that education has advanced much in this area. The research suggests that the number of teachers capable of integrating technology is low (Kozma, 2003). True, Kozma (2003) reached that conclusion at the beginning of the century, but Tondeur et al. (2012) reaffirmed the underlying truth that technology is considerably underutilized by pre-service and new in-service teachers, primarily because a disconnect exists between technology courses in teacher preparation programs and the practices and constraints of a real classroom. The current literature finds that most pre-service teachers are unable to use innovative (i.e. technological) or creative ways for promoting students' higher order thinking (Andersson, 2006; Dawson, 2006; Kay & Knaack, 2005; Wright & Wilson, 2005). The reason educators and education researchers should be concerned about a lack of progress is because the research claims that it is not just a matter of time before technology bubbles into every classroom. There is something wrong with teacher training at the outset, and something wrong with technological professional development, such that there is not a narrowing, but a widening of the gap between "digital immigrant" teachers and "digital native" students (McClure, 2011).

There are two primary issues at play here. The first is related to my experience that caused me to start to wonder about this area of research. What are the barriers that prevent teachers from adopting technology? Why were the teachers I interacted

with in my high school placement unable or unwilling to load their exams into their computers and deliver them electronically? Why are papers still being graded by hand, rather than being automatically spell-checked in a word processor, and being evaluated for plagiarism in an online repository of written works? Why are some teachers still operating in the way the Secretary of Education believes, with no instructional tools besides a blackboard (or whiteboard) and a piece of chalk (or a marker)?

The research suggests a number of factors at play. The first is what many may suspect, and that is that teachers simply lack the materials or hardware to integrate technology in the classroom. If your building has Internet that does not mean very much if you lack devices to connect students to it.

The second are demographic factors. Some research suggests that women are just less likely or less capable of using technology than men. More believably, young people may be more capable or invested in technology adoption that older people. And some research claims that it has to do with what discipline the educator works in.

Rather than assume that there are inherent differences between different demographic groups, most research attempts to explore differences in the mindsets of teachers. A significant body of research examines the interplay between anxiety and technology adoption, with many finding that it is precisely the divide between digital immigrant teachers and digital native students that scares teachers out of even trying.

Unsurprisingly, attitudes about the usefulness of technology also have a significant impact on the use of technology by teachers. Perhaps more unexpected, the use of technology may also be related to how constructivist a teacher is in their

approach to teaching. The more teachers believe students should build their own knowledge, the more likely they are to bring in tools, such as instructional technologies, that may facilitate that.

The primary determinant may be teacher-efficacy with technology, and it may be that beliefs and attitudes are actually caused by efficacy levels. All of these factors will be explored in greater depth in the next section.

The second issue with the use of technology in the classroom is related to the first, but rests on the difference between the words “adoption” and “integration.” Technology adoption is just the presence of technology in the classroom and the use of the technology by the teacher. It can be as simple as my cooperating teacher’s use of automatic grading software. Adoption encompasses all professional uses of technology, including recording grades in spreadsheets, emailing, and writing with a word processor. Integration is much more difficult. Integration requires that students be using the technology, and not just to make regular academic processes more efficient. Integration requires technology to be used as a critical piece of a pedagogically sound instructional strategy that could not have been accomplished in the absence of the technology. This would include using a computer to play videos that model molecular interactions, or using virtual reality simulations to tour the human cardiovascular system. While barriers to technology adoption are certainly of interest, there is no doubt that technology integration is where most of the benefits of technology are found.

Many of the same barriers exist here as with technology adoption. Beliefs and self-efficacy are key. But now also added are structural considerations, like district

management and integration policies, and the substance of teacher preparation programs. The presence or lack of pressures from administrators, fellow teachers, and from parents can strongly influence whether a teacher attempts to integrate technology into their classroom.

Another factor affecting integration is poor professional development. The literature shows that professional development is too techno-centric, and does not show teachers how technology can mesh with pedagogy, instead just showing off the features of the latest gadget or software. This can lead to a mismatch between the substance of a professional development session and whole disciplines or genders in the audience. When professional development is unproductive, it may leave teachers feeling like they just didn't get what was being talked about, lowering self-efficacy, or make them feel like professional development is too disconnected from the real mechanics of teaching to be useful. Either way, poor professional development can be, and is, devastating to the technology integration movement.

The final research question deals with how the emphasis on technology adoption has influenced teacher burnout levels, given the apparently large gap between the thirty-year push and billions of dollars spent on integrating technology in the classroom and the actual levels of integration. The literature does not directly address this question, but a synthesis of technology literature and burnout literature suggests the following relationships: burnout may be increasing because teachers are uncomfortable with the constantly-changing nature of technology, which is causing them anxiety in an environment where they feel pressured to be on top of the latest technological

advancements (Christensen, 2002; Li, Worch, Zhou, & Aguiton, 2015). The pressure to perform with technology may also compound existing self-efficacy problems that teachers might experience, because they are now faced with another area in which they must be proficient. This low self-efficacy would only be made worse by the poor state of technology professional development, which, as was stated, could leave teachers feeling like they just don't get what is going on with technology, or could leave them feeling like their professional development sessions are a waste of time, which would contribute to burnout in its own right. It also appears that teachers do not become inoculated to these pressures, because veteran teachers are more likely to experience burnout than newer teachers (O'Brennan, Pas, & Bradshaw, 2017).

These research questions regarding barriers to technology adoption and integration, and the relationship between technology adoption and integration and teacher burnout will be addressed at length in the following section. The thesis will conclude with implications for future research and professional applications.

CHAPTER II: LITERATURE REVIEW

Literature Search Procedures

The original intent of this thesis was to focus more on the relationship between technology and burnout, but finding that the current body of literature does not include many, if any, pieces of research on that relationship (at least in the ERIC database), the focus was expanded to the questions of general barriers to adoption and integrating technology. The new study began by searching generally for peer-reviewed journal articles that had to do with those barriers in the ERIC database. The intention was to focus on research from the last five years, and those parameters yielded Efe and Efe (2016), Incik and Akay (2017), and Tambunan (2014).

It quickly became clear that either education research had not delved very deeply into this topic, that ERIC simply did not house the relevant research, or that the research had taken place before the time period in question. So, further studies were pulled from the reference of the first three articles reviewed to identify what the background research in this field was. When a relevant article was identified, its references were combed for relatively recent studies in the same area, and this pattern was continued until studies were included from the early 1990s. It will be noted both here and in the implications for future research how troublingly quickly this process led back to the first decade of the 21st century. This field of study needs an update and warrants continuous updates to keep pace with new technology and developing technological pedagogy.

Factors Influencing Adoption of Technology

There are several factors that influence the adoption of technology, or the use of technology to improve efficiency in the classroom. The first that will be discussed is the simple lack of materials or technological hardware and then demographic factors. From there, the section will work backward along a chain of factors leading to the most antecedent general factor, self-efficacy.

Lack of Materials or Hardware

It is a simple enough idea that in order to use technology in the classroom, a teacher or school must have the technology. And despite funding issues and uncertainties that schools face every time a levy goes up to be voted on, the promise of adding technology to a classroom has proven to be a fairly strong magnet for dollars. From the Apple Classroom of Tomorrow initiative, begun in 1985, which brought new technology to five schools in its pilot stage to President Obama's ConnectED initiative that drew $750 million in commitments from tech companies (Huetteman, 2014), the idea that classrooms should have a digital component has been met largely positively.

And yet, research shows that physical facilities continue to be a factor in the low rate of technology adoption by teachers and schools (Ertmer, 2005). It would be reasonable to assume that in the last 13 years, things have gotten better. That may well be the case; the research dries up about 7 years ago. Goktas, Yildirim, and Yildirim (2009) provided questionnaires to 53 deans of schools of teacher education, 111 teacher educators (people who educate pre-service teachers), and 1330 prospective teachers to identify the barriers to technology adoption in pre-service teacher

programs. This study takes place in Turkey, and at the university level, so it can only provide a general indicator at best of what is going on in United States public schools, but a substantial part of the educational technology literature is based on studies from Turkey, so it cannot be ignored or overshadowed by US-based studies. They found that the top factors preventing the inclusion of technology in pre-service teacher training programs was a lack of ongoing professional development, a lack of appropriate software and materials, and a lack of hardware. Two of the top three limiting factors are related to having the basic technological materials in the classroom.

The generalizability of the study is very limited because of the poor response rate (49.8% of teacher educators and 62.9% of prospective teachers), no defense that the missing responses were random, the Turkish setting, and the university-level focus,. But there are reasons to take Goktas, Yildirim, and Yildirim (2009) seriously. First, despite a poor response rate, the initial sample size was large, which was exceedingly rare in this review of the literature. Second, the follow-up open-ended component of the study matched the results of the quantitative component, indicating that the study had at least internal consistency. Third, it is not an unreasonable assumption that universities in Turkey might face many of the same funding challenges as locally and state-funded public schools in the United States, and that those problems could possibly be worse in the United States. While most of Turkey's tertiary education funding comes from the national government, determined only by legislators, a significant portion of public school funding in the United States comes from citizens willingly voting for themselves to pay higher taxes. If Turkish universities have a hard time acquiring

educational technology, it is not unreasonable to imagine that US public schools would too.

Hutchison and Reinking (2011) supported that idea. Another rare study with a substantial sample size, it is based on a survey that was distributed to every International Reading Association member reachable by email. This population was chosen because they are predominantly literacy educators, and because every state has state and local councils, allowing for convenient access to a group that is diverse in grade level, teaching experience, and location. While only 2% of the total IRA population responded, there is no reason to believe that any members were systematically excluded based on factors related to the investigation. The survey was constructed by the researchers, and then edited by a focus group of three teachers representing different levels of Information and Communication Technologies (ICT) competency. It was distributed over three months with multiple contacts to increase participation. They found that while the Internet was ubiquitous in classrooms as of 2011, a sizable minority of teachers lacked laptops, and even projectors. The second most common response to how teachers would improve technology adoption was improving access to technology.

The research shows that access to technology has been improving over time, as could be expected, but there is clearly much room for improvement. There might be a temptation to assume that this problem will eventually solve itself, or that it can only trend toward being solved, as if the total population of schools in the United States is a bucket and technology is like water being poured in; the bucket can only get more filled, or at least stay the same. But there is a need for ongoing research on this question,

because a more accurate analogy would be a bucket filling with water on a hot, dry day. As time passes, technology becomes out of date, and may no longer provide the benefits to education or teacher efficiency that it once did. The water level in the bucket will go down as technology depreciates, so education researchers should track the level to which *relevant* technology has been provided for classrooms and teachers.

Demographic Factors

If the only thing standing between technology in classrooms was the resource-requirement of actually procuring the technology, then there would be little need for research in this area. Simple monitoring of slow but steady progress toward universal adoption would be all that is required. But there are clearly more factors at play, and much research has been devoted to finding demographic factors that affect technology adoption.

Gender. Despite education being a female-dominated profession for much of its history in the United States, some research shows that female teachers actually use computers less than male teachers (Zogheib, 2006). This may be because of gender role expectations that caused female teachers to perceive the usefulness and ease-of-use of computers as lower than male teachers when the idea of digital technology in the classroom was newer (Yuen & Ma, 2002). But studies have shown that those differences may still exist among the latest generation of teachers to join the profession. Colley and Comber (2003) and Vale and Leder (2004) both found that gender differences in computer attitudes grow large by 8th grade. That would mean that female teachers who

obtained their licensure as recently as five years ago could possibly still be operating with low opinions of the usefulness and ease-of-use of technology.

Zhou and Xu (2007) examined this question at a Canadian university that had just completed a ten-year plan to have 50% WebCT (a precursor to Blackboard, the online learning management system) adoption by 2005. They sent a 30-item survey with Likert items, ranking items, and open-ended questions to 2105 full-time faculty and sessional instructors at the university, and received 341 valid surveys in return, for a 16.2% response rate. While the response rate is less than ideal, and males are slightly overrepresented in the response pool, their results are worth examining. They found that females had lower confidence and less experience in the use of computers in teaching, and that males were more likely than females to believe that students can learn the material more easily or thoroughly with technology. Males were also more likely to use the technological or professional functions of technology (those that increase teacher efficiency, i.e. adoption) than females. Females were found to be more likely than males to blame unstable hardware or software, lack of training, and limited research evidence as reasons to avoid technology.

The complaint by female teachers about lack of training opportunities is a valid one, which will be discussed at great length later in this thesis. Professional development, even when done well, is geared toward the male mindset about how to approach and learn technology. But it is less believable that technology is actually more finicky for female teachers. It is possible that there is some inherent difference between

men and women that leads to lower technology adoption by female teachers that cannot be otherwise explained.

But the research is far from a consensus on that point. Sang, Valcke, van Braak, and Tondeur (2010) wanted to research the effect of gender on technology adoption outside of a Western setting. They surveyed four teacher education universities in China. They followed best practices in developing their instruments using back translation, where the survey items are translated into the target language, and then translated back by a separate team. The teams compare notes to identify any areas of difference between the original and the back translation to ensure the best possible clarity. They also derived their instruments from previously used scales to ensure the validity of their instruments. They found that gender does not directly affect ICT adoption. More interestingly, they found that gender is significantly correlated to whether a teacher holds constructivist views, with female teachers being more likely to be constructivist. Constructivist views were, in turn, associated with technology adoption. The relationship between constructivism and technology adoption will be explored more later, but the results of Sang et al. (2010) suggest that female teachers may be more likely to adopt technology.

There are a number of reasons to take those results with a grain of salt. While Sang et al. (2010) had an excellent response rate of 97%, amounting to 727 completed surveys, 93.5% of all respondents were female, which is an overrepresentation of the 81.1% of all Chinese student teachers that are female. It also begs the question of how much weight should be put on a study that rests on the responses of about 40 male

student teachers. Also, all of the studied universities had linkages to a Belgian university, which is why they were chosen. This may actually make their results more generalizable to the United States, if there is some kind of diffusion of the Western value of at least nominal equality between men and women, but it leaves the study vulnerable on two sides. On the one hand, the purpose of the study was to examine a Confucian education system, and the fact that they studied Belgian-linked universities opens them up to the criticism that their subjects may have been too Western. On the other hand, while the results may be more generalizable to a population of interest (the United States) because of that linkage, the respondents were still all Chinese student teachers, and therefore any generalizability must be strongly questioned.

Other research also counters the idea that females are less likely to adopt technology, however. Volman, van Eck, Heemskerk, and Kuiper (2005) directly contradict Yuen and Ma (2002) and Colley and Comber (2003). Volman et al. (2005) found that gender differences in attitudes toward computers are minimal in primary school students, and that girls are only slightly less positive than boys about computers at the secondary level (not the large gap by 8th grade discovered in other research). They optimistically predict that gender differences may disappear altogether with the passing of a generation, which leads to the next demographic factor.

Age. It is entirely possible that simply waiting until more digital-native generations take over the teaching profession will lead to greater technology adoption. In a study not focused on the education sector, Morrs, Venkatesh, and Ackerman (2005) found that while there were gender differences among 342 workers being introduced to

a new computer, those gender differences were far greater among older workers than younger workers. This reinforces the idea that differences in genders with regards to technology adoption have more to do with old-fashioned conceptions of gender roles than with inherent differences between genders. This also offers hope that time will fix at least part of the problem with low technology-adoption rates. But adoption is only the first part of the problem, and "waiting it out," will not work when it comes to integration.

Discipline. At first brush, age and even gender may seem obvious demographic factors to investigate. But the discipline of the teacher make just as much, if not more sense as a factor in that teacher's decision to adopt technology. There is unquestionable face validity in the assumption that a science teacher is more likely to use a computer than a reading teacher, so it is imperative to explore whether the evidence bears that out. While their primary concern was teacher efficacy with technology (which is the subject of the next subsection), Incik and Akay (2017) spoke to the question of discipline-related technology adoption as well.

Incik and Akway (2017) took the results of prior research that says technology self-efficacy is an important part of teachers adopting technology and attempts to answer very important, related questions: How many pre-service teachers actually feel like they have technopedagogical competency, how many of them actually even feel like technology is important to education, and what do they believe they need in order to successfully integrate technology into their classrooms?

To answer these questions, Incik and Akay (2017) conducted a mixed methods study, consisting of quantitative data gathered through the Technopedagogical Education Competency (TEC) Scale and the Technology Perception (TP) Scale, and qualitative data gathered through an open-ended question form. The quantitative study was conducted using 35% of the 1778 students in training in the Faculty of Education at Mersin University, or 626 pre-service teachers. The qualitative aspect only included 67 pre-service teachers. Sixty-three percent of the respondents were women, and 37% were men. Twenty-four percent were studying Turkish Language Teaching, 22% Elementary School Teaching, 20% Pre-School Teaching, 13% English Language Teaching, 11% Science Teaching, and 11% Mathematics Teaching. The TEC Scale has 33 5-point Likert items, and the TP Scale has 28 5-point Likert items. The open ended form had two questions: “Explain the effect of instructional technology on your education throughout Faculty of Education” and “What are your suggestions to improve contributions of instructional technologies to the education of pre-service teachers?”

Incik and Akay (2017) found that pre-service teachers regard themselves with a moderate level of technopedagogical competency, and feel positively toward technology and believe it is useful. Their recommendations for improving educational technologies are to improve physical infrastructure and have better pre-service training in the use of educational technologies. Importantly for this demographics subsection, they also find that there is no variation in self-perceptions of competency or anxiety across class and gender, but they do find wide variation across subject area. Contrary to what might be expected, Turkish literature and English language teachers reported the

most competency, while science and math teachers reported the lowest. This may be because it is easier to use technology for "adoption" uses in literature and language classes (looking up translations, using word processors for grading), while technology use in a science or math class would require a greater level of integration (videos with scientific models, pictorial representations of mathematical problems). This last finding somewhat undercuts Morrs, Venkatesh, and Ackerman (2005), who found that technology will become more ubiquitous in the classroom as digital-age pre-service teachers populate the workforce, and shows how attitudes toward technology might be sticky across generations.

Many resources have been devoted to determining links between demographics and technology adoption, but nearly all of the mentioned studies falter over the same obstacle. They all require some other factor to mediate the relationship between their demographic factor and technology adoption. If demographics are accepted as the underlying cause, then the problem is immutable. Older generations are bad at technology, inherently, and unable to learn. Female educators are afraid of technology, and nothing can fix that. Math and science teachers just do not believe they can be successful with computers. But even when being facetious, mediating terms cannot be avoided. Older generations "are bad at" technology, meaning there is a lack of skill, which is changeable. Female educators "are afraid of technology," meaning they suffer from anxiety that can hopefully be assumed is not biological in its origin, and may have a separate cause that is just also correlated with gender (such as poor professional development, which will be discussed at length under the next guiding question). Math

and science teachers “do not believe they can be successful,” which means they have a self-efficacy problem, which could plague any teacher, not just math and science, and can be corrected. These mediating factors, which have broader applicability, and importantly, greater capacity for change, than demographics, are the subject of the following subsections.

Anxiety

Anxiety about computers has a clear and obvious relationship to computer use, but anxiety is equally as flawed an explanation of low computer adoption rates as demographics, because while anxiety is not static like demographics, it is itself the effect of some antecedent condition, unless it can be believed that a large portion of the teaching profession suffers from chronic anxiety. That being said, anxiety has been the focus of a not-insubstantial body of literature, and this is a literature review. Fortunately, that research also suggests what some of those antecedent conditions might be.

Mahar, Henderson, and Deane (1997) concluded that there is a positive and significant relationship between computer anxiety and computer experience. That is, the more time a person spends with computers, the more anxious they will become about them. They suggest that this may be due to the constantly change and advancing nature of technology. Similarly, Chua, Chen, and Wong (1999) found that people may actually develop anxiety about technology during their experiences in technology classes. These results may seem counterintuitive, given that the hope would be the more training an individual has in something, the comfortable they are with that thing.

But if that thing is technology, which is such a vast concept as to include computers, everything available on the Internet, podcasts, multimedia presentation software, computer games, and more, and which is constantly expanding at an exponential rate, then increased exposure to technology and technology training may only reveal to a person how little they know. And more, it may reveal to them the truth that in the time it took them to learn the latest technological tool, so many more were developed that they actually know a smaller percentage about the technological universe than they did before they started.

This anxiety can only be heightened in the classroom environment. Every year, a teacher will be confronted with new technology to learn, and more professional development seminars on technologies they have never heard of. It is necessary for the teacher to learn that new technology, because their students will only have background knowledge of the latest technology. This means that the actual knowledge the teacher has previously learned is no longer useful (although the skills of acquiring technological knowledge would hopefully still be useful), and they must learn a new set of knowledge. This is a repetitious cycle. Christensen (2002) identified this anxiety about staying one step ahead of technologically competent students as being a negative factor in the continued use of technology. In other words, teachers that never adopted technology are not the only concern, but also about teachers who grow weary of this cycle and just drop technology from their classroom altogether.

Efe and Efe (2016) attempted to test whether this relationship between computer anxiety and computer experience holds across cultures. Efe and Efe (2016)

wanted to explain what causes technology anxiety among pre-service (student) teachers, and identify where those factors are interactive with culture. To do this, they studied 538 pre-service teachers studying at Dicle University Ziya Gokalp Education Faculty in Turkey and 188 pre-service teachers studying at the St. Gallen Teacher Education University in Switzerland during the 2011-2012 academic year. They fielded questionnaires to establish levels of technology anxiety, technology self-efficacy, and attitudes toward technology among their sample, and then attempted to determine how those factors, as well as frequency of technology use and level of experience, assumed to be duration of training with technology, affect technology anxiety levels. To assess those dimensions, Efe and Efe (2016) used the State Anxiety Scale (Spielberger 1983), a 20-Likert-type-item questionnaire to measure technology anxiety, the Self-Efficacy Perception for Technology Scale (Askar and Umay 2001), an 18-Likert-type-item questionnaire to measure technology self-efficacy, and the Pre-Service Science Teachers' Attitudes toward Educational Technology Scale (Efe, 2011), a 5-point Likert scale used to collect attitudes toward technology.

Efe and Efe (2016) attributed any differences in how the identified factors affect technology anxiety to differences in culture between Switzerland and Turkey, which they generalized to differences between West and East. They found that there are differences between Switzerland and Turkey in how the pre-service teachers' technology anxiety levels are affected by the identified factors. The more experience Swiss and Turkish pre-service teachers have with instructional technology, the higher their level of anxiety about it. But the higher the frequency of instructional technology

use, the more anxiety a pre-service Swiss teacher feels toward it, and the less anxiety a pre-service Turkish teacher feels about it.

Their generalization to this being a schism between East and West is a sticking point, for a number of reasons. First, their results do not exactly match up with other research that attempts to find an East-West divide, including Rosen and Weil (1995), who found somewhat different results for similar factors compared to Efe and Efe's (2016) Swiss results, and even across countries in the same hemisphere within their own study. Also, Efe and Efe (2016) found that Swiss pre-service teachers experience greater technology anxiety the more they use technology. An attempt to state that those in the West experience greater anxiety the more practice they have with technology, based on a few hundred Swiss pre-service teachers, does not pass face validity. Efe and Efe (2016) make an incredibly valuable contribution to an all-too-small push to bring this body of literature out of the time when teachers may have had one computer in their room and used it to play Oregon Trail, but either researchers should stop looking for a clash of civilizations, which must be the ultimate in vague demographic factors, or more research needs to be done that spans more than just one country in either the East or West to draw such general conclusions.

Beliefs and Attitudes Related to Teaching

Beliefs and attitudes are one step closer to the antecedent conditions that affect technology adoption. They are necessarily a precursor to anxiety. Blignaut, McDonald, and Tolmie (2002) found that instructional technology-related attitudes play a determinant role in anxiety. In the mind of a teacher with negative technology attitudes-

"I believe that technology is difficult, therefore I am anxious about using it. I believe that students will always be one step ahead of me with regards to technology, therefore I feel anxiety about being perceived as out of touch if I am not constantly updating my knowledge." There are two kinds of attitudes or beliefs that impact technology use: attitudes about technology generally and beliefs about constructivism versus traditionalism in teaching.

General attitudes about technology. Altun (2002) and Teo (2010) both found that teacher attitudes are the most important factor determining technology use. Teo (2009) found that the intention to use technology was directly affected by the perceived usefulness of technology, attitudes toward computer use in general, computer self-efficacy (the next and final section in this guiding question), and indirectly affected by perceptions of the complexity of using technology. Perceived usefulness, attitudes about use, and perceptions of complexity are all beliefs or attitudes about technology. This leads to an important point: it is not useful to think about "attitudes" as a monolithic concept or force. Everyone is capable of having a multitude of beliefs about different aspects of technology that conflict with one another, but some will be more influential in the choice to use technology than others. One would hope that if a teacher simultaneously believes that technology will be beneficial for students and that technology is difficult to use, they will be more heavily influenced by the former belief and choose to use technology. Fortunately, the literature explores these intricacies.

The first and most basic belief a teacher might have that stands in the way of technology adoption is that technology may just not be a useful tool to facilitate

learning (Cuban, 2001). Fortunately, research would suggest that this idea is out of date, as Incik and Akay (2017) determined that pre-service teachers generally have positive perceptions of technology and view it as useful. In some fields, 16 years may not be enough to radically reshape conclusions, but where the usefulness and ubiquity of technology is concerned, repeated and frequent updates to the literature are required.

Varol (2013) also wanted to determine teacher attitudes toward ICTs, computers, and the Internet. To determine these, two questionnaires were sent to 157 elementary school teachers that were randomly selected from the eastern part of Turkey in the 2012-2013 school year. Of those, 125 agreed to fill out the questionnaire, and only 100 filled it out fully enough to be used. Varol (2013) found that the more positive a teacher's attitude toward technology, and the more they engage with it, the more likely they are to use it. The next research question will deal with Varol's (2013) other results concerning teacher knowledge about technology and some of the deeper limitations of the study, but for now, it is enough to be aware that 1/3 of the sample did not respond, and no defense was given of the randomness of this non-response rate, which limits the value of the study.

Beliefs about constructivism vs. traditionalism. By the very definition of the word, it may come as no surprise that traditionalist teachers are less likely to use technology than constructivist teachers (Becker, 2001; Judson, 2006; Niederhauser & Stoddart, 2001). That result is tentatively confirmed in Hermans, Tondeur, van Braak, and Valcke (2008), who attempted to take the focus off of technological factors, such as beliefs about technology and attitudes toward computers and treat teachers'

educational beliefs about traditionalism vs. constructivism as the antecedent of computer use. They seek also to control for those technological factors, and typically assumed demographic factors like sex and age. They specifically define teacher beliefs as "the individual conceptions about desirable ways of teaching and conceptions about how students come to learn," where traditionalist teachers favor a more teacher-focused classroom, while constructivists believe that students should construct their own learning, with the teacher in a facilitator role. To gather the data, they sent a survey to 525 primary school teachers from 68 schools in Flanders (the Dutch-speaking area of Belgium). Participants were distributed about evenly across primary school grades, were 81% female, and averaged 37 years of age. Once the data was collected, multilevel modeling was employed to analyze the effect of demographics, computer experience, general computer attitudes, supportive computer use, and teachers' constructivist and traditional beliefs on the use of computers.

Hermans et al. (2008) found that constructivist beliefs had a positive impact on computer use, while traditionalist beliefs had a negative impact. They also found that 18% of the variance in use was attributable to differences between schools, which they interpreted as indicating that cultures of pro- or anti-computer use could develop. Social pressure to use or not use computers will feature prominently in the structural considerations section of the next guiding question. One of the major limitations of this study, as far as classifying it under the first or second guiding question of this thesis is that Hermans et al. (2008) aggregated eight applications of technology, some of them "adoption" applications and some of them "integration" applications, into one

dependent variable “class use of computers.” This aggregation means that this study can only serve as an indicator in the formation of future hypotheses on this subject, and cannot itself serve as a pointer to a conclusion. It may be that constructivist teacher education beliefs positively impacted adoption applications of technology, but negatively impacted integration applications, only to a lesser extent, or vice versa. It could be that they had no effect on one, and a positive effect on the other. By aggregating their dependent variable, they removed the ability to know exactly what their results point to, so it can only be said with that caveat that Hermans et al. (2008) confirmed the results of prior research.

One peculiar topic in this question of the impact of constructivist views on use of computers is the interplay between constructivist views and gender, and their combined relationship to use of technology. Recall earlier that Sang et al. (2010) determined that gender does not directly affect ICT adoption. They also concluded that constructivist views were correlated with ICT adoption. Curiously, Zhou and Xu (2007) found that female teachers were more likely to use student-centered pedagogical (i.e. constructivist) approaches in teaching than males, but that females also had lower confidence and less experience in the use of computers in teaching. It is difficult to see how these two studies can coexist, when one says that constructivism leads to ICT adoption, while the other says that female teachers are simultaneously more constructivist and less likely to use computers than males. Once again, the literature is not definitive in its assessment of the impact of gender on computer use, even when teacher education beliefs are introduced as a mediating factor.

Keys (2007) and Pajares (1992) found that teacher beliefs toward technology are based on their experiences as students and are shaped by their teacher training. These studies also find that those beliefs become rigid when they start serving as teachers, but the important point for this thesis is that teachers are shaped by their vicarious experiences when they are students and student teachers. This will be relevant in the following discussion of self-efficacy and its impact on technology adoption.

Self-Efficacy

Self-efficacy is the most antecedent general factor in computer use. To be sure, self-efficacy can be influenced and altered by other conditions, but for the first time, these are concrete conditions. Where gender reassignment or age reduction treatments not universally viable, desirable, or efficacious (or real), ownership of a personal laptop is something that can be changed, quality of professional development is something that can be changed, and the systems that provide teachers-in-training with vicarious technology experiences can be changed to engineer greater self-efficacy levels, which then flow through more positive attitudes to greater computer use.

Knoblauch (2008), Putman (2012), and Sure (2009) all determined that self-efficacy is a big component of computer use. Likewise, Gardner, Dukes, and Discenza (1993) and Paraskeva, Bouta, and Papagianni (2008) found that self-confidence and the teacher's belief in their ability to use computers is significantly positively correlated with their actual use of computers. Russell, Bebell, O'Dwyer, and O'Connor (2003) sought to examine the relationships between teachers' comfort with technology, beliefs about technology, and professional uses of technology. They also sought to examine the

extent to which teachers who have recently entered the teaching profession are comfortable with technology and use technology for professional purposes. To do this, they analyzed data from the Use, Support, and Effect of Instructional Technology Study (USEIT), which was conducted on 120 district administrators, 122 principals, 4400 teachers, and 14,200 students across 22 Massachusetts school districts. Their data focused in on 2894 teachers. Using that data, they coded six weakly related, mostly independent, uses of technology that include some adoption applications and some integration applications. They were use of technology for preparation, use of technology for content delivery, teacher-directed student use of technology (integration), use of technology for special education accommodation (integration), use of email, and use of technology for recording grades.

While the study is limited in its generalizability across geography because of its limited Massachusetts focus, and across time because it is now 15 years old in an ever-changing field, it should be evident by now that there are very few perfect studies in this body of literature, so the results must be treated as worth interest. This study is actually better than most, because it shares the all-too common limited geographic focus of other studies, but overcomes the frequently abysmal response rates and sample sizes. Russell et al. (2003) found that confidence in using technology was only a factor in the delivery and preparation uses of technology. It makes sense that teacher use of email and teacher use of technology for recording grades would not require self-efficacy. The are both private tasks that increase efficiency, and a teacher is free to try and fail at them without public shame until they have attained mastery of them, or at least

competency. It may seem odd that self-efficacy is not related to the integration uses of technology, teacher-directed student use and use of technology for special education accommodation. These are, likewise, not public uses of technology on the teacher's part. Students are the ones using technology in the former and the teacher uses technology behind the scenes to prepare for the latter. And if preparations do not go well, the audience of the failure is a relatively small number of people. But with general preparation and delivery, the teacher's technology abilities are on display, so self-efficacy understandably plays a major role in whether the teacher even attempts to use technology.

Self-efficacy and gender. Similarly to how Sang et al. (2010) pointed to the possibility that attitudes, not gender, were the real antecedent behind computer use, Teo, Fan, and Du (2015) pointed to self-efficacy, not gender, as being the true antecedent. Their goal was to fill a gap left in the research that was left due to poor operationalization of technology acceptance and use in previous studies by offering a theoretical model of how different factors influence computer use. Specifically, they asked how potential gender differences are shown in several dimensions of technology acceptance- attitude, perceived usefulness, perceived ease of use, and intention for using technology. They then tested those differences at multiple stringency levels. The first, configural invariance, is satisfied if the basic model structure is invariant across groups. The second, metric invariance, is satisfied if the scores on items or scales can be meaningfully compared across groups. The third, scalar invariance, is satisfied when a same score across groups means the same thing. They fielded their survey to 339 pre-

service teachers enrolled at a teacher training instituted in a southeast Asian country at the beginning of regularly schedule computer lab classes. No incentives were given for participation, and participation was anonymous. Of the respondents, 13.5% were undergraduates, 80.5% were in a one-year post-graduate diploma program for secondary education, and 5.6% were in a one-year post-graduate diploma program for primary education. Exactly half of the respondents were female and half were male. The average age was 28.5. They found that scalar invariance was not supported, and then tested partial scalar invariance to identify the indicators that were not invariant between gender groups.

They found that there is no statistical difference on perceived usefulness, attitudes about technology, or intention to use technology between genders, but that female pre-service teachers had lower scores on perceived ease of use. Disregarding the empathy a teacher might feel for a less-skilled counterpart, their assessment of how easy something is to use or do is based entirely on their confidence in using it, or their self-efficacy with it. By saying that female pre-service teachers use technology less (an uncertain claim itself) because they have lower self-efficacy with regard to technology, rather than saying that they use technology less without providing explanation, the claimed difference in gender use becomes mutable and reducible. And perhaps most importantly, it ceases to be the fault of female teachers, and the responsibility for change is transferred elsewhere.

Self-efficacy and beliefs. There is also reason to believe that self-efficacy drives beliefs, making it the true antecedent of all technology-adoption factors considered

here. Hasan (2003) and Salanova, Grau, Cifre, and Llorens (2000) found that individuals with a high degree of technology self-efficacy were found to more eagerly participate in activities involving technology, to have higher expectations from such work, and to more easily cope with technological problems they come across. They key point there is that higher self-efficacy with technology actually causes individuals to believe that technology can do more for them, and also to believe that technology is less obdurate when it has issues. Low perceived usefulness and the belief that technology is too difficult to work with were both previously shown to be factors limiting technology adoption, and now it is shown that self-efficacy is the cause behind the cause. This idea is confirmed in two more-recent studies: Li, Worch, Zhou, and Aguiton (2015) and Spaulding (2013).

Li et al. (2015) sought to identify the barriers of digital generation teachers to the use of educational technologies. They defined “digital natives” as people who grow up in the digital world with digital technology as an integral part of their lives. Alternatively, it may be defined as people born after 1980 who have access to technology and possess technology skills. The study falls into the same trap as much of the rest of literature in that its sample is small and not extremely diverse in some areas. Only 71 of the 141 student teachers contacted responded to an online survey about their technology use. Of them, 93.4% were white, 65.3% were between 22 and 24 years old, and all were from the same Midwestern university. In other ways, the sample redeemed itself with diversity. Two-thirds of the respondents were female and they were fairly evenly spread across grades 7-12 and across math, science, ELA, and social studies.

The first phase of the study was a quantitative Likert-type survey that evaluated the impact that risk-taking, self-efficacy, and technology support and access had on the adoption of technology. Six respondents were intentionally chosen to participate in follow-up interviews meant to explain the results of the quantitative component. The qualitative participants taught in five different fields, and each interview lasted about 20 minutes.

Li et al. (2015) found that the use of technology in the classroom was significantly correlated with self-efficacy and self-perceived computer skills. They determined that digital generation student teachers are not necessarily more comfortable keeping pace with the fast rate of technology change, and that low technology users are more troubled than high technology users. Essentially, people who are not confident about their technology use do not use it, and perceive recurring high barriers to entry, while people who are confident about technology use it, and may never encounter the high barriers that low users imagine. Once again, self-efficacy drives beliefs about the difficulty of staying on top of technology trends.

Spaulding (2013) found very similar results. Spaulding was interested in comparing the attitudes of toward technology integration and the expectations of technology integration in pre-service teachers with those of in-service teachers and their actual technology integration. He aimed to identify why the pushes to integrate technology have fallen short of expectations. His sample of pre-service and in-service teachers was limited to a convenience sample at a southeast rural university and southeast rural county. The 112 pre-service teachers that responded out of 125 and the

118 in-service teachers that responded out of 309, spanned K-12 and all curricular areas. Limiting the generalizability of the study further, 76% of the in-service respondents went to the same university and the pre-service respondents. Of the pre-service respondents, 73.2% were female, and 83.9% of the in-service respondents were female.

To assess teacher perceptions, Spaulding (2013) used the Teacher Technology Questionnaire, a 20-item instrument to assess teacher perceptions on five constructs- Impact on classroom instruction, impact on students, teacher readiness to integrate technology, overall support for technology in the school, and technical support. Spaulding (2013) only used the first three constructs in this study. All participants were contacted with an email explaining the study and including the questionnaire. Aside from lack of generalizability, the study is also extremely limited because pre-service teachers were given a modified version of the survey that asked them to project their responses to certain future situations they might encounter, which is likely not very accurate. There is a large difference between theory and practice.

Spaulding (2013) found that pre-service teachers show a greater level of confidence in their ability to integrate technology and more positive beliefs about technology than in-service teachers. Crucially, though, it is uncertain whether he was trying to make his results fit his hypothesis; he made no mention in his results or discussion of the study-altering conclusion in his abstract that these differences disappear when self-reported technology skill is included. In effect, there is no difference between pre-service and in-service teachers, because that difference disappears when self-efficacy is included. Spaulding (2013) took the unique approach of

trying to find where the weak link was in technology integration, but ended up with the same conclusion as the other studies discussed here: people who are not good at technology (or do not believe they are good at it) do not want to use it and do not believe it is valuable.

Antecedents of self-efficacy. Before moving on to the second guiding question, "What factors prevent teachers from moving from technology used for administrative purposes to technology used for instruction," it is worth discussing Tambunan (2014), who sought to create a theoretical model of factors leading to technology competency, which must surely be highly correlated to technology self-efficacy. The sample included 245 vocational high school teachers out of 728 in Medan-Indonesia, and the sample was taken by stratified proportional sampling from the 17 vocational high schools in Medan.

Tambunan (2014) created a logical model of how various factors directly and indirectly affect technology competency. The model hypothesized that Interpersonal Communication (IC) and Use of Information Technology (UIT) would each have a direct effect on Information Technology Competency (ITC), and would also have a direct effect on Teacher Perceptions (TP) of Technology. IC, UIT, and TP would each directly affect Self-Improvement with regard to information technology (SI), and SI would in turn directly affect ITC. To test the model, Tambunan (2014) used both a quantitative questionnaire and a qualitative observation sheet.

Tambunan (2014) found that IC, UIT, and TP are all exogenous variables affecting Information Technology Competence. In accordance with his model, he finds statistically significant impacts of IC and UIT on each of the other variables. In fact, every connection

in his model is found to be significant, except the untested connection between IC and UIT. Based on his model, if there is low use of information technology, then there will be little positive interpersonal communication about it. If those are both negative influences, then the rest of the chain will surely be negative and not lead to competence. This points to structural considerations that will be explored in the next guiding question.

Factors Preventing Movement from Technology Adoption to Integration

Recall that the difference between technology adoption and technology integration is basically that adoption is the use of technology for administrative or efficiency purposes, such as emails, word processors, and even PowerPoints, while integration is the use of technology in pedagogically sound ways to enhance learning, such as videos that show atomic models at a viewable scale, or guided virtual reality tours of ancient Egypt. While technology adoption is a necessary first step and the core of the anecdote at the beginning of this thesis, it is not where most of the gains from technology are made.

Unfortunately, research shows that teachers mostly use technology for administrative, non-learning tasks instead of for student learning (Cuban, Kirkpatrick, & Peck, 2001; Kurt, 2012; McCannon & Crews, 2000; Sang et al., 2010; Seferoglu & Akbiyik, 2005). And it is not just that all teachers who use technology just split their time unevenly, favoring administrative tasks. Mundy, Kupczynski, and Kee (2012) found that more than half of teachers only use computers for administrative tasks, and that only half of students report using technology more than once per week.

Some of the same barriers are involved with integration as with adoption, such as beliefs and poor self-efficacy. But two new factors that will be discussed are structural considerations, such as district management and social pressures, and poor professional development. The section will close with some possible steps forward.

Beliefs

The teacher beliefs that impact integration are much the same as those that impact adoption. The primary difference is that some teachers believe there is no difference between adoption and integration. The difference in how the usefulness of technology is perceived in these two spheres is also discussed.

Scope of integration. The most basic problem with technology integration is faulty beliefs about the scope of integration. Okojie, Olinzock, and Okojie-Boulder (n.d.) argued that technology integration is narrowly perceived and that this misperception might hinder teachers' understanding of the role of technology in integration. They find that 70% of student teachers surveyed say that technology is a tool for instruction, and do not relate it to pedagogy. They argue that technology should be thought of as integral to instruction, not as an adjoining enhancement.

Usefulness of technology. Just as with beliefs and attitudes regarding technology adoption, the beliefs of the teacher regarding the usefulness of technology integration play a key role in determining integration rates. These beliefs are obviously very closely related to beliefs about the usefulness of adoption, but they are distinct. A teacher could believe that emails and spreadsheets will help them be more efficient with their time, and accept the usefulness of those technological applications, but be doubtful that

a computer game that puts their fifth graders in the place of European explorers looking for the New World will really help them learn cartography, geography, and history.

Miranda and Russell (2011) made this distinction perfectly. Their goal was to combine the micro- and macro-level factors affecting technology integration into one study. That is, they wanted to identify and assess the district, school, and classroom-level factors that impact teachers' instructional use of technology, and observe how those factors interact within and across levels of a school to affect that use of technology. Their data came from the USEIT data set discussed earlier (USEIT was a study done in the Greater Boston area to assess the use of technology in schools). This led to two limitations acknowledged by the authors: The small number of districts may have inflated the effect of district-level factors, and the study was commissioned for a specific purpose in a specific area, which may limit its generalizability. With that said, this study's major strength is that it builds a conceptual framework to explain teacher integration of technology that encompasses both micro- and macro-level factors, while most other studies reviewed rely on quantitative instruments with too-small convenience samples in an attempt to measure the effect of one factor in a vacuum. Those studies are not generalizable because of their convenience samples and do not make compelling arguments because of their small sample sizes. While Miranda and Russell may have based their study on a non-generalizable dataset, they have developed a conceptual framework that is just waiting for a larger, more representative dataset.

What Miranda and Russell (2011) found is that the strongest predictors of teacher directed student use of technology were the teacher's experience with

technology, the belief that technology is beneficial *to meet instructional goals*, and a series of structural factors that will be considered in the next subsection. Those first two results are intertwined. A teacher's experience will certainly feed into their beliefs about whether technology can be used to meet instructional goals. And Schunk (2000) found that even vicarious experiences (such as watching your supervising teacher use technology during a practicum), can be powerful learning tools, because observing "similar others" serves both an informative and a motivational, "if they can do it, so can I" function.

Ottenbreit-Leftwich, Glazewski, Newby, and Ertmer (2010) used a slightly different terminology when talking about teacher beliefs. In their study to discover how and why teachers use technology to enhance teaching and learning, they talk about "teacher value beliefs." These are beliefs about a thing's value, and they "encompass the perceived importance of particular goals and choices" (p. 1322). Therefore, teachers' value beliefs about technology are based on how well they think technology will serve them in meeting instructional goals that they think are important. To identify the value beliefs that lead to integration, Ottenbreit-Leftwich et al. (2010) interviewed eight teachers who had won an award for technology integration in Michigan out of a total population of 31 (23 declined). To qualify, teachers had to explain how they met Michigan's technology standards and provide links to artifacts that supported their claims.

Ottenbreit-Leftwich et al. (2010) emphasized that they were conducting a hermeneutical phenomenological study, which means that they interpreted the

described experience of the focus individuals to understand their technology integration. They key in this type of study is to try to perceive the situation through the subject's understanding, because they are the one in the full context of the situation. The study was structured as a two-phase multiple-case study, where each teacher was analyzed as a case study in phase one, and then their results were compared to each other teacher in phase two, in order to identify whether any value beliefs transcended individual participants. What they found was that all eight teachers used technology to meet professional (teacher-focused) needs, and also that teachers believed that technology enhances student motivation and engagement, and could improve comprehension. The two value beliefs that they pulled out of this are that teachers like to be efficient, and that teachers believe they should act in a way that helps students.

There are significant limitations with this study. The first is that the authors themselves cite the data being self-reported and based on teachers' perceptions as a limitation. But they intentionally chose a research design that treats self-reporting and subjective perception as a strength, so it seemed as if the authors were not sure about the merit of their own research philosophy. Secondly, the authors cited the small sample size and the fact that all of the participants were female and from Michigan as limiting generalizability. And yes, a 75% dropout rate from a population of 31 is not great, but again, they intentionally chose teachers who had won awards for technology integration. Their goal was not generalizability, but to find the value beliefs held by ideal teachers that could serve as a model in training other teachers, so again, the authors seem uncertain about the merit of their own research design. But the real problem is

that they did not need any participants at all to come to the conclusions that they did. Whether they had one respondent or 1,000,000 respondents, they were going to discover that teachers value efficiency and that teachers believe they should act in ways that help students. Even if the authors showed consistency in discussing their research philosophy and design, they did not discover anything unexpected. More than that, once the results made clear exactly how general a value belief was, the point of the study seemed questionable at all.

But the conclusion that teachers believe, above other considerations, that they should act in a way that helps students, raises an interesting question when taken with one of the results from Hutchison and Reinking (2011). Hutchison and Reinking (2011) found that one of the primary obstacles to ICT integration was a perceived lack of incentives to integrate technology. This is odd, because virtually all of Hutchison and Reinking's (2011) respondents believed that technology integration would benefit students. This would either seem to contradict the result of Ottenbreit-Leftwich et al. (2010) that a primary teacher value belief is that they should act in a way that benefits students, or it indicates that teachers over-report how useful they believe technology is, possibly because of social pressures to conform to that vogue belief. Such social pressures will be discussed in the next subsection.

Before that, it is worth taking another look at Russel et al. (2003), who also revealed something curious about teachers' beliefs about the usefulness of technology. Somewhat counter-intuitively, new teachers report a high level of comfort with technology and use it more for preparation, while more experienced teachers use

technology more often in classrooms when delivering instruction *or having students engage in learning activities*. Reaffirming that conclusion, they also find that new teachers have significantly stronger beliefs that the use of technology harms student learning and work quality. This is a striking opposition to how one would normally think of age affecting technology integration.

Russell et al. (2003) also found that teacher beliefs about technology improve the more access they have to technologies, particularly when that technology is designed for student use. This means that asking teachers what they need in terms of technology may actually result in lower technology adoption rates, because teachers that do not have technology are less likely to report needing it. Effort should therefore be made to pair pre-service teachers with technology-experienced teachers, so that new teachers develop positive beliefs about technology use in the classroom through vicarious experience, in accordance with the conclusion of Schunk (2000).

Structural Considerations

This section on structural considerations follows that line of thinking. It is concerned with how contextual factors, teacher preparation programs, district management, and social pressures work to influence technology integration. It concludes with a recommendation for future action that draws on a tie-in from the political science concept of audience costs.

Contextual factors. The literature on technology integration is much less concerned with demographics than the literature on technology adoption, but Warschauer (2007) made a point that is worth paying attention to. Warschauer (2007)

found that teachers in richer schools are more likely to integrate technology because they believe their students will have access to the resources at home to complete assignments. To some extent then, technology-directed funding not only aids in adoption, but also integration.

Teacher preparation programs. Gao, Choy, Wong, and Wu (2009) sought to measure the changes in pre-service teachers' technology skills during their teacher preparation programs, track the development of their opinions on the use of technology for classroom teaching and learning, and identify how and why they do or do not use technology during their teaching practicums. To answer these questions, they employed a mixed methods study that involved surveying 310 pre-service teachers enrolled in the Postgraduate Diploma in Education (Primary) initial teacher preparation program at the National Institute of Education in Singapore. All had completed a bachelors degree, and most of them had contract teaching experience ranging from one month to one year at local schools. Only 118 participants completed all three surveys used In the study. Then, ten participants were chosen to participate in the qualitative component of the study, based on their self-reported ICT skills in the pre-survey, in order to get a representative sample of the quantitative group. These ten were each interviewed twice, once during their ICT course in their preparation program, and once at the end of their practicum. Each interview lasted 30-50 minutes. They also had two focus group discussions, one at the beginning of their practicum and one in the middle.

Gao et al. (2009) found that the majority of pre-service teachers were not able to put their constructivist beliefs and self-reported technology-knowledge gains into

practice. They tended to use their increased competency to enhance teacher-centered uses of technology, particularly PowerPoint. The authors raise the possibility that the pre-service teachers did not actually become more competent with technology over the course of their teacher-preparation programs, but that they may have just started grading themselves as competent after seeing how their cooperating teacher did (or did not) use technology effectively. With that in mind, it is crucial that teacher preparation programs pair students with technology-competent teachers.

District management. Numerous studies conclude that school and district policies are structural considerations that have an impact on technology integration (Fitzgerald, 2003; O'Dwyer, Russell, & Bebell, 2004; Anderson & Dexter, 2005). Williams (2017) identified one way that districts can support technology integration, and inadvertently identified one possible reason that adoption is more prevalent than integration. The focus of her study is the perceptions of in-service teachers concerning the effectiveness of technology training, which will be discussed in greater depth in the self-efficacy and professional development subsections of this research question. Her sample was K-12 teachers at a southeastern public school district during the 2015-2016 academic year who had completed a four-year degree and completed the Digital Opportunity Trust TeachUp! USA Program. The study consisted of on-site interviews at two elementary schools. The population of teachers at these schools was 127, but only eight interviews are discussed. It is not clear whether more than eight teachers were even interviewed, or if more than eight interviews were solicited.

Williams (2017) found that teachers desired technology-training experiences to ensure they are able to implement technological innovations in everyday teaching. The desire for implementation-focused training instead of technology-focused training will be a major point of discussion toward the end of this research question. The interviewed teachers identified the most positive aspect of TeachUp! USA as being its regular updates for new developments. They stated that they needed dedicated technology support to stay on top of new technology developments. So district policy that can support technology integration is dedicated technology support that monitors new updates and crafts presentations on how to integrate it. This may also point to a reason that adoption is more prevalent than integration. There is much less of a need to have dedicated monitoring of new administrative uses of technology, because spreadsheets, PowerPoints, and email do not regularly change in drastic ways. A teacher is able to stay on top of those developments by themselves. Once a teacher has made the leap to technology adoption, it is not difficult to just tread water there.

Pressure from above and beside. It was mentioned above that Miranda and Russell (2011) found that some of the strongest predictors of teacher-directed student use of technology were teachers' experience with technology, teachers' belief that technology is beneficial to meeting instructional goals, and some structural factors. Those structural factors will be explained in greater depth now. The third greatest factor they found, and the greatest of the structural factors, was perceived pressure to use technology. This was followed by the principal's use of technology, then technology standards and the level to which teachers and students were held accountable to the

standards, and lastly the principal's technology-spending discretion. This study primarily deals with pressure from above, or pressure from the district and principal level, although there is room in "perceived pressure to use technology" for pressure from other teachers. Recall that Hermans et al. (2008) determined that 18% of the variance in technology adoption was attributable to variance between schools, which the authors believed indicated school culture effects. Culture does not flow only from the leaders of an organization, but also from the members (the teachers). Only two of these factors, principal's technology-spending discretion and teacher accountability to the standards, can be called district policies. The others are various forms of social pressure that influences whether teachers do or do not integrate technology. Miranda and Russell (2011) found that pressures against or neutral to technology integration can provide teachers who have negative beliefs about the instructional use of technology cover for not using technology, in a sort of trickle down effect. But teachers with positive technology beliefs may seek outside sources for technology training and may not be dissuaded by district level factors.

Anthony (2011) also examined how social pressures can influence technology integration. Anthony's (2011) major contribution to the field was to provide an overarching theory that captures both individual and institutional factors affecting technology implementation. As stated in the title of her article, she uses activity theory as a framework for tracking changes in district-classroom interactions over time and their impact on technology implementation. Anthony (2011) took the unique approach of conducting a three-year longitudinal study on two middle school teachers in a rural

part of a Midwestern state who participated in a school district's laptop learning program. Anthony (2011) conducted semi-structured interviews with each teacher and with administrators during the first three years of the program in order to gather information about professional development programs and teaching practices. Anthony (2011) also conducted four observations with each teacher to observe their technology integration practices, conducted five observations of district-led professional development workshops, and attended three district laptop meetings. Through her observations, she was tracking changes in the frequency of technology use, and the centrality of technology to classroom routines.

Anthony's (2011) study is better than most other qualitative works reviewed, because its results could be believed to be generalizable. Most other qualitative studies in this review were appendages to a quantitative study with an extremely small sample, and were meant to be short follow-ups that provided some quotes to explain the quantitative results. They made no attempt to increase the external validity of the study. Anthony (2011), however, has followed teachers and administrators over the course of three years and used those observations to construct a more general model of how district- and classroom-level factors interact to influence technology practices. Even though the model is based on a very small number of individuals, it is based on a sizable number of observations over an impressive length of time, improving validity. In short, it was not an effort to explain an invalid quantitative experiment; it was a fully-developed study with unique and meaningful results.

Anthony's (2011) primary conclusion was that the dispersion of technology leadership responsibilities among multiple district personnel, including superintendents, principals, technology specialists, and teachers can create isolated implementation plans that contradict each other. This is made worse by the uneven distribution of power among those actors. Adding to Anthony's (2011) conclusion that the powers are unevenly distributed, they are also siloed. The superintendent has the power to make technology policies, but they do not have the power or ability to operationalize them or implement them, or really even enforce them. Technology specialists have the power to operationalize technology policy, but they cannot implement them in the classroom or enforce them. Principals are in a better position to enforce technology policy, but they do not have the expertise to monitor them as well as a specialist would. And only teachers are in a position to actually implement technology policies. If not all of these players have a unified idea about technology-policy implementation and technology integration, they will each act with a varying amount of pressure at cross-purposes. And if that becomes the case, Anthony finds, the teachers who are necessary for implementation may become disenchanted with technology altogether and refuse to cooperate.

Baek, Jung, and Kim (2008) also examined the factors influencing a teacher's decision to use technology in the classroom setting, and added the study of how teaching experience affects those factors. In their first phase, they surveyed 64 teachers in Korea, 47 of whom were female and 17 male, 38 of whom worked in an elementary school and 26 in a middle school, and who had an average teaching career length of

9.76 years. Phase I respondents received a blank piece of paper and were told to list all of the reasons they used technology in the classroom. “Technology” was limited to hardware. Responses were translated between Korean and English using back translation. This phase yielded 88 factors. In phase II, 202 teachers, 2/3 of whom were female, and 3/5 of whom were elementary school teachers, and who had an average experience of 10.2 years, received those 88 factors and were asked to rank how important each was using a 5-point Likert scale.

The number one response was adapting to external requests and others’ expectations, or following external pressures. They found that although the majority of teachers intend to use technology to support teaching and learning, only new teachers are likely to do this according to their own will. More experienced teachers typically only do this in response to external pressures.

The design of this study is interesting, because it uses teachers to construct the data-gathering survey. Rather than the researchers pigeon-holing respondents into a handful of factors of interest, they are allowing teachers to tell them what influences them, but in a quantitative format so factors are comparable. Unfortunately, the study is limited by its sample size. Only external pressures are discussed, because it is the only factor that received a reasonable number of responses in the phase I survey. Fifteen teachers out of the phase I sample of 64 listed it as a reason. The bottom three of their top six factors had only four responses, though. That means that 82 factors had less than four responses, and this is after similarly worded responses were grouped together. If the phase I sample were made larger in a future study, this type of study

could yield some very meaningful results. For now, the only one that can be considered is that external forces are important influences on technology integration.

Lack of Knowledge, Bad Examples, and Poor Self-Efficacy

Just as in technology adoption, self-efficacy is an essential component for technology integration (Moore-Hayes, 2011). This section will deal with two major antecedents of low self-efficacy: lack of ability and lack of positive experiences with integration. It will conclude with a subsection discussing whether digital natives are inherently more likely to have high self-efficacy with regard to instructional uses of technology.

Lack of ability. The unfortunate truth is that one of the reasons that technology integration rates are low is that the number of teachers capable of integrating technology is low (Kozma, 2003). Most pre-service teachers are unable to use innovative and creative ways for promoting students' higher order thinking; that is, they are not able to merge technology with sound instructional pedagogy (Andersson, 2006; Dawson, 2006; Kay & Knaack, 2005; Wright & Wilson, 2005). Even more troubling, the development of technology abilities seems to follow a similar pattern as the development of beliefs about technology's value. Just as Russell et al. (2003) found that teachers who have access to technology report valuing its potential more than teachers who do not have access, Gersten, Chard, and Baker (2000) found that teachers who have high self-efficacy are more likely to participate in professional development that leads to the implementation of innovative strategies. So, the natural order is for teachers who believe they can handle and use technology for good educational

outcomes to pursue more training to become more competent, while teachers who do not have such skills tend to not pursue opportunities to develop them.

Lack of positive experience with integration. Mueller et al. (2008) found that there are seven interacting variables that influence ICT integration among primary school teachers. Chief among them is positive experience, following by teacher comfort with technology, beliefs about computers as instructional tools, number of professional development sessions they have experienced, assistance from others, teaching efficacy, and their score on a scale of preferences about challenges in their work. It is not difficult to see how positive experiences, teacher comfort, and professional development attendance would be related to self-efficacy, and professional development will be the subject on the next section in this guiding question. That positive experience would hold such a key place in technology integration makes the following result from Chavis and Kim (2015) all the more troubling: some in-service teachers report having had no prior experience with the effective use of technology in the classroom.

This does not just mean prior personal experience as a teacher, or even prior experience as a pre-service teacher observing a cooperating teacher during a practicum or field experience, but can even include their experiences from when they were students (Ertmer & Ottenbreit-Leftwich, 2010). They suggested that teacher-training programs require proof that teacher candidates can use technology to aid student learning, to ensure that no teacher enters the field without some past positive experience. Gao et al.'s (2009) finding that pre-service teachers were unable to translate their technology competency into their teaching practice, and even became less

constructivist in their beliefs, when cooperating teachers did not model positive ICT usage would support that recommendation, but would also require that pre-service programs make finding technologically-competent cooperating teachers a priority, and that the culture of the teaching profession shift to make participation in those relationships mandatory, or at least not a point of personal discretion.

Digital native disconnect. As mentioned above, simply knowing technology is not enough to have the confidence to use it in an instructional setting (Otero et al., 2005). Even when teachers know how to use technology in their personal lives, they need help understanding how to use it for student learning. Even the same skills are not necessarily transferable. A teacher who knows how to upload a video to YouTube does not instinctively understand how they skill could be applied to student learning. They do not automatically understand how this could afford students a greater array of possibilities in making presentations than limiting them to what they can physically place in front of a classroom. And digital generation teachers are not necessarily more comfortable or confident keeping pace with the fast rate of technology change (Li et al, 2015; Mundy & Kupczynski, 2013). Just because a teacher knows how to use their computer to watch television, or their phone to pay for things at the grocery store does not mean they know how to sift through the myriad podcasts available online and find one that can provide their students with an update to current events, use virtual reality software to allow students to paint in three dimensions or put an engine together without physical parts, or understand (or even be aware of) the next innovation that could reshape education.

Nadelson et al. (2013) provided the most comprehensive study on the subject of technology integration and self-efficacy, and reaffirmed the troubling conclusion of Gersten, Chard, and Baker (2000). Nadelson et al. (2013) sought to determine pre-service teachers' confidence with, perceptions of, and intentions for using instructional technologies to teach and learn. They hypothesized that the pre-service teachers they were studying would have moderate to high experience with technology, because they were digital natives, but that their confidence in using that technology for instruction would be lower, and would be much lower for non-standard technologies (those with a primarily educational application). To study this, they surveyed pre-service teachers enrolled in programs at multiple universities in the Rocky Mountain West region. Only 52 completed the survey, and their average age was 23.69 years. Respondents were disproportionately planning to enter high schools, 75% were female, 90% were white, 50% were of suburban background, and 32% were of urban background. The survey was accessible through a Survey Monkey link for a two-week period.

As other research has suggested, participants had great experience with administrative (adoption) uses of technology, but much lower experience with educational technologies like podcasts and virtual worlds. Also, as has been concluded by other research, participants held confidence levels regarding each type of technology matching their personal experience level with those technologies, and foresaw using each technology with a likelihood that matched their experience and confidence with those technologies. While the study has the standard limitations of a small convenience sample that is largely homogeneous, and a lack of a conceptual framework that could

explain whether experience, preference, or comfort came first, the conclusions they reached have face validity, and are bolstered by similar findings in other studies. Nadelson et al. (2013) concluded what will be a major focus of the next subsection- that teacher preparation programs and professional development need to include specific applications for specific technologies, and it is overly optimistic to assume that digital native teachers will just transfer personal knowledge of technologies to the classroom.

All of these results point to an unfortunate cycle. A lack of expertise with new technologies leads in-service teachers to not be able to provide a positive vicarious experience to pre-service teachers. Because they have no positive personal experiences with educational technology and their personal use of technology does not transfer into the classroom, and because they received no good vicarious experience from in-service teachers, pre-service teachers will suffer from low self-efficacy and negative beliefs regarding technology. They will then be poor examples as in-service teachers as well. There is hope that professional development can improve teachers' confidence and preference for using technology, as was the case in Yildirim's (2000) study, but the scarcity of good professional development which prevents that is the subject of the following section.

Poor Professional Development

Poor preparation of teachers to integrate technology, whether that comes in a pre-service preparation program or in professional development, leads to infrequent or ineffective use (Bauer & Kenton, 2005; Wozney, Venkatesh, & Abrami, 2006). This apparently self-evident statement summarizes what has been discussed about self-

efficacy and its relationships to beliefs and usage. Cope and Ward (2002) provides the perfect conclusion to describe that relationship: Experienced teachers who had minimal professional development in the use of instructional technologies were less likely to use them and were less likely to see the benefit of using them. It is because of this chain-effect that Rother (2004) stated that professional development is the most needed component in raising self-efficacy levels.

And there is research to support that. Hsu (2010) found that the better trained a teacher is in the use of technology, the more likely they are to successfully integrate it into the classroom. Brinkerhoff (2006) largely concluded the same thing in a deeply flawed study. Brinkerhoff (2006) studied a long-term academy that was designed to help teachers overcome the barriers to technology adoption and integration that had been identified in prior research. Many of these barriers have already been discussed in this thesis. The intention was to study the best-case scenario, much as with Ottenbreit-Leftwich et al. (2010). Some of the things that made this academy so ideal were that it paid a stipend for attendance and provided accommodations for those living beyond driving distance, and it also paid for substitutes during in-service days. These were supposed to remove the barriers to attendance. It also had seminars on how to apply for technology grants, so that teachers could continue what they learned in their classrooms, even if they currently lacked materials. Lastly, it had teachers complete projects using the technology that they could replicate in their classrooms, so they would have ideas about pedagogical applications for the technology. As an added

bonus, teachers would be able to take home some ICTs if they completed the final project.

Participants in the academy were recruited through application forms distributed by blanket mailings through New Mexico. Applicants with limited prior technology training and with recommendation letters from administration, suggesting a desire to expand technology skills were selected. Twenty-four females and one male participated in the first year. Participants spanned grades one to nine in public, private, and Native American schools. Twenty-three of them taught at the elementary level. Teaching experience ranged from one to thirty years.

A survey was fielded three times throughout the two-year academy to gather data on participants' self-assessed technology skills, beliefs regarding the use of technology in the classroom, feelings concerning technology integration in instruction, and computer self-efficacy. Additional information was gathered through interviews. Only teachers who stayed in the academy for all of its seminars over the two years were included in the analysis, so the true sample size of this study is actually 19, not 25.

In a positive sign for the efficacy of professional development, participants perceived an increase in their technology skills as a result of the academy. They reported being less fearful and more confident toward technology at the end of the training. Some even reported feeling that they were able to be more constructivist in their classrooms, because they now had the tools to match their prior beliefs. Brinkerhoff's (2006) suggestions for improved professional development will be

discussed below, but for now, it is enough to see that professional development can be useful.

This study has a number of concerns, however. The first is that the Chronbach Alpha for the technology belief section of the survey was .69, which is in the minimally acceptable range at best. The dimensions of technology beliefs need to be operationalized in a better way. The sample size of the study is also very small, and interview responses did not cluster around particular aspects of the academy that participants found useful, other than that it involved group work with hands-on experience, so it is difficult to say if any of the other aspects of the academy are important. Even the author seems uncertain on a number of points. Brinkerhoff (2006) claimed that the volunteer nature of the academy may have made it successful, but that claim has no basis in the results; no participant stated in an interview that the academy was better because everyone wanted to be there. In fact, three people out of the 25 dropped out for having bad attendance, so it not even as if everyone did want to be there. Even if that were the case, though, the result is unhelpful, because teachers who have bad attitudes about professional development cannot just be written off. Also, Brinkerhoff (2006) simultaneously argued that the length of the academy was a strength, because it was sufficient for the development of technology integration skills, but then also said that it was insufficient for the development of those skills when faced with the result that technology integration practices did not change. There was also no control for outside professional development training that may have occurred during the two-year period, so any results might be attributable to other programs. That raises

another issue. While self-reported skills were positively impacted by academy attendance, the final projects, where teachers designed projects and assessments that they could use in their classrooms, were of low quality, and seemed to only have been completed to meet the requirements to take their materials home with them. It is unclear if the participants actually gained any new knowledge or skill. Yet, Brinkerhoff (2006) made conclusions about what is good practice for professional development based on this academy.

If even the ideal professional development program yields possibly nothing in the way of new knowledge or skills, then it is no wonder Incik and Akay (2017) reported that one of the two primary recommendations pre-service teachers have for improving educational technologies in the education process was better teaching of educational technologies. This begs the question: What are the specific problems with professional development? The next two subsections will address two- a lack of pedagogical focus, and a mismatch of existing professional development programs and professional development needs by gender.

Lack of pedagogical focus. There is no shortage of research analyzing professional development, with good reason. It is a major use of resources, often replacing instructional days, and it can frequently reach the upper echelons of teacher complaints. A prevailing conclusion about professional development programs related to technology is that they are too technocentric. That is, they operate more as sales pitches for technology, sometimes not even a particular technology, than as forums for learning and discussing new ways to improve pedagogy using technology (Groff &

Mouza, 2008; Hutchison & Reinking, 2011; Levin & Wadmany, 2008; Russel, O'Dwyer, Bebell, & Tao, 2007; Zhao, Pugh, Sheldon, Byers, 2002). Harris, Mishra, and Koehler (2009) created a conceptual framework for how to think about instructional technology that goes beyond the technocentric approaches that just focus on the capabilities and limitations of technology, and involves technology, pedagogy, and content knowledge. They creatively label the peak level of their framework "technological pedagogical content knowledge," where pedagogical techniques are used that apply technologies appropriately to teaching content in differentiated ways according to student learning needs. The authors determine that the logical outflow of their framework is that professional development programs are too often just demonstrations of technology, and it is frequently left to teachers to figure out how to apply technology. One of the reasons that technology integration rates are low is because not every technology demonstrated in a professional development seminar goes with every activity or even every content area.

This reality may be one explanation for the results of Kent and Giles (2017). Their goal was to investigate elementary pre-service teachers' self-efficacy beliefs regarding educational technology. They surveyed 28 teachers one year (27 female, 86% 20-29 years old, and 89% white) and 35 teachers the subsequent year (33 females, 89% 20-29 years old, and 74% white), using a five-item Likert type survey on teacher efficacy. Participants reported moderately high levels of technology self-efficacy, with the highest score being for the belief that they could integrate technology across their curriculum, and the lowest score being for actually implementing the technology in their field

experience. The major barrier between their beliefs and actions was that they were more confident in their ability to implement technology than in their ability to *select* the proper technology before implementation. While the study suffers from the usual culprit of a small, homogeneous sample, it is noteworthy for going beyond the question of how self-efficacy influences technology integration to asking where pre-service teachers feel the most and least self-efficacy. One possible reason that teacher suffer from low self-efficacy in technology selection might be that they are presented with too large a number of technologies, only some of which pertain to their content area, and they are not taught the skills to sift through them alone.

The focus on technology and not on technological pedagogical content knowledge can have cyclical effects that further reduce integration rates. When professional development focuses only on new technology, and not on how that technology can specifically intersect with content area pedagogy, it reinforces teachers' ideas that integration just means technological addendums, and not curricular integration. Not only will teachers not know how to integrate technology into their curriculum, but they will lose awareness that they are not integrating. This cycle is not hypothetical. When asked in the 2007 National Speak Up survey what their primary uses of technology "to facilitate learning" were, 51% of teachers responded with completing assignments on computers, assigning practice drills on a computer, and writing reports on a computer. At best, only one of those facilitates learning, rather than just replacing a pencil-and-paper task with an equivalent technological one. Yet, the teacher respondents believed that those uses constituted integration. This is why technology

development needs to be done within disciplines, rather than en masse, so that every teacher knows how to integrate technology into their curriculum in a meaningful way (Williams, 2017).

Professional development needs and gender. As was shown above, plenty of research has been done identifying differences in how each gender perceives and adopts technology. For example, Campbell and Varnhagen (2002) found that males pick up technology skills first, and then learn how to apply them to pedagogy, while females start by identifying their instructional needs and then adopting technology to fit them. This clearly has implications for how professional development should happen.

Li (2015) examined how gender differences toward technology usage were mitigated after participation in a statewide professional development program. One of the great strengths of the study is how comprehensive it is. It sought to determine whether gender differences exist in teacher attitudes, beliefs, and confidence toward technology, and if so, how they are altered by professional development. It also sought to determine whether there are gender differences in higher-level use of technology and lower-level use of technology, and how those differences are changed by professional development. The professional development program in question was a web-based program that supported summer face-to-face sessions, and facilitated an academic learning community through the first half of the academic year.

Data were collected across two academic years from teachers from public schools across the state, which was not specified, and included general education math and science teachers, as well as special education teachers, resource teachers, and

inclusion teachers who taught at least one regularly schedule class in K-12. Of the 1020 teachers who completed the pre-questionnaire in August 2011 or August 2012, 862 were females and 158 were males. Of the 822 who completed the post-questionnaire in December 2011 or December 2012, 712 were females and 110 were males.

The data showed that male teachers held more-positive attitudes and confidence in suing technology than females, but that this difference was insignificant after professional development. Female teachers exhibited enhanced levels of integration after participation. No significant differences in lower-level use were found before or after professional development. Li concludes that professional development can remedy gender differences in technology usage when the differing needs of each gender are considered by the program. One strength of this program was that it was interactive, which is immensely beneficial for female teachers, because they learn technology skills from others, while males would benefit more from a hands-on program, which this was not, because they learn by themselves in the course of doing things. Obviously, these results speak to the average, not to every person who falls into each gender category.

Based on those studies, the evidence strongly suggests that professional development would be more beneficial if it were targeted by gender and discipline, or at least by gender to prevent it becoming cost-prohibitive. But Zhou and Xu (2007) left room for future research. While their abstract, which states that females learn more from others while males learn more from their own experiences, aligns with the previously discussed research, they explicitly say twice in their results section that there

was no difference between genders on "learning from experience." There was only a statistically significant difference in the *preference* for learning styles. So, it is undetermined whether there is any actual difference in learning by gender, or if there is only a difference in preference. This will become relevant in the next guiding question about teacher burnout and technology, but either way, multiple studies report that teachers cite poor professional development as one of their major obstacles to integration, so variation by gender is a reasonably-supported place to start.

Possible Steps Forward

There are four paths to improving integration identified by the literature. They concern improvements to professional development, strategies to intentionally use outside pressures, changes that could be made to teacher preparation programs, and the simple passage of time. These shall be summarized in the conclusion of the thesis.

Improving professional development. Anthony (2011) suggested a number of steps for improving professional development so that the powers held at the district, school, and classroom level work in concert with each other, and do not leave openings for negative beliefs or low self-efficacy to inhibit technology integration. Planners need to obtain software and hardware that directly addresses curricular goals, which will likely involve working with teachers to determine what is needed. Ottenbreit-Leftwich et al. (2010) also suggested that teachers have more opportunities to contribute to a discussion of what technologies are valuable for teaching and learning, rather than relying on technocentric professional development seminars.

As was discussed before, though, teachers who do not have technology tend to undervalue it, so planners and other district officials will have to use their power to set the range of possible implementations from which teachers can choose. Planners also need to be able to assess technology before investing in hardware, because bad experiences can mar teachers' opinions of technology. In order to aid planners in these goals, professional development needs to be specific, rather than offering platitudes about how technology is good for learning. It may make sense for planners to also attend professional development, so that they have the end goal in mind when they assist teachers in implementation.

While Brinkerhoff's (2006) analysis of the long-term professional development academy was riddled with uncertainty, the raw interview results yielded some strengths that could be replicated elsewhere. Professional development should center around participants' teaching interests, rather than around technology. Seminars should include hands-on components that vary between individual, paired, and small group activities. Participants also need to be held accountable for creating integrated lesson plans based on the professional development program. In short, greater effort needs to be made to make professional development meet varying learning needs and preferences among teachers.

Structural considerations. Anthony (2011) also concluded that social influences from parents, students, and other teachers can push teachers to adopt technology, and recall that Baek, Jung, and Kim (2008) found that adapting to external requests and others' expectations was the primary reason that teachers integrate technology, more

so than personal beliefs in the usefulness of technology. This connects to the political science concept of audience costs, discussed in Fearon (1994). The concept of audience costs primarily deals with how democratic leaders have greater credibility in international negotiations than autocracies, because when democratic leaders publicly signal their positions, they are held accountable by voters. The same is not the case for autocratic leaders. Essentially, once democratic leaders commit to a position, the cost of backing down from that position is a loss of voter support, so their cost of backing down is greater than for an autocratic leader. Because the cost of backing down is greater for democratic leaders, when they state a position or make a threat, it is more credible.

When considering Anthony's (2011) conclusion that parents and students are a source of pressure on teachers to integrate technology, the theory of audience costs becomes relevant. If district administrators signal to parents and children, perhaps through a mass mailing, that teachers will be making a greater effort to integrate technology in the classroom, and even suggest that parents should ask their students about it at home, this might generate potential audience costs that drive teachers to actually integrate technology. This is no longer a credibility game, but the administration is generating potential costs that teachers will not be willing to incur. At the very least, it will push administrators to increase pressure on teachers to better integrate technology, because if teachers prove willing to incur those costs, the administration will be forced to absorb at least some of them. Teachers may not be willing to tolerate that pressure forever, but research shows that changes in beliefs follow changes in

practice, so by forcing change in the short term, administrators may see ongoing change driven by changed teacher beliefs (Ertmer, 2005; Guskey, 1986).

Teacher preparation programs. It was stated a number of times above that vicarious experiences can have a powerful effect in shaping and changing beliefs (Ertmer, 2005; Schunk, 2000). Put another way, observing successful others increases the perceived need for change and reassures one that change is not impossible (Zhao & Cziko, 2001). This leads to the simple conclusion that pre-service teachers need better role models. Apprenticeship needs to become a basic part of being a teacher, rather than something of which teachers elect to be a part. While some teachers may try to stop improving before they qualify to be mentors, the teachers society needs to be mentors would continue to try to improve and model good practice.

There also needs to be a shift in how teachers perceive technology integration. Zhao and Cziko (2001) found that teachers use technology to make their current goals easier, not to allow them to reach new goals. They are actually less likely to adopt technology if they feel pressured to use it to achieve new goals. Starting with teacher preparation programs, the narrative needs to stop being about how teachers need to integrate new technologies and needs to start being about how technology can better help teachers achieve their goal to help students learn. It cannot feel like an assignment or a chore.

Lastly, Ertmer and Ottenbreit-Leftwich (2010) suggested that pre-service teacher training programs must include proof that teacher candidates can use technology to aid student learning. If changes are made to how pre-service teachers are paired with in-

service teachers for observations and their practicum, there should be no reasons not to assess pre-service teachers' ability to integrate technology for student learning. In fact, the only reason it would not be assessed now is that pre-service teacher preparation programs are not teaching technology integration well enough to be confident in positive results.

Wait it out. Gao et al. (2009) found that students pushed the pre-service teachers in their study to adopt more ICT, so it may be that students will be the catalyst for change. This is essentially the same as the argument that digital natives will change ICT integration by virtue of not knowing a world without technology. Of course, numerous studies cited above echo Mundy, Kupcynski, and Kee (2012) in saying that digital native teachers need instruction in how to apply their technology skills to curricular integration. Just because a current student knows that something is wrong with the way they are being taught does not mean they know how to fix it. Saying that the teacher should use more technology is a far cry from designing a lesson plan with technology integration, so waiting it out is probably not the best option.

Teacher Retention

Unlike with technology adoption and technology integration, there has been no research done directly on the link between technology adoption/integration and teacher burnout, at least that could be found using the methods employed in this thesis. Because of that, much of this section will involve the same literature as the previous two sections, but will frame those studies in a new light. The lack of research is likely because the immediate need is to boost adoption/integration rates. It could also be

because researchers on the subject assume that if beliefs and self-efficacy must change in order to increase adoption/integration rates, and negative beliefs and low self-efficacy cause burnout, then solving the first problem will help avoid the second one. In this section, four possible links between technology pressures and teacher burnout are suggested: anxiety due to constantly changing technology, anxiety due to low self-efficacy or lack of abilities, anxiety and frustration due to lack of or poor professional development, and the possibility that outside pressures to use technology become more burdensome over time. While changing beliefs and efficacy levels may mitigate some of these issues, it will not address all of them. The definition of burnout used is the combination of emotional exhaustion, depersonalization, and reduced personal accomplishment that results from prolonged work related stress (Kyiacou, 1987; Maslach & Jackson, 1981; Pas, Bradshaw, Hershfeldt, & Leaf, 2010).

Anxiety Due to Constantly Changing Technology

As was stated multiple times above, teachers are uncomfortable with the constantly-changing nature of technology (Mundy & Kupczynski, 2013). They are afraid that they will constantly have to update their knowledge to stay ahead of technologically adept students (Christensen, 2002). This would reasonably cause teachers to feel overwhelmed by the unending flow of information they will have to confront over the course of their careers about the single topic of educational technology. It may also make them feel despondent, because they know that they will have to discard that information as soon as the next update reveals itself. They are essentially shoveling down a mountain, one shovel full at a time, and throwing it over

their shoulder, for what can certainly feel like no reason. They have to accept what must be an existentially difficult position that they will never have complete knowledge about the tools available, and that their knowledge on the subject will never be entirely reliable (Ertmer & Ottenbreit-Leftwich, 2010).

This sense of despair is self-propelling. Low technology users are more troubled by this need to keep up with new technologies than are high technology users, and are less likely to engage with technology (Li et al., 2015). This means that the people prone to anxiety about technology are more likely to avoid using it and learning about it, which will both increase their anxiety about not being caught up with the latest trends, and damage their self-efficacy, because it is a dominant belief that good teaching practice requires the use of technology (Ertmer & Ottenbreit-Leftwich, 2010). High technology users are not necessarily free from this anxiety either. Mahar, Henderson, and Deane (1997) found a positive and significant correlation between computer anxiety and computer experience, possibly because the more time people spend with computers, the more they realize how much they have to learn. This study was published in 1997, though, so more weight should probably be give to Li et al.'s (2015) results. However, even Li et al. (2015) found that high technology users are not entirely devoid of anxiety, only that it is less than low technology users.

It is not difficult to reach the conclusion that constant anxiety, and possibly even existential questioning, could cause teacher burnout. The main thing to understand in making that link is that the anxiety felt from needing to continuously update technology knowledge is *continuous*. Every lesson plan is supposed to be integrated with new

technology, something to keep students impressed and interested. To better understand this link, more research needs to be done in two areas. It would be important to know how often new technological innovations related to the classroom are released, and how much time teachers actually do (or should) spend thinking about updating their classroom technology. It is possible that teachers really do not suffer much anxiety in this area, because they delegate the responsibility of staying up to date to district technology personnel, or perhaps because they realize that budget constraints limit their ability to act on any new information they find. These are all possible areas of future research.

Anxiety Due to Low Self-Efficacy or Lack of Ability

In what is a truly dismal hypothesis, Pelgrum (2001) postulated that teachers may fail at using instructional technologies because they have inadequate cognitive, affective, and psychomotor skills. As discussed in the section on barriers to technology adoption, self-efficacy is inextricably intertwined with abilities. Low abilities cause low self-efficacy, which causes people to avoid helpful professional development and other opportunities to better their skills, which causes low abilities.

In their study of burnout among high school teachers, O'Brennan, Pas, and Bradshaw (2017) found that low self-efficacy is significantly related to burnout. The purpose of their study was to find the most important staff and school level characteristics related to burnout within high schools. They specifically examined self-efficacy, connectedness, suspension rates, and urbanicity. The participants were 3225 high school staff in 58 high schools across Maryland, 82% of whom were white, 67% of

whom were female, and 75% of whom were teachers. The students in the schools in which the participants worked were 48% minority, 50% suburban, 28% rural, and 22% urban. Seventy-two percent were at least proficient in algebra, 70% in English, 68% in biology. The average study body size in the participating schools was 1254. Participants completed the Maryland Safe and Supportive Schools School Climate Survey, which was part of a multiyear study of high school climates. Principals signed letters of commitment to get their staff to participate, but participation was voluntary and anonymous.

In addition to their finding that self-efficacy is significantly related to burnout, the authors found that perceptions of connectedness and safety were significantly related to burnout. The only school level factor that was significant is school-wide suspension rates. Interestingly, white and female staff reported higher levels of burnout than minority and male staff. It may make sense to some that female staff, facing a probable work culture of at least subtle sexism and a general culture that places the responsibility on them to manage their homes and a job, would experience higher burnout. Zhou and Xu (2007) also found that female teachers had lower confidence and less experience using computers, and it makes sense that female teachers with low self-efficacy in technology would experience greater burnout. It is more surprising that white staff experience higher burnout. More research should be conducted to identify the causes of both of these findings. Lastly, teachers reported greater burnout than non-teaching staff.

The study's primary strengths are its great sample size and its impressively low missing-response rate of 8.4%. They also determined that the missingness is not related to any covariates of interest. The two limitations of the study are that it only studies high schools, and that all of the self-efficacy questions in the survey were related to handling behavioral problems, and had no bearing on teaching competency. This limited operationalization may also account for the finding of higher burnout among female teachers, who may feel they are less able to discipline students or command the respect of their classrooms in a culture that often portrays the male figure as the arbiter of justice in the household. The limited operationalization of efficacy also limits the applicability of the study to this thesis, but it is not unreasonable to assume that self-efficacy with handling behavioral problems and self-efficacy in instruction would have at least a loosely similar relationship with burnout.

That assumption is bolstered by Savas, Bozgeyik, andEser (2014), who utilized a more comprehensive definition of efficacy. These authors sought to answer the same question as O'Brennan, Pas, and Bradshaw (2017)- what is the relationship between teacher self-efficacy and burnout? Their study included 163 randomly chosen teachers who worked in various primary and secondary public schools in the center of Gaziantep, Turkey. About two-thirds of participants were male, 25.8% were under 30, half were between 31-40, and 20% were over 41 years old. About one-quarter had less than seven years of teaching experience, about half had 8-15 years, and about one-quarter had 16+ years. So while the study does not boast as impressive a sample size or as externally

valid a location as O'Brennan, Pas, and Bradshaw (2017), it does provide a decent spread by gender, age, and teaching experience.

Savas, Bozgeyik, and Eser (2014) used the Maslach Burnout Inventory and the Teacher Sense of Efficacy Scale, which includes items for efficacy in student engagement, efficacy in instructional strategies, and efficacy in classroom management (the only component included in O'Brennan, Pas, and Bradshaw (2017)) to measure burnout and efficacy in participants. They determined that there was a significant, medium, negative correlation between self-efficacy and burnout levels, amounting to a .495-point drop on a five-point scale.

But the road to building efficacy is a challenging one. As stated above, Chua, Chen, and Wong (1999) found that people may develop anxiety about technology during their experiences in technology classes, because classes reveal how much you just do not know. Many in-service teachers, on top of anxiety developed in their technology classes, also never experienced positive vicarious uses of technology, which can only add to anxiety about using it (Chavis & Kim, 2015). It is no wonder that King (2002) found that the number of teachers using technology is low because the process is intimidating, confusing, and disappointing for both teachers and students. If pre-service technology classes make a teacher feel overwhelmed, and they have never had a positive experience with instructional technology, of course they would be worried about disappointing students.

Hoy (2000) identified three main factors at play in building self-efficacy. The first is having a positive teaching experience at the beginning of one's career. The second is

the observation of effective teaching practices by other teachers. The third is receiving praise of good practices and the constructive criticism of inefficient practices. All of these support prior conclusions that pre-service practicums must place a greater emphasis on pairing pre-service teachers with excellent in-service teachers, and not just teachers who feel like they have time on their hands, or who need an extra pair of hands in their classroom.

In summary, experiences of teacher burnout are related to low levels of self-efficacy to motivate, instruct, and discipline students (Martin, Sass, & Schmidt, 2012; Skaalvik & Skaalvik, 2010). These experiences of burnout due to low self-efficacy are worse in teachers that understand the importance of competence but lack self-confidence in their abilities, which also prevents them from pursuing opportunities to develop competence (Brouwers & Tomic, 2000; Friedman & Farber, 1992; Leiter, 1992). And teachers with low levels of mastery feel more stress, which leads to increased likelihood of burnout (Chwalisz, Altmaier, & Russell, 1992; Friedman & Farber, 1992).

Anxiety Due to Lack of or Poor Professional Development

Skaalvik and Skaalvik (2011) found that when staff feel supported and respected, they are able to thrive, allowing them to better meet the needs of their students. Part of being supported and thriving professionally is receiving meaningful professional development. Unfortunately, as was discussed at length in the previous section, professional development is not always meaningful, and is often designed with the needs of only one gender or some disciplines in mind. Because O'Brennan, Pas, and

Bradshaw (2017) found that female staff are more likely to experience burnout, it is worth revisiting how professional development often underserves female teachers.

The shortcomings are primarily related to the difference in how female and male teachers learn new technology skills. Female teachers tend to learn technology from others, while male teachers tend to learn it through their own experience (Zhou & Xu, 2007). The order in which they learn new skills is also different. Male teachers learn technology skills first and then consider the application to teaching, while female teachers learn pedagogy first, and then consider what technologies can best assist (Campbell & Varnhagen, 2002). When professional development is mismatched to gender needs, at least some of the staff, likely female staff, is not going to feel supported. Even if some staff finds the professional development meaningful, others will feel like the administration wasted their valuable time, which could have been spent preparing lesson plans or exploring technology on their own.

While schools do not have direct control over how professional development seminars are designed, this is perhaps the connection to burnout over which they have the most control. Yldirim (2000) found that teachers' confidence and preference for using technology significantly improved after participation in a computer literacy course, which means that meaningful professional development has the potential to eliminate some of the anxiety surrounding technology that leads to burnout.

Outside Pressure to Use Technology

One result from O'Brennan, Pas, and Bradshaw (2017) that was not mentioned earlier is that tenured staff are more likely to experience burnout. On the surface, it

might make sense that older workers are more likely to quit their jobs, but the definition of burnout includes emotional exhaustion, depersonalization, reduced personal achievement, and constant stress. It is not ideal that everyone would end their careers feeling those things, even if they made it to retirement age. This recalls Baek, Jung, and Kim (2008), who find that teachers use technology more to meet external pressures than because they actually believe technology will bring benefits to the classroom, and that those beliefs become more negative as teachers become more experienced. Consequently, more weight is put on external pressures when they consider whether to use technology or not. When teachers have personal beliefs that technology is not helpful, but are under continuous pressure, and growing pressure relative to their personal beliefs, to use technology by administration, they are not going to feel supported, which, as was stated, leads to job-related stress and burnout (O'Neill, & Chapman, 2011; Pietarinen, Pyhältö, Soini, & Salmela-Aro, 2013; Sharplin, Skaalvik & Skaalvik, 2011).

But Bradshaw, Reinke, Brown, Bevans, & Leaf (2008) found that strong working relationships between staff and administration often start by sharing responsibility and leadership for school-wide policies. On top of that, these positive working relationships are necessary for programs to succeed. Therefore, if districts are interested in both boosting technology integration rates and decreasing teacher burnout, teachers should be involved in discussions of what technologies are valuable for teaching and learning, rather than administration adopting policies and then try to coerce teachers into following them (Ottenbreit-Leftwich et al., 2010).

CHAPTER III: DISCUSSION AND SUMMARY

Summary of Literature

The three research areas explored in this thesis were the barriers to the adoption and integration of technology, the connection between the emphasis on technology adoption and integration, and teacher burnout.

Barriers to Technology Adoption

The factors affecting technology adoption began with the most basic and easily fixable problem: some teachers simply lack access to the hardware. Whether it is the computers themselves (Ertmer, 2005; Goktas, Yildirim, & Yildirim, 2009) or reliable access to the Internet (Hutchison & Reinking, 2011), some teachers continue to lack basic technological materials.

From there, the discussion of barriers to adoption worked backward along a series of factors to find the most antecedent factor. The first discussed were demographic factors, unsatisfying as an explanation because they are almost entirely unchangeable. Some studies found that gender was an important influence, with female teachers using technology less (Colley & Comber, 2003; Vale & Leder, 2004; Zhou & Xu, 2007; Zogheib, 2006) and perceiving it as less useful (Yuen & Ma, 2002). Others disputed any difference in gender at all (Sang et al., 2010; Volman et al., 2005). Morris, Venkatesh, and Ackerman (2005) found that differences in gender were conditional on generation, with older people displaying gender differences in usage, while younger people showed gender parity. Incik and Akay (2017) found no differences in gender, but did find that disciplines varied in their usage.

Next, technological anxiety was discussed. Mahar, Henderson, and Deane (1997) found a relationship between computer anxiety and computer experience, and determined that it could be due to a growing realization about the constantly-changing nature of technology. This was reaffirmed by later conclusions that anxiety may develop in technology classes (Chua, Chen, & Wong, 1999) and that teachers are afraid of keeping up with their students year after year (Christensen, 2002). Efe and Efe (2016) made dubious claims that anxiety was conditional on culture, but extremely limited sampling and other research draw those results into question.

Beliefs and attitudes toward technology were also found to be an important factor in determining use (Altun, 2002; Blignaut, McDonald, & Tolmie, 2002; Teo, 2009; Teo, 2010). The most important attitude in numerous studies was related to the usefulness of technology (Cuban, Kirkpatrick, & Peck, 2001; Incik & Akay, 2017). Varol (2013) made the interesting observation that teachers with more positive attitudes use technology more, and that that relationship may go in both directions. Beliefs about constructivism and traditionalism were also important, with constructivist teachers being more likely to use technology (Becker, 2001; Hermans et al., 2008; Judson, 2006; Niederhauser & Stoddart, 2001; Sang et al., 2010). Zhou and Xu (2007) related this back to gender, finding that females were more likely to be constructivist, which raised the question of why (and whether) females use technology less than males, if they are more constructivist and constructivism is related to technology use. Keys (2007) and Pajares (1992) raised the interesting point that teacher beliefs are based on experiences as students and are shaped by teacher training, but that they become rigid when teachers

start working. This indicates that changes in beliefs and attitudes might need to be made at the pre-service level, and only other solutions may be employed at the in-service level.

The most antecedent general factor was self-efficacy. Numerous studies identified self-efficacy as a determining factor in technology adoption (Gardner, Dukes, & Discenza, 1993; Knoblauch & Hoy, 2008; Paraskeva, Bouta, & Papagianni, 2008; Putman, 2012; Russell et al., 2003; Sure, 2009). Teo, Fan, and Du (2015) found that there were no differences in beliefs and attitudes between genders, but that females had lower self-efficacy with computers. It was decided that rather than something being inherently less technology-capable in female teachers, there was some other issue that caused their lower self-efficacy. This was explored further in the later discussion of professional development. Hasan (2003) and Salanova et al. (2000) found that individuals with high self-efficacy more eagerly participated in technology activities and had better attitudes toward it, which improved their perceptions about ease-of-use, and contributed to a positive feedback cycle of self-efficacy, use, and attitudes. Li et al. (2015) reaffirmed this relationship. Spaulding (2013) attempted to point to a generational divide in self-efficacy and beliefs, but ended up only reaffirming the importance of self-efficacy in any generation. Lastly, Tambunan (2014) provided a model for where self-efficacy might come from, with interpersonal communication and the use of technology being the most antecedent factors. This foreshadowed later findings that school cultures about technology can influence individual teacher use.

Barriers to Technology Integration

The next research question dealt with technology integration, or the use of technology for pedagogical purposes, not just efficiency purposes. The divide between adoption and integration was well established (Cuban, Kirkpatrick, & Peck, 2001; Kurt, 2012; McCannon & Crews, 2000; Mundy, Kupczynski, & Kee, 2012; San et al., 2010; Seferolgu & Akbiyik, 2005). Some of the factors influencing integration were the same as adoption. The first was beliefs. One important belief was simply about the scope of integration, and whether teachers understood its pedagogical focus (Okojie, Olinzock, & Okojie-Boulder, n.d.). As with adoption, the usefulness of technology was important, this time its usefulness for learning, not for time-saving (Miranda & Russell, 2011). Schunk (2000) established that vicarious experiences as a pre-service teacher were essential for developing positive beliefs about the usefulness of technology. Hutchison and Reinking (2011) discovered that some other factors must be at play, because their respondents were nearly unanimous in their positive beliefs about technology's usefulness for learning, but they also reported a lack of incentives to integrate technology, despite Ottenbreit-Leftwich et al. (2010) finding that the primary motivation of teachers is the desire to benefit students. Russell et al. (2003) found that teachers who have technology have more positive beliefs about it, suggesting that the way administrations can change beliefs is by forcing technology on teachers, although there are clear endogeneity questions in that relationship.

Structural considerations were considered next. Warschauer (2007) found that teachers in wealthier districts were more confident with integration because they

believed their students would have the resources to complete homework. Some responsibility was placed on teacher preparation programs by Gao et al. (2009), who found that pre-service participants who were partnered with cooperating teachers that did not use technology had greater difficulties using technology themselves. District policies became the primary focus of this subsection, with the findings that such policies can meaningfully impact classroom technology use (Anderson & Dexter, 2005; Fitzgerald, 2003; O'Dwyer et al., 2004). Williams (2017) determined that the most helpful thing district administration can do is have designated support staff stay on top of the latest classroom technology, so that teachers do not have to add that to their work responsibilities.

Outside pressures were also an important determinant of integration (Baek, Jung, & Kim, 2008; Miranda & Russell, 2011). Anthony (2011) identified the various sources of pressure in a district and argued that they had to be in sync to effect change. Otherwise, teachers with negative attitudes would find ways to escape integration.

As with adoption, self-efficacy was important to integration (Moore-Hayes, 2011). A number of studies showed that, sometimes, poor self-efficacy is earned by authentically poor skills (Andersson, 2006; Dawson, 2006; Kay & Knaack, 2005; Kozma, 2003; Wright & Wilson, 2005). Unfortunately, only teachers with high self-efficacy are likely to pursue remedies to those deficiencies (Gersten, Chard, & Baker, 2000). These skill deficiencies came in part from a lack of personal and vicarious positive experiences with technology (Chavis & Kim, 2015; Ertmer & Ottenbreit-Leftwich, 2010; Gao et al., 2009; Mueller et al., 2008). The research also showed that it was naïve to assume that

digital natives would necessarily solve the integration shortfall. Evidently, personal uses of technology do not automatically translate to educational uses (Dexter, Doering, & Riedel, 2006; Nadelson et al., 2013; Otero et al., 2005). Digital natives are also not any more comfortable keeping pace with technology change than digital immigrants (Li et al., 2015; Mundy & Kupczynski, 2013). Yildirim (2000) did suggest that professional development could improve self-efficacy, though.

Professional development was found to be a key influence on technology integration (Cope & Ward, 2002; Hsu, 2010; Rother, 2004). But the impact of professional development is not guaranteed to be positive, with bad experiences having negative effects on integration (Bauer & Kenton, 2005; Brinkerhoff, 2006; Wozney, Venkatesh, & Abrami, 2006). And it seems professional development is not helpful as often as it is, because Incik and Akay (2017) found that the number two recommendation teachers had for improving educational technologies was the better teaching of technology.

One of the primary issues with professional development is that it is too technocentric, acting more as a sales pitch for a piece of technology rather than as an instructional setting for new pedagogical aides (Groff & Mouza, 2008; Harris, Mishra, & Koehler, 2009; Levin & Wadmany, 2008; Russell et al., 2007; Zhao et al., 2002). Because professional development does not often explain how specific technologies can be specifically applied in the classroom, Kent and Giles (2017) found that pre-service teachers feel more confident about implementing technology than they are in selecting appropriate technologies. Findings from Hutchison and Reinking (2011) and Project

Tomorrow (2008) indicate that poor professional development actually narrows teacher beliefs about the scope of integration, as Okojie, Olinzock, and Okojie-Boulder (n.d.) warned. Teachers need pedagogically focused professional development that provides regular updates on available educational technologies (Williams, 2017).

Another shortcoming of professional development is that it can often be focused on the needs of only male teachers. Male and female teachers differ both in the order they learn technology and pedagogy (Campbell & Varnhagen, 2002) and in the methods they learn technology (Zhou & Xu, 2007). When professional development includes a variety of instructional and experiential methods, both genders learn new technological skills about equally (Li, 2015). Suggestions were made at the end of this research question for the improvement of a number of integration-limiting factors. Those have been moved to the section on implications for professional application immediately preceding the conclusion.

Connection between Technology Adoption/Integration and Burnout

There was limited literature specifically researching the link between the continued emphasis on technology adoption and integration and teacher burnout. New connections had to be made between the literature on technology-related anxiety and teacher burnout. Four connections were identified: anxiety due to constantly changing technology, anxiety due to low self-efficacy or lack of abilities, anxiety and frustration due to poor professional development, and the increasingly burdensome outside pressure to use technology.

Teachers repeatedly expressed fears and discomfort about being able to keep up with the constantly-changing nature of technology (Mundy & Kupczynski, 2013). This was made worse by the understanding that each wave of students would bring a newer understanding of technology to the classroom, increasing the pressure to keep up, and invalidating much prior knowledge (Christensen, 2002). Teachers must regularly confront the existential reality that they will never have complete knowledge about technology (Ertmer & Ottenbreit-Leftwich, 2010). This anxiety seems inescapable. Digital natives are not more comfortable with the rapid pace of change (Li et al., 2015), and classes teaching new technology skills only expose teachers to the depths of their lack of understanding and the vastness of the world they do not know (Chua, Chen, & Wong, 1999; Mahar, Henderson, & Deane, 1997).

Teachers also experience anxiety over their low self-efficacy and lack of abilities (Chwalisz, Altmaier, & Russell, 1992; Friedman & Farber, 1992; Martin, Sass, & Schmidt, 2012; O'Brennan, Pas, & Bradshaw, 2017; Pelgrum, 2001; Savas, Bozgeyik, & Eser, 2014; Skaalvik & Skaalvik, 2012). And there seem to be no ways to build self-efficacy that do not involve more exposure to causes of anxiety. As stated, people develop anxiety in technology classes Chua, Chen, & Wong, 1999; Mahar, Henderson, & Deane, 1997), poor practicum experiences leave pre-service teachers with no positive vicarious experiences (Chavis & Kim, 2015), and without those prior experiences, practicing in front of your own classroom generates more anxiety (King, 2002). Self-efficacy deficiencies gain more weight in causing burnout when the teacher is aware of the importance of competence but lack self-confidence (Brouwers & Tomic, 2000; Friedman

& Farber, 1992; Leiter, 1992). Hoy (2000) identified three main factors influencing self-efficacy: positive teaching experience at the beginning of one's career, observation of effective teaching practices by other teachings, and the receipt of praise for good practices and of constructive criticism for inefficient practices.

Teachers also feel anxiety and frustration from poor professional development. When they feel supported and respected, they thrive (Skaalvik & Skaalvik, 2011). But due to gender-need mismatches in professional development (Zhou & Xu, 2007; Campbel & Varnhagen, 2002), staff rarely feel supported from professional development experiences. But meaningful professional development has the ability to change that (Yildirim, 2000).

O'Brennan, Pas, and Bradshaw (2017) found that tenured teachers are more likely to experience burnout, indicating that the external pressures identified by Baek, Jung, and Kim (2008) become more burdensome over time. If that pressure is coming from administration, then staff are likely to feel like their relationship with administration is adversarial rather than supportive, which increases burnout (Pietarinen et al., 2013; Sharplin, O'Neill, & Chapman, 2011; Skaalvik & Skaalvik, 2011). If administration involves staff in the creation of those pressure-generating policies, though, staff are likely to experience buy-in and forge positive relationships with administration (Bradshaw et al., 2008; Ottenbreit-Leftwich et al., 2010).

Limitations of the Research

The original intent of this thesis was to focus more on the relationship between technology and burnout, but finding that the current body of literature does not include

many, if any, pieces of research on that relationship (at least in the ERIC database), the focus was expanded to include the questions of general barriers to adoption and integrating technology. The new study began by searching generally for peer-reviewed journal articles that had to do with those barriers in the ERIC database. The intention was to focus on research from the last five years, and those parameters yielded Efe and Efe (2016), Incik and Akay (2017), and Tambunan (2014).

It quickly became clear that either education research had not delved very deeply into this topic, that ERIC simply did not house the relevant research, or that the research had taken place before the time period in question. So, further studies were pulled from the reference of the first three articles reviewed to identify what the background research in this field was. When a relevant article was identified, its references were combed for relatively recent studies in the same area, and this pattern was continued until studies were included from the early 1990s. This process led back to the first decade of the 21st century. This field of study needs an update, and warrants continuous updates to keep pace with new technology and developing technological pedagogy.

The research methods used in this thesis likely do not provide a comprehensive view of the field. For all of the studies included, there was remarkable little dissonance in their conclusions, with the main lack of clarity occurring in the impact of gender on technology use. In most, if not all, other areas, the literature was highly consistent. This could point to one of two things. The first is that despite a host of methodological issues and sometimes great variety in context, the literature has identified universal truths so

fundamental that they cannot help but be discovered. The second possibility is that the method of working back through the reference sections of generations of articles, beginning with only three source articles, yields only research that is in agreement. This would indicate that authors do not attempt to capture the full breadth of the field in their literature reviews, but only search for studies that agree with their hypotheses. This is not necessarily a bad thing, because hypotheses should be based on prior research, so that the field keeps moving forward, unless there is strong evidence to suggest that prior research is flawed or outdated.

Implications for Future Research

There are three areas that require the efforts of future researchers. The first is a general update of the literature, the second is the expansion of the in-service body of literature, and the third is the clarification of the role of gender in technology adoption and integration.

General Update of the Literature

One source of anxiety that was repeatedly discussed was the constantly-changing nature of technology. It follows, then, that the research on technology in education needs to be regularly updated. It was troubling how quickly the research led back to articles from a decade ago, and that some of the most cited articles included in this thesis were from 2005 and even back to the 1990s. While this may not affect fundamental truths, like the ever-changing nature of technology, it certainly has an impact on the types of technology being recommended, on the structure of district technology personnel, and on the quality of professional development being discussed.

For example, Doe (2006), Harris (2002), and Wang (2000) all found that the use of multimedia technologies is becoming more prevalent because it creates positive attitudes, a more interactive learning environment, and the freedom to work at varying levels. In 2000, that would have consisted of PowerPoint. Today, PowerPoint is regularly demonized as being inflexible, boring, and too teacher-focused. New research needs to be done to update the meaning of "multimedia" and check whether the use of technologically automatically creates a more interactive learning environment.

Another example is Ertmer (2005), who has been cited over 2400 times in studies found on Google Scholar. Ertmer (2005) wrote that sometimes only one in nine teachers "knew how to use high-tech tools such as spreadsheets, presentation software, or digital imaging to enhance their lessons" (pp. 26). Any discussion of barriers to technology adoption that rests on such outdated articles (and this one only being 12 years old), or even rests on literature that is based on research from that time, requires the leap of faith that technology has not been getting easier or more difficult to learn, and that every teacher, no matter the generation or technology, faces the same barriers to entry as the previous generation did. So the research needs to be continually updated to identify what new technologies still have positive effects on students, if old technologies lose their positive effects on students when they are no longer on par with technologies in their personal lives, and whether improvements have been made in education with regards to the problems identified in literature even as recent as 5-10 years.

Expand the In-Service Body of Research

There is a general shortage of research that is based on in-service samples rather than pre-service samples, and both suffer from the same problem of small, homogeneous samples. At least the in-service research needs to be developed to include studies using teachers from multiple states and grade levels, rather than drawing from one school or one country, or even one metro area. But the main reason that the field needs more research based on in-service teachers is that technology research based on pre-service teachers may not be valid at all. Becker (1994), Hooper and Reiber (1995), Marcinkiewicz (1993), and Sandholtz, Ringstaff, and Dwyer (1997) all concluded that it takes five to six years for a teacher to accumulate enough expertise to use technology in truly constructivist ways. This conclusion has the potential to be catastrophic for the abundance of research that deals with how pre-service teachers use or plan to use instructional technologies. Pre-service teachers' beliefs might be important, but if it takes five to six years to gather the experience for integration-level use, then studies that only examine pre-service beliefs are missing five to six years of barriers to entry, including all institutional barriers to might stifle or change beliefs. This reaffirms the need for an update to the literature to see if those numbers, and that extremely troubling conclusion still holds.

Clarify the Role of Gender in Technology Adoption and Integration

The disparity in gender-related results was discussed at length in the body of the thesis, so only a few areas will be reiterated here. The first is the apparent contradiction between Hermans et al. (2008) and Zhou and Xu (2007). Hermans et al. (2008) found

that constructivism has a positive impact on computer use. Zhou and Xu (2007) found that females were both more constructivist and less likely to use computers. Further research needs to be done to identify the magnitude of the effect of constructivism on computer use and to identify the mitigating factors that limit female use of computers, despite their constructivism. Some have already been suggested, such as designed-for-males professional development. The basic finding that male teachers integrate technology more than females (Jamieson-Proctor, Burnett, Finger, & Watson, 2006) also needs to be reassessed. Incik and Akay (2017) found no difference in usage between genders, so more new research must be conducted to see if an old gender gap has now disappeared. A similar update needs to occur for confidence levels regarding technology by gender. Markauskaite (2005) found that male teachers are more confident in their use of computers in the classroom than female teachers, but other research has disputed whether that divide has ever existed, or if it does, when it begins. New research should be conducted to see if male teachers are still more confident with professional uses of technology.

Implications for Professional Application

Several steps forward were suggested near the end of the second research question. They concerned professional development, district policies, and teacher-preparation programs.

Improvements to Professional Development

Anthony (2011) determined that specialized technology planners need to assess technology before investing in hardware, because bad experiences mar teacher beliefs

and attitudes. Despite Brinkerhoff's (2006) uncertainty about what his study indicated, the raw responses showed that the focus of professional development should be on participants' teaching interests; that participants should be allowed to practice in small groups, pairs, and individually; and that participants need to be held accountable for quality deliverables at the end of a professional development session. Ottenbreit-Leftwich et al. (2010) also suggested that teachers be involved in discussions of what technologies to adopt and what professional development to pursue, because they are most likely more aware of their pedagogical needs in the classroom than administrators are. That does not remove the need for administrator involvement, though, because of Russell et al.'s (2003) finding that teachers who do not use technology are likely to undervalue it. Administrators are a necessary part of the integration process, because they are endowed with the power to compel change, even if teachers have negative attitues (Anthony, 2011).

Generating External Pressure to Integrate

Based on Anthony's (2011) and Baek, Jung, and Kim's (2008) findings that external pressures are powerful influences on technology integration, the suggestion was made to modify Fearon's (1994) audience cost theory to encourage technology integration. The theory is that public declarations of intention by leaders who are accountable to the public will have the dual purpose of making that leader's declarations credible and also compelling that leader to hold to their declaration, both due to the fact that a public declaration generates "audience costs" if the leader backs down from their word. Administrators can use this theory to generate audience costs

for themselves and vicariously for teachers by announcing to the public that teachers will be implementing more technology in the classroom. These potential costs can be made greater if the administrator suggests ways for parents to hold teachers accountable for the integration measures. Even if teachers prove willing to incur the audience costs and parent displeasure, the audience costs that the administrator could potentially incur will drive the administrator to hold teachers accountable. So whether teachers feel the pressure directly from parents or indirectly through administrators, they will be more likely to integrate technology. Ertmer (2005) and Guskey (1986) indicated that forcing change in practices can lead to changes in beliefs later on, reaffirming earlier research showing that teachers who use technology have more positive beliefs about it (Russell et al., 2003). This suggests that teachers would not need to bear that pressure forever, but just long enough to recognize the benefits of technology integration for themselves.

Improvement of Teacher-Preparation Programs

There were three suggestions made for the improvement of teacher-preparation programs. Based on research that concluded that vicarious experiences are powerful tools in shaping teachers beliefs and practices (Ertmer, 2005; Schunk, 2000, Zhao & Cziko, 2001), the suggestion was made that pre-service teachers only be paired with technology-adept in-service teachers during their practicums. Currently, in-service teachers volunteer for such pairings. In order to ensure that technology-adept teachers participate, it may become necessary for participation in practicums to be assimilated into the regular responsibilities of a teacher, at the discretion of the administrator. Zhao

and Cziko (2001) also suggest that technology integration be reframed in teacher-preparation programs from being a goal unto itself to being an aide in the existing goal of helping students. This is based on their finding that teacher balk at pressure to achieve new goals, but readily integrate new strategies for achieving existing goals. Lastly, Ertmer and Ottenbreit-Leftwich (2010) state that teacher-preparation programs must include proof that teacher candidates can use technology to aid student learning, and that this is not taken for granted after the completion of a technology class.

Conclusion

The barriers to technology adoption were found to be demographics, technology anxiety, beliefs and attitudes regarding technology, and self-efficacy, with self-efficacy being the most antecedent general factor. Technology integration faced some of the same barriers, with beliefs and attitudes and self-efficacy still playing a role. In addition, district management and the low-quality of professional development explained some of the lack of technology integration, and provided some explanation of the apparent difference in technology attitudes and usage between genders. Lastly, various sources of anxiety served to connect the pressure to use technology to teacher burnout, including anxiety over the constantly-changing nature of technology, anxiety due to low self-efficacy and lack of abilities, anxiety and frustration due to poor professional development, and the increasingly burdensome pressure to integrate technology.

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