Sources of Ambiguity in Teaching Technology

By Susan Thies

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ABSTRACT

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The public school system is charged with the endeavor of preparing students for college and/or careers. Currently there is a shortage of qualified individuals to fill jobs in the technology field. These job opportunities will continue to grow while the amount of potential employees dwindles. There is an issue with supply and demand, what are public schools doing to fill this need? They invest millions of dollars to put technology in the hands of students but what is being taught about technology and how is it being taught?

The purpose of this qualitative study is to describe the current situation in public schools and the universities that supply teachers to those public schools with regard to teaching technology in a Midwestern area. Three groups of individuals were interviewed: teachers, directors of curriculum, and university professors that teach education technology to preservice teachers. Interviews were audio recorded and transcribed then coded for specific words and phrases. Findings showed that a majority of participants were focused on technology integration and student engagement rather than teaching technology concepts. Teachers and university professors had the freedom to choose what they taught about technology yet had very little training on teaching technology. Most were self-taught and located resources on their own time. With this freedom to create lessons on their own, ambiguity arises concerning the content,

coherence, consistency, and reliability of the resources used in the development of the lessons. The educational professionals in this study are the gatekeepers of technology, which could affect equity, academic achievement, cultural capital, and future career choices of students.

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CHAPTER 1 INTRODUCTION

Overview

According to the Bureau of Labor and Statistics (2012), the United States is adding 136, 620 jobs in computing each year. However, the National Science Board (2012) reports that only 2.38% of college students graduate with a degree in Computer Science each year (about 40,000 students). Therefore about 100,000 jobs go unfilled in the computing industry each year. How can the United States remain economically competitive with the amount of technology jobs that go unfilled each year? Researchers are looking toward early exposure to students in K-12 as one possible answer (National Academy of Engineering, 2014).

How can this gap in the job market continue when school districts in the United States have a substantial amount of economic investment in technology adoption? "At the state and federal level, vast amounts of funds are expended annually on educational technology and related professional development, yet few, if any, funds are earmarked to research the effects of these massive investments" (Bebell, O'Dwyer, Russell, Hoffmann, 2010, p. 47). What is the status of technology education/technology literacy in the 21st Century? Are technology skills being taught? Are technology concepts being taught? What is preventing students from going into the technology field? The pipeline that directly feeds into college and career readiness is the K-12 sector. Amiel & Reeves (2008) suggest, "Educational technology researchers should be concerned with examining the technological process as it unfolds in schools and universities and its relationship to larger society" (p. 37). There are three main groups within K-12 sector that can help answer these questions. This study will look at three main influential groups: general education teachers, school district curriculum directors, and university professors in the college of education.

Technology in the classroom, on the surface, sounds simple and conjures up traditional images of students using a computer or playing an educational game. However, it is much more than that and truly a complex and ever-evolving idea. What do university faculty members in education perceive as significant in terms of preparing preservice teachers to teach technology? Their views will directly impact their teaching of future teachers. What do school districts expect their teachers to be teaching their students about technology? Their vision will shape not only their teachers but forever influence their students. What do classroom teachers believe is significant in terms of teaching technology? Their attitudes or beliefs will directly impact the day-to-day learning of their students.

This study will unearth and compare these views on the significance of teaching technology. There is a suspicion that there are many diverse and competing views with factors that present roadblocks in forming a consensus view on technology for the 21st Century. Currently, there is a multitude of literature on teacher beliefs about technology and teacher/student use in the classroom. However there is limited literature on best practices in teaching technology to students at the teacher level, the school district level, and university level.

One outcome of this research is to highlight the agreement or disagreement of education professionals on technology literacy in the classroom. This is an important issue because at different points of a student's life, the educational professionals are the gatekeepers of technology, which could affect equity, academic achievement, cultural capital, and future career choices.

Subjects of this Study

The participants of this study will be professors in the college of education that teach education technology courses, school district curriculum directors, and classroom teachers.

Education is a hierarchical system and to accurately understand the effects of the decisions that are made it is best to study each level of the hierarchy (Bebell, O'Dwyer, Russell, & Hoffmann, 2010). "At each level in an educational system's hierarchy, events take place and decisions are made that potentially impede or assist the events that occur at the next level" (Bebell, O'Dwyer, Russell, & Hoffmann, 2010, p. 45). Bebell, O'Dwyer, Russell, & Hoffmann (2010) also found, "To date, only a handful of published studies in educational technology research have applied a hierarchical data analysis approach" (p. 46). This study will add to this growing body of research and help to create a foundation for hierarchical data analysis in future education technology research.

Most colleges and universities only employ one or two professors that teach educational technology. To collect a wider variety of college professors from colleges of education that are informed on the current status of technology instruction for preservice teachers, interviews will be conducted within a Midwestern area where many universities are concentrated. Research has shown that, "Other higher-education faculties have little understanding of the changes technology is bringing to the K-12 classrooms and have not adjusted their own teaching methodologies to reflect these changes" (Baslanti, 2006, p. 33). Therefore by targeting professors specifically unified on the premise of technology instruction it is the belief that the members will be knowledgeable on the current status of technology instruction of preservice teachers.

School district curriculum directors directly impact the curriculum that they oversea, which then impacts what the material teachers teach and thus what content the students should have access to throughout their academic career. To gain research from a variety of school

district curriculum directors, interviews will be conducted in a Midwestern area where many school districts are concentrated in single area.

Three teachers from each of the Midwestern school districts will be interviewed. To get a good representation, one teacher from the primary level (Kindergarten - 5th grade), one teacher from the middle level/junior high level (6th – 8th grade), and one teacher from the high school level (9th-12th grade) will be interviewed from each school district for a total of eighteen classroom teachers. To maintain consistency, the teachers will be from the same grade levels. Therefore, a fourth grade teacher, a middle school/junior high school computer teacher, and a high school computer teacher will be interviewed in all six districts. These grade levels have been chosen by the National Center for Educational Statistics to take the National Assessment of Educational Progress Technology and Engineering Literacy Assessment.

Statement of the Problem

It is the responsibility of the public school educational system to prepare students for college and/or careers. The U.S. Department of Education states it is their mission, "to promote student achievement and preparation for global competitiveness by fostering educational excellence and ensuring equal access." The public school system is the pipeline for the future labor market. Computers and technology have been in the school systems for over three decades yet 100,000 computing jobs go unfilled each year (Bureau of Labor and Statistics, 2012).

Unfortunately teachers (Fadjo, Brown, & DeLyser, 2013; Bers, Seddighin, & Sullivan, 2013), district curriculum directors (Russell, Bebell, O'Dwyer, & O'Connor, 2003), professors in the college of education (Lambert, Gong, & Cuper, 2008), have little research-based evidence to assist them in teaching preservice and inservice teachers to teach technology. Technology is a young subject in comparison to math, reading, and science. The core subjects (math, reading,

and science) have been disaggregated into researched based curriculums with scopes and sequences that have benchmarks and indicators that spiral throughout each grade level. Technology is ever-present in our society so students should be able to understand the basic concepts surrounding technology as with any other core subject. Technology education is going through a transformational process from basic operational skills to a complete subject that students will need to understand because it will affect equity, academic achievement, cultural capital, and future career choices and opportunities. Kafai and Burke summarized Collins & Halverson's notion by stating, "Teaching word processing and how to create PowerPoint presentations, don't engage students in the deeper analysis needed to think more creatively and critically" (Collins & Halverson, 2009, cited in Kafai & Burke, 2013). Yasmin Kafai and Quinn Burke (2013) also asserted, "Most youth have no or very little conception of computer science as a discipline or how it could apply to their daily lives" (p. 63).

College and university professors are not well equipped with the training to teach technology to preservice teachers (Baslanti, 2006). However, according to an Office of Technology Assessment (U.S. Congress, 1995), "The most direct and cost-effective way to educate teachers about technology is through the preservice education they receive in colleges of education or other institutions" (p. 166-167). Even though that quote is twenty years old, it remains relevant today as with any other core subject being taught in preservice teaching programs.

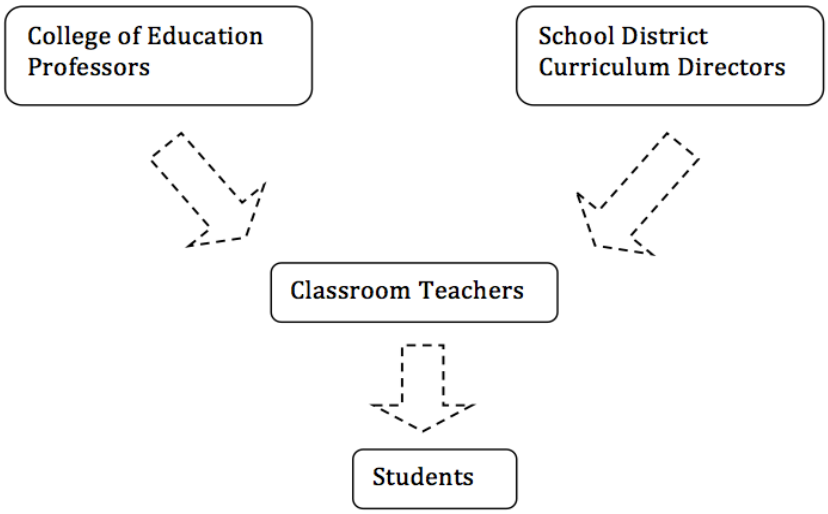
Even less research is available on school district curriculum directors and their knowledge on teaching technology. A majority of the research focuses on technology adoption at the school district level rather than best practices in how to teach technology. This represents a gap in the literature, which this study will fill by interviewing school district curriculum

directors to better understand their expectations of their teachers. Curriculum directors were once teachers themselves so it is vital to remember that their experiences as a teacher along with their experiences in attaining a graduate degree at a university influence the decisions they make. A typical curriculum director is expected to provide leadership in researching, planning, developing, implementing, and evaluating the curriculum and instruction in district schools. Therefore, the curriculum directors make curriculum decisions that directly impact the teachers and the students. If they do not understand the most effective way to teach technology, then the decisions that they make could be detrimental to teachers and students.

Teachers directly impact students in every aspect of their day. Teachers must have the proper training to effectively teach any subject including technology. If they are a new teacher, they rely on what they learned at the university. If they are a veteran teacher, they rely on the training provided by the district. If either of these guiding entities does not provide adequate training, then the teacher is ill prepared and passes that on to his/her students, which could greatly impact the students' future career choices and opportunities.

The hierarchical nature of teaching is exhibited in Diagram 1. This diagram shows the direct effect university professors and school district curriculum directors have over teachers. The diagram also shows the indirect influence of the university professors and school district curriculum directors have on public education students as well as the direct impact teachers have on student learning. It is a simplistic representation of the major components in the education technology ecosystem. It is not necessarily a caustic model but shows the hierarchical relationship to students.

Diagram 1: Hierarchical Nature of Teaching



Research Questions

Current technologies (computers, software, hardware, etc.) have been in the classroom for over thirty years, yet according to Bureau of Labor Statistics, approximately 100,000 technology/computing jobs go unfulfilled each year. Can anything be done at the K-12 level to improve this situation? This study will attempt to find an answer through the following research question and sub questions.

- What is the meaning of teaching technology for college of education professors, school district curriculum administrators, and classroom teachers in a Midwestern area to prepare students for college and career readiness?
    - What essential technology skills/knowledge/concepts do students need to learn?

- Is there a consensus among the education field on technology skills/knowledge/concepts students should have?
- How do college of education faculty, school district curriculum administrators, and teachers decide what technology skills/knowledge/concepts to teach?
- How does college of education faculty, school district curriculum administrators, and teachers convey technology skills/knowledge/concepts?

Purpose of this Study

The purpose of this study is to discover the current views of education stakeholders about important technology skills and concepts. In Language Arts and Mathematics, essential learning has been outlined and a majority of education professionals agree on the skills and knowledge needed for students to achieve in these core areas. This is exhibited by the Common Core Standards in English Language Arts and Mathematics. However, in the realm of technology there is limited information on whether education professionals are in consensus on "meaningful use" of technology and the essential skills and concepts needed by students.

For purposes of this research, the definition of technology use in the classroom is any technology tool, skill, knowledge, application, concept, or way of thinking that is taught within a classroom environment. To define "meaningful use" is challenging. A "meaningful use" of technology is where there is growth in the student's ability to solve problems through the use of any tool, skill, knowledge, application, concept, or way of thinking. This study will show the current status of "meaningful use" of technology in the classroom to suggest a course of action to meet the needs of the 21st century job market.

Importance of this Study

Computer science education is a very young field when compared to mathematics education or science education. Many of the national associations in science or math have been around for more than eight decades with very specific standards and indicators. However, in computer science education, the oldest association is only a mere forty years old with many other associations having just started in the last decade. This puts computer science education at a disadvantage for research and funding (Wilson & Guzdial, 2010). With significant amounts of money being poured into technology by universities and school districts, a consensus is needed to highlight technology skills and concepts that are important for students to learn and will directly impact their economic future.

According to Wilson and Guzdial (2010), overall there are few standard measures of computing education. This study is intended to question higher education professionals, school districts, and classroom teachers to discover what technology skills and concepts are important and to see if there is consensus among the three entities. By outlining the necessary knowledge and skills, this study hopes to lay a foundation in computer science education for the K-12 sector. From this foundation, educational professionals and policymakers can move forward with a solid research base from which further curriculum decisions or purchasing decisions could be made.

Since the beginning of public education, evidence of technology use in the classroom has been prevalent in a variety of forms depending on the definition that is used and the time period. One could consider pencils and ballpoint pens as technology or the advent of the electronic calculator as technology. In both of these instances, technology is being viewed as a tool rather than a skill or knowledge.

Thinking of technology as a skill or type of knowledge would yield yet a different image, possible one that would be a student using a desktop or laptop computer to write a report or present a presentation. Again, this could be considered technology use in the classroom. A third type of evidence of technology use in the classroom is a separate class such as one of the exploratory classes in elementary, middle, or high school, where they teach skills and applications.

More modern evidence of technology in the classroom is when students learn to program. Learning computer programming is a much more complex use of technology. Students may learn to create webpages or develop basic computer games through problem solving. The evolution of technology in the classroom from tools to skills, to applications, to a way of thinking is not only evident but also directly related to the needs of 21st century industry.

This abstract way of thinking or problem solving is called Computational Thinking. "Computational thinking is taking an approach to solving problems, designing systems and understanding human behavior that draws on concepts fundamental to computing" (Wing, 2006, p. 33). Jeannette Wing suggests that computational thinking combines elements of mathematics, engineering, and science. She states,

> It shares with mathematical thinking in the general ways in which we might approach solving a problem. It shares with engineering thinking in the general ways in which we might approach designing and evaluating a large, complex system that operates within the constraints of the real world. It shares with scientific thinking in the general ways in which we might approach understanding computability, intelligence, the mind and human behavior (Wing, 2008, p. 3717).

Technology tools and applications have long been sought after by industry to attain the competitive edge over industry rivals. This need is then forced on the supporting institutions such as public schools, technical schools, colleges, and universities to provide individuals with this new training (Nelson, 1994). The K-12 school system has mirrored this need within their attempts to teach technology over the last three decades.

Teaching technology in the K-12 system began about thirty years ago as computers became more accessible to students and their families. Schools saw the need to teach students procedural knowledge to operate the machine. Schools began with basic programming skills but as computer manufacturers and software manufacturers began to develop more user-friendly computers, the need for understanding programming becomes unnecessary (Kafai & Burke, 2013). At this point, schools began to teach students to use computers as a tool. Students were taught how to use applications that focused on tasks such as word processing, spreadsheets, Internet searches, email, etc. These skills were known as computer literacy and are still being taught today in many schools. The U.S. Department of Education (1998) defines computer literacy as, "computer skills and the ability to use computers and other technology to improve learning, productivity, and performance."

The next focus was on information literacy, which was and still is highly promoted by the American Library Association (ALA). The ALA began promoting information literacy in higher education and outlined the definition of it in 1989. Information literacy is the ability to, "recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information," (ALA, 1989). Over the next couple of years with the advent of the World Wide Web and the rampant proliferation of information, the ALA saw the need to educate all students on information literacy not just higher education students on the importance

of information literacy. In 1998, the ALA released its groundbreaking book Information Power: Building Partnerships for Learning where they outlined Information Literacy standards for students in K-12. This book became the focus of universities educating Library Media Specialists across the United States and is one of the main influences on school library standards in many school districts.

The K-12 school system has incorporated and focused on concrete skills (Computer Literacy) and slightly more abstract skills (Information Literacy) yet it has been difficult and slow to move the focus from skills (lower level use of computers) to concepts such as computational literacy or computational thinking. The next more recent movement has been toward Technological Literacy. This movement occurred in 2000 when the International Technology Education Association (ITEA) came out with their Standards for Technological Literacy. ITEA defines technological literacy as, "the ability to use, manage, assess, and understand technology" (ITEA, 2007, p. 7). Approximately about the same time, the International Society for Technology in Education (ISTE) came out with technology standards as well. Other organizations followed releasing their versions of technology standards and what they deemed important. The U.S. Department of Education then created a National Education Technology Plan in 2004, then revised it in 2010, and further revised it in 2016. The National Education Technology Plan 2016 currently endorses the ISTE standards.

While several technology organizations released standards, which was a good beginning, however it has caused confusion on which standards teachers should use and questions still remained on how to teach it. The National Education Technology Plan is only a recommendation and not mandatory for school districts to follow. The ITEA stated that,

> To have an impact, they [the standards] must influence what happens in every K-12 classroom in America. This will not happen without the development of new curricula, textbooks, and student assessments, to name just a few of the more important factors. And, certainly, it cannot happen without the participation of teachers — all teachers, not just technology educators (p.vi).

With this in mind yet another organization, the Computer Science Teachers Association (CSTA) released their standards and curriculum in 2003. A revision was completed in 2006, then another revision in 2011 with the most current revision in 2016. CSTA pushes education stakeholders to move beyond basic technology literacy in K-12 education and proposes computer science principles to be taught at all grade levels. This includes computational thinking as well. Even though more modern and updated standards exist, a majority of the school districts in the United States use the ISTE Standards, which are primarily based on technology literacy.

At this point in the technology timeline, new tools and applications are being invented daily. The need for higher level thinking skills and problem solving has become a necessity. However, what are the views of the supporting institutions? Do the public schools perceive the need for high-level problem solving skills such as computational thinking as important skills/knowledge for the classroom? What do the classroom teachers in the public schools view as important technology skills/knowledge? What do university professors in education believe are important skills/knowledge in technology?

Significance of the Study

This qualitative study contributes to the limited research on best practice in teaching technology skills and concepts to prepare students for 21st century college and career readiness. Even though there is a wealth of research on technology skills and technology use in the

classroom by teachers and students, little research focuses on early exposure to technology concepts such as computational thinking, algorithms, programming principles, etc. In addition, there is very little research that suggests an ideal K-12 curriculum that uses a student-centered instructional strategy and higher-order thinking skills. Many technology organizations may suggest activities, lessons, or even a curriculum but these have not been measured against what is deemed as best practice in the education field.

While many teachers may be consumers of technology and feel comfortable using technology, few teachers may feel prepared to teach students how technology works (i.e. technology concepts). At the same time, this study will discover the expectations school district curriculum administrators hold about teachers teaching technology and what they want the teachers to teach. Finally, this study will also triangulate the data by researching how college of education professors are teaching preservice teachers to teach technology to their students.

Overview of Methods

Qualitative research is used to explore and understand "the meaning individuals or groups ascribe to a social or human problem" (Creswell, 2009, p. 4). This qualitative study will examine professors from the college of education, school district curriculum directors, and classroom teachers. Interviews will be used at the university, school district, and classroom teacher level to extract data on current teaching of technology from a hierarchical designed study.

As a qualitative research study, answers to interview questions will be recorded, transcribed, and analyzed to gain insight on the current situation of teaching technology at the university, school district, and classroom level. Face-to-face interviews are a component of

qualitative research. Patterns are expected to emerge from each hierarchical level and will be reported. Therefore, with the use of interviews, this study will be considered a qualitative study.

Definition of Terms

Computer Literacy is defined by the U.S. Department of Education (1998) as, "computer skills and the ability to use computers and other technology to improve learning, productivity, and performance." This focuses solely on the use of computers or software to run the computer.

Information Literacy is the ability to, "recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information" (ALA, 1989). The American Library Association promotes information literacy and these standards are a main influence on library standards in public education.

Digital Literacy is, "the ability to understand and use information in multiple formats from a wide range of sources when it is presented via computers" (Gilster, 1997, p. 1-2). This literacy focuses mainly on the understanding of information in a variety of formats and being able to use a wide range of sources. Effective use of the Internet would be an example of digital literacy.

Technology Fluency is, "the ability to use and apply technology in a fluent way, effortlessly and smoothly, as one does with language for many different purposes" (Bers, 2010, p. 14). This focuses on using and applying technology, not on problem solving or how technology works.

Technology Literacy is defined by the International Technology Education Association as, "the ability to use, manage, assess, and understand technology" (ITEA, 2007, p.7). This definition encompasses more aspects of how the technology works rather than just using it or applying it.

Computational Thinking, "is taking an approach to solving problems, designing systems and understanding human behavior that draws on concepts fundamental to computing" (Wing, 2006, p. 33). Kafai and Burke (2013) adds,

> Computational Thinking – while often strictly associated with computer science – actually is better understood as extending computer science principles to other disciplines in order to help break down the elements of any problem, determine the relationship to each other and the greater whole, and then devise algorithms to arrive at an automated solution (p. 62).

Once computational thinking is learned and practiced, it can transfer well into other subjects and is easily used for solving real-world problems.

Computational Literacy is, "the ability to understand, and to make oneself understood through computational materials" (Fernaeus, Aderklou, & Tholander, 2004, p. 1). This idea focuses on using understanding computational thinking and being able to communicate it through computational materials or any computational medium such as programming, computers, software, hardware, etc.

CHAPTER 2 LITERATURE REVIEW

Overview

This chapter provides a review of the literature on technology curriculum, school districts and teaching technology, higher education and teaching technology, and teachers and teaching technology. Much of the literature about technology in education focuses on integration of technology or access to technology. Little research exists on how to teach technology.

> Schools, as well as educational technology research, often turn to how much time students spend using technology and what technology is available as indicators of successful technology integration, but do not measure whether or not, or how, technology is being used in meaningful ways in teaching and learning (Lei & Zhao, 2007, cited in Lim, Zhao, Tondeur, Chai, & Tsai, 2013, p. 63).

"Many researchers and decision makers have found past and current research efforts to be unsatisfactory" (Bebell, O'Dwyer, Russell, & Hoffmann, 2010, p. 31). Bebell, O'Dwyer, Russell and Hoffmann (2010) summarized research from Roblyer & Knezek, (2003); Strudler, (2003); Weston & Bain, (2010) and found that specifically educational technology research have lacked a focus on two areas: "lack of guiding theory as well the failure to provide adequate empirical evidence on many salient outcome measures" (p. 31).

Another area with little existing research is in the design aspect of the studies. In most of the research, researchers do not take into account the hierarchical nature of the school systems. "Although an informative body of research has examined factors that influence the extent to which individual teachers use technology, primarily for instructional purposes, little empirical research has focused on the role of schools and districts in shaping teacher use of technology" (O'Dwyer, Russell, & Bebell, 2004, p. 18). Miranda and Russell (2011) also stated this issue in terms of macro-level and micro-level terminology. They stated,

> Research on educational technology identifies several factors that may influence the use of instructional technologies. Some of these factors reside at the organizational (e.g. school and/or district) or macro-level, whereas others are specific to teachers and students and are classified as micro-level factors (p. 303).

Two areas of consensus are the fact that computers have been in the classroom regularly for the last three decades and an extensive amount of money has been devoted to putting computers in the classroom. Bebell, O'Dwyer, Russell, & Hoffmann (2010) reported "educational leaders and policy makers have made multibillion dollar investments in educational technologies" (p. 30). While Lim, Zhao, Tondeur, Chai and Tsai (2013) corroborated this statement more recently but extended it worldwide, "The technology investment in schools worldwide has increased more than a hundredfold in the last two decades" (p. 59).

As for technology curriculum, there are a variety of resources that offer suggested activities, lessons, and standards. There is not a specific curriculum for technology that is nationally endorsed like the Common Core Standards or the Next Generation Science Standards. Without a national curriculum or making technology mandatory, professors in the college of education, school district curriculum directors, and teachers have to figure out on their own what to teach, if they teach technology at all.

Current Status of Technology Curriculum

The International Society of Technology Education (ISTE) primarily drives education technology in the United States. They have released National Educational Technology Standards for Students, Teachers, and Administrators. It is a national plan that "calls for applying the advanced technologies used in our daily personal and professional lives to our entire education system to improve student learning, accelerate and scale up the adoption of effective practices, and use data and information for continuous improvement." The focus of this plan is technology use. The recommendations are broad and not tied to best practices in the educational field. Most school districts model their technology indicators after the ISTE standards because this is the

endorsed plan by the Department of Education and it is tied to funding. To highlight the importance placed on the ISTE standards, in 2008 the federal government required all 50 states,

> To report to the U.S. Department of Education on technology literacy, using information and communication technology (ICT) standards based on the National Educational Technology Standards (NETS) for Students (International Society for Technology in Education [ISTE], 2007). Seven states have formal assessments for technology literacy (Metiri Group, 2009, p. 1-2).

As previously stated, the ISTE standards are mainly skill and application oriented which lack the higher-order thinking skills. The computer science education community advocates for K-12 schools to teach technology in a way that can help students learn higher-level problem solving skills (computational thinking). These concepts can be taught with or without a computer.

Currently the Common Core Standards have been developed for Language Arts and Mathematics and 44 states have accepted them. Technology is woven into these standards as a tool to facilitate these two core areas however they lack the higher level problem-solving avenue that is endorsed by the computer science education community. The federal government has recognized that a specific assessment for technology literacy is needed. A National Assessment of Educational Progress (NAEP) test has been developed to assess the nation's students in Technology and Engineering Literacy. Some of the same organizations that support the interwoven technology skills in the Common Core Standards also support the separate NAEP Technology Literacy assessment that addresses the higher order thinking skills and problem solving skills that are not present in the Common Core Standards. This may present a conflict of interest.

The developers of the NAEP for Technology literacy recognizes the current situation with their statement found on their website,

> Unlike science and mathematics, which have a sequential curriculum taught by subject-area specialists in high school or by generalists in elementary school, technology and engineering education as a whole does not have a unified scope and sequence…While ICT learning is often infused into existing core subjects, it is not always assessed and reported as part of these subjects. Additionally, there is not a clear scope and sequence for ICT knowledge and skills, either as a stand-alone curriculum or integrated into core subjects, which may result in an inconsistent application of technology literacy standards across different grades, different subjects, and different states. As mentioned earlier, all teachers have a role in teaching technology, so in most cases teachers are not singled out as technology teachers in the same way that, for example, mathematics or history teachers are identified with those subject areas. The result (and implication for this assessment) is that the specific technology concepts and practices to which students have been exposed are hit and miss and mostly unknown. Students can say what mathematics or science courses they have taken, but specifying the full range of their education in technology and engineering and their use is more ambiguous (p. 1-14).

A standard of measure that can be used to interpret the level of complexity of a lesson, activity, or standard is to compare the indicators of a curriculum to a higher-order thinking taxonomy, like Bloom's Taxonomy. Bloom's Taxonomy, "is a framework for classifying statements of what we expect or intend students to learn as a result of instruction" (Krathwohl, 2002, p. 212). Benjamin Bloom and his associates developed it over the course of seven years and it was first published in 1956 (Krathwohl, 2002). Bloom's Taxonomy has six major

categories in the cognitive domain: Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation (Krathwohl, 2002). Each of these categories was further broken down into subcategories to create specific definitions (Krathwohl, 2002). The six categories "were ordered from simple to complex and from concrete to abstract" (Krathwohl, 2002, p. 212).

Recently Lorin Anderson and David Krathwohl have revised Bloom's Taxonomy. They maintained the six categories but have changed the titles to Remember, Understand, Apply, Analyze, Evaluate, and Create. These six categories changed from nouns to verbs and fall under what Anderson and Krathwohl call the Cognitive Process Domain. In addition, Anderson and Krathwohl have made the Revised Taxonomy two-dimensional by adding the Knowledge Dimension. In the Knowledge Dimension, he states that there are four types of knowledge: Factual Knowledge, Conceptual Knowledge, Procedural Knowledge, and Metacognitive Knowledge. These can be easily represented on a table Anderson and Krathwohl call a "Taxonomy Table" (Krathwohl, 2002).

Table 1: Taxonomy Table (Krathwohl, 2002)

THE KNOWLEDGE DIMENSION	THE COGNITIVE PROCESS DIMENSION					
	REMEMBER	UNDERSTAND	APPLY	ANALYZE	EVALUATE	CREATE
FACTUAL KNOWLEDGE						
CONCEPTUAL KNOWLEDGE						
PROCEDURAL KNOWLEDGE						
META-COGNITIVE KNOWLEDGE						

By updating Bloom's Taxonomy, it has made it more relevant to current educational issues such as computer science education. The ability to compare technology lessons or activities to Anderson and Krathwohl's Revised Taxonomy allows the teacher to assess his/her

own lessons and revise them to be more complex and abstract. Lessons at the higher end of Anderson and Krathwohl's Revised Taxonomy represent higher order thinking skills. Higher order thinking skills are those skills and concepts that allow students to function at the Analyze, Evaluate, and Create levels of Anderson and Krathwohl's Revised Taxonomy (Hopson, Simms, & Knezek, 2002).

Along with higher-order thinking skills Christopher Dede (1990) states that, "New concepts and skills are best remembered and integrated with existing knowledge if learning is active and constructive rather than passive and assimilative" (p. 63). Dede is referring to the constructivist learning theory of education. The constructivist learning theory was developed by Jean Piaget and is one of the major instructional strategies taught to preservice teachers. Piaget believed that, "knowledge is experience that is acquired through interaction with the world, people, and things" (Ackermann, 2001, p. 3). Therefore, "constructivism posits that children actually invent their ideas" (Stromment & Lincoln, 1992, p. 468) or as Kafai and Resnick (1996) simplified it, "Children don't *get* ideas, they *make* ideas" (p.1). "Constructivism is both a theory of learning and a strategy for education" (Kafai & Resnick, 1996, p. 1) so it creates the perfect environment for teaching and learning technology.

However, Seymour Papert extended Piaget's Constructivist theory with his own theory of "Constructionism." Ackermann (2001) states, "Piaget's theory tends to overlook the role of context, uses, and media as well as the importance of individual preferences or style, in human learning and development" (p. 4). Seymour Papert used Piaget's constructivism as a basis for his theory (Kafai & Resnick, 1996). Constructionism asserts "learners are particularly likely to make new ideas when they are actively engaged in making some type of external artifact" (Kafai & Resnick, 1996, p. 1). The Constructionist theory emphasizes that knowledge construction

takes place when learners build objects and that is where constructionist type of technology lessons will benefit the students. Teachers help students develop higher order thinking skills, problem solving, and computational thinking by designing technology lessons that rate high on Anderson and Krathwohl's Revised Taxonomy and by using the constructionist learning theory.

A newer focus in K-12 education is STEM (Science, Technology, Engineering, and Mathematics). It is a relatively newer collective topic in education. Science and mathematics have an established history in the education field. Technology and engineering are the new comers and lack the established curriculum base. However, when a technology course exists in a district, it is typically at middle level and secondary levels but they tend to be elective and not mandatory. These technology classes compete with other electives such as band, choir, drama, family and consumer science. It is possible that a student could create a schedule where he/she never takes a technology class and therefore never exposed to technology, which could impact his/her future opportunities.

One topic that has a growing amount of literature surrounding it is computational thinking or computational literacy. Jeanette Wing coined the term "computational thinking" in 2006 and it is defined as "an approach to solving problems, designing systems and understanding human behavior that draws on concepts fundamental to computing" (p. 33). Jeannette Wing suggests that computational thinking combines elements of mathematics, engineering, and science. Computational thinking has appeared in the "Next Generation Science Standards," although only at the high school level and not at the middle school or elementary level.

Difficulties were found in search terms and the currency of the information. It was found that a variety of search terms were needed to yield the literature that was needed for the review. The variety of search terms added to the ambiguity in attempting to exhaust all sources of

information. The dynamic nature of technology adds to the difficulty of locating current resources/information and its relevancy/validity.

Currently, there is a multitude of literature on teacher beliefs about technology and teacher/student use in the classroom. However there is limited literature on best practices in teaching technology to students at the teacher level, the school district level, and university level. Many articles and organizations espoused the skills 21st students should have but few articles focused on best practices for teaching technology to expose students early to abstract technology concepts, which could affect equity, academic achievement, cultural capital, and future career choices.

Districts and Teaching Technology

The educational system within the United States is having a difficult time deciphering what technology skills and knowledge their students must have and how to teach it (Williams, Foulger, & Wetzel, 2009). In 2004, a National Education Technology Plan was created by the United States Department of Education. It highlighted seven very broad "action steps." The seven steps were to strengthen leadership, consider innovative budgeting, improve teacher training, support e-learning and virtual schools, encourage broadband access, move toward digital content, and integrate data systems. The latest revision of the National Education Technology Plan was completed in 2016. This plan continues to be very general with five broad goals however, they have added more explanations to the goals attempting to be more specific. Yet, there are no specific essential outcomes or indicators targeted by the National Education Technology Plan. Therefore, states do not have a list of specific skills or concepts that must be taught and are left to their own devices. States must look to other national associations or committees on what technology skills/concepts to teach their students.

One possible resource for school districts to refer to is the International Society of Technology in Education (ISTE). ISTE is an association, "for educators and education leaders engaged in improving learning and teaching by advancing the effective use of technology in PK-12 and teacher education" (ISTE, 2011, p. 2). ISTE has created National Educational Technology Standards for students, teachers, and administrators.

However, when comparing the National Educational Technology Standards to Anderson and Krathwohl's Revised Taxonomy, the standards are very broad and general. The standards hover around the "Apply" taxonomic level and use lower order thinking skills. They also fail to target specifically which technology skills or concepts (i.e., scope and sequence) students should learn and teachers should teach.

Another source that school districts can look at is the Consortium for School Networking (CoSN). This consortium suggests a Framework of Essential Skills. This framework helps districts with planning for technology in the big picture sense (CoSN, 2011). Yet again does not outline specifically what important technology skills and concepts students should be taught. They do compile a yearly report of potential technology trends called the Horizon Report. It outlines the trends in three different stages, one year or less, two to three years, and four to five years. This report only outlines the upcoming trends and not important technology skills/concepts that students need to learn and teachers need to teach.

A third resource might be the Partnership for 21st Century Skills (P21). According to the P21 website, this is a national organization that advocates for 21st Century readiness. They also have a framework for states and districts to use for technology skills. However, again similar to the other previously mentioned resources when they are compared with Anderson and Krathwohl's Revised Taxonomy levels they range around the "Apply" level and they are very

vague with general statements. For example, the technology skills outlined in the P21 framework list access and evaluate information, use and manage information, analyze media, create media projects, apply technology effectively, as critical skills for students to learn. Again, these are very broad and without specific details on how to teach these skills or assess them.

The International Technology Education Association (ITEA) would be considered a fourth resource for possible standards that a school district could use. The ITEA released their Technological Literacy Standards in 2000 then were revised in 2002 and 2007. These standards include problem solving ideas yet never directly address computational thinking. When compared to Anderson and Krathwohl's Revised Taxonomy, the standards tend to lean toward the "Apply" stage as well. While they are more detailed and defined than the previous three resources, they lack the curriculum component that outlines lessons and activities for the teacher to incorporate into their classrooms.

A potential fifth resource for school districts is the National Research Council. They too have a suggestion for improving education technology. They are proponents of Computational Thinking. ISTE and the Computer Science Teachers Association (CSTA) joined in agreement with the National Resource Council on its suggestion of integrating computational thinking into school curriculum. As defined by ISTE and CSTA, computational thinking is a problem solving process that includes (but is not limited to) the following characteristics:

- Formulating problems in a way that enables us to use a computer and other tools to help them,
- Logically organizing and analyzing data,
- Representing data though abstractions such as models and simulations,
- Automating solutions through algorithmic thinking (a series of ordered steps)

- Identifying, analyzing, and implementing possible solutions with the goal of achieving the most efficient and effective combinations of steps and resources
- Generalizing and transferring this problem solving process to a wide variety of problems

Computational Thinking scores high on Anderson and Krathwohl's Revised Taxonomy however it is just one component of teaching technology and not an entire curriculum. Even though ISTE and CSTA have partnered together in an effort to publicize the importance of computational thinking, ISTE has not revised all its standards to integrate computational thinking. Current revisions to the ISTE Standards are underway at the time of this study. The ISTE standards are the foundation for The National Education Technology Plan and could have a great influence over many K-12 school districts in the United States.

Searches were done on state-level curriculum for technology and it is nearly nonexistent (CSTA, 2003). Therefore in a 2003 report, Computer Science Teachers Association (CSTA) proposed the need for a K-12 computer science curriculum. They suggested that very specific computer science outcomes and indicators for students are needed in K-12 education. The report outlined several areas that a new curriculum should target such as formulate content standards, define professional development needs, develop curriculum, and disseminate information to students in the classroom. In the appendix of this report, several lesson plans were included. Once again, this resource shows the overall big picture without the specific details needed to implement it at the classroom level as a core subject. In 2006, the curriculum was revised with more details and lesson plans. Next, the curriculum was revised in 2011 to include computational thinking. Recently, the curriculum was updated again in 2016 but model curriculum from CSTA is only a basic foundation for others to help begin designing a

curriculum. It is more of an outline or partial curriculum. The lessons that have been created rate high on Anderson and Krathwohl's Revised Taxonomy. It lacks a scope and sequence to facilitate learning like other core curriculums such as math, reading, and science.

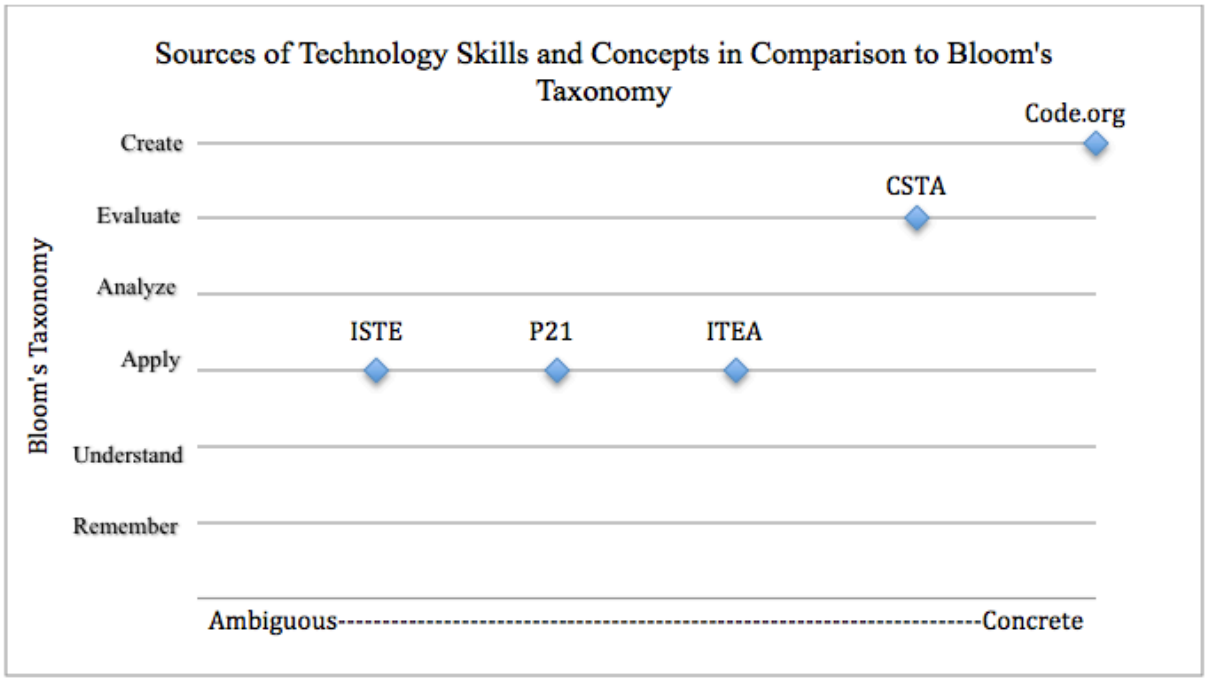
The latest entry into the technology curriculum and standards literature is an organization that supports coding in schools. The organization www.code.org has publicized the need for coding in schools with its Hour of Code in 2013. Following the Hour of Code, they released a K-8 coding course and in September of 2014 released a K-5 Elementary Coding curriculum with lessons and activities for teachers to use with or without access to computers. The elementary curriculum is embedded in their latest offering of Code Studio. It is a four-part succession of coding classes that scaffold. Also, code.org provides a curriculum for two courses for students in grades 7-9. The first course is Computer Science Discoveries, which is a full year introductory course survey course of computer science. The second course is called Computer Science Fundamentals – Accelerated. Those students who did not complete the Computer Science Fundamentals course can take the accelerated version. At the high school level code.org offers a curriculum for an Advanced Placement (AP) computer science program. As with computational thinking, coding is considered one element of teaching technology and code.org tries to focus on the entire field of computer science. Due to higher order thinking and problem solving built into programming (coding), this curriculum rates at the highest level (Create) on Anderson and Krathwohl's Revised Taxonomy.

Unfortunately, there is limited literature on school districts and teaching technology because a majority of studies on technology focus on technology integration in K-12 schools especially at the teacher level and the student level (Hew & Brush, 2007). O'Dwyer et al. (2004) concluded that it is important to examine potential technology-related policies that exist at the

school and districts levels because technology-related decisions that can impact practices at the classroom level are typically made outside of the classroom.

From the evidence presented above there are a variety of national resources that suggest different technology skills and knowledge needed for students to be successful in the 21st century. However, all of the frameworks or standards presented are broad and vague or focus mainly on basic skills and applications rather than the high-level thinking and problem-solving outcomes needed in computer science careers. Districts have a tough time defining the essential knowledge/skills needed in concrete terms and each district or school could be defining them differently, which presents an ambiguous and chaotic situation. What technology skills/concepts are school district curriculum administrators expecting their teachers to teach students and how should those skills and concepts be taught?

Diagram 2: Sources of Technology Skills and Concepts in Comparison to Bloom's Taxonomy



Higher Education and Teaching Technology

Previously in higher education, the idea of academic freedom and ivory towers came to many peoples' minds when they thought of college professors (Light et al., 2009). University professors seem to be free to construct their own curriculum and use any method to deliver instruction. Currently the majority of the population of higher education faculty is sixty or older (National Center for Education Statistics, 2003). This particular group of professors seems to be characterized by a traditional view of instruction. Light et al. (2009) has defined this as the ad hoc paradigm, in which the teacher believes,

> That a good teacher is born, not made. Associated with 'elite' systems of student participation and prevalent until the late 1960s and early 1970s (although still prevalent in much of higher education), its underlying assumption is that teaching is something one picks up and grasps informally and individually. It is non-reflective in the broader sense. The teacher is left to her own devices and draws upon past experience of being taught, trial and error, help from sympathetic colleagues when available, and her own natural affinities for teaching (p. 12).

Due to the high population of professors over the age of sixty, this mentality may permeate the higher education system so it is possible that when a change is proposed professors may be reluctant to change or they may not feel the need to change. With regard to technology use from the university faculty member's perception, what technology skills/knowledge is important considering the potential conflicting views they might have about change?

These professors which hold fast to traditional ways tend to teach as they were taught in a teacher directed fashion rather from the constructivist point of view (Light et al., 2009). The constructivist idea that individuals construct new knowledge from their experiences can be

attributed to Jean Piaget. Therefore, unlike in direct instruction the teacher is a facilitator rather than the one that imparts all the knowledge to the student. In the direct instruction situation value is placed on correct answers, sitting quietly, listening, and taking notes whereas in the constructivist setting risk, exploration, collaboration, and collective problem solving is applauded.

These constructivist type skills are at the very heart of technology education in the classroom (Zuga, 1997) and if professors are not modeling this behavior for students or expecting these types of behaviors from students, students will not be open to new ideas or change as well. The cycle is perpetuated. These professors that teach or lecture as they were taught tend to use minimal technology and can be recognized as low-level technology users (Spotts, 1999). They tend to use technology for basic communication purposes such as word processing, email, and presenting lectures.

Conversely, professors that are specifically situated in Education Technology at the university level may in fact be more open to change and understand the pressing need to integrate higher-level problem solving skills and knowledge. However, the position of Education Technologist is a miniscule part of the education program within a university setting with limited access to education students. These professors tend to be high-level technology users and not only use technology frequently but also integrate daily into the classes they teach. Likewise, they also expect their students to be using and interacting with technology on a daily basis by requiring students to turn in technology-integrated assignments. These high-level users of technology tend to be members of national educational technology committees or other types of groups for the advancement of education technology as discussed previously.

In the middle of this spectrum are the faculty members that use technology for basic tasks such as word processing, email, etc. but also use it in their personal life such as cell phones, personal laptops, playing video games, etc. They have a modest interest in technology and use it personally yet don't feel the need to integrate it into daily coursework.

As one can observe from the previous descriptions, faculty members in higher education institutions are split into three main divisions when looked through a technology lens. There are low-level users, mid-level users, and high-level users (Spotts, 1999). These different levels of application have direct impact on the students in their courses (Waxman et al., 2003). The amount of technology used in a class has a direct connection to the instructor's perception of "an advantage or value to using an instructional technology" (Spotts, 1999, p. 7).

However, this situation in higher education is not one-sided. Students too can be at fault for resisting higher-level thinking and technology infused lessons. Unfortunately, many students are accustomed to the teacher teaching to the test, Moore, Fowler, and Watson (2007) called this passive learning. Many students are products of assessment-driven curriculum that rewards them for correct answers and little personal responsibility for learning (Moore, Fowler, & Watson, 2007). Creating an interactive learning environment can quickly turn the students around from passive learners to active learners. This can be accomplished through the use of technology (Moore, Fowler, & Watson, 2007).

Nevertheless, the faculty member's decision to use technology influences the college course far more than the student's response. Therefore, the professor's perception of the value or advantage of specific technology is the driving force on whether he/she integrates it into his/her teaching. With such divergent views and ability levels with regard to technology and the freedom to integrate technology as they see fit, what technology skills/concepts are college of

education professors teaching preservice teachers in preparation for them to teach technology skills/concepts to students?

Teachers and Teaching Technology

Timothy Teo (2011) cites teachers as one of the key players in effectively integrating technology in the classroom. The nature of teachers can be influenced by a multitude of factors from personal experience in schooling, to the professors in college, to the school district they work for. Some were mentioned in the previous two sections, School Districts and Teaching Technology and Higher Education and Teaching Technology. Many barriers can affect a teacher's integration of technology as well. According to Hew and Brush (2007), there are six main categories of barriers: lack of resources, lack of knowledge and skills, institutional barriers, teacher attitude and beliefs, pressure of assessments, and subject culture.

The first category that Hew and Brush (2007) suggest is the lack of resources. Within this main category, there are several different individual barriers: the lack of technology, the lack of access to available technology, the lack of time, and the lack of technical support. A second major barrier category is the lack of knowledge and skills. The lack of knowledge and skills not only includes limited technology skills and knowledge but also the lack of technology-supported-pedagogical knowledge/skills and the lack of technology-related-classroom management knowledge/skills.

A third category of barriers suggested by Hew and Brush is attitudes and beliefs. The personal beliefs and attitudes of each individual teacher about technology are the main focus of this category. Institutional Barriers are the fourth category of barriers Hew and Brush (2007) suggest. The individual barriers within this category are leadership, school timetabling structure (scheduling), and school planning.

Assessments are considered a fifth potential barrier category as well by Hew and Brush (2007). They concede that the pressures of high-stakes testing can be a major barrier in using technology in the classroom. Teachers may fear that they need every minute in the classroom to prepare the students for the assessments therefore having no time to teach technology (Fox & Henri, 2005; Butzin, 2004). The final category of barriers proposed by Hew and Brush (2007) is subject culture. Subject culture is the "general set of institutionalized practices and expectations which have grown up around a particular school subject, and shapes the definition of that subject as a distinct area of study" (Goodson & Mangan, 1995, p. 614). Teachers may find it difficult to integrate technology that appears unsuited for a particular school topic or subject (Hennessy, Ruthven, & Brindley, 2005).

The six categories of barriers are described individually but can be grouped together into First-Order barriers and Second-Order barriers (Ertmer et al., 1999). Included in the First-order barriers are the lack of resources, institutional barriers, subject culture barriers, and assessment barriers. Second-order barriers are comprised of attitudes/beliefs and knowledge/skills (Hew & Brush, 2007). First-order barriers are external to teachers while second-order barriers are intrinsic to teachers (Ertmer, et al., 1999).

With all these potential barriers working against technology and teachers, there are strategies that can overcome these barriers. By creating a shared vision and technology integration plan, obtaining necessary resources, having alternative modes of assessments, facilitating attitude change, and facilitating teacher knowledge and skill are all ways to address the barriers (Hew & Brush, 2007). However, the gap lies in the beliefs and attitudes barriers,

> There is a need to develop clear operational definitions of the beliefs. Currently, different researchers view teacher beliefs about technology differently-thus complicating efforts by

researchers and educators to interpret the findings across studies (Hew & Brush, 2007, p. 242).

What technology skills/concepts are teachers teaching students and how are they teaching them? After examining the literature at each hierarchical level (School District, Higher Education, and Teacher), a gap exists in the current technology literature in the area of best practice in teaching technology skills and concepts to prepare students for 21st century college and career readiness. This research will aim to fill that gap and expand on the research base for best practices in teaching technology at the K-12 to increase awareness and draw attention to the need for improvements in technology education.

Summary

In sum, the U.S. Department of Education presented the newly revised National Education Technology Plan in 2016. It is a national plan that is a, "call to action, a vision for learning enabled through technology, and a collection of recommendations and real-world examples." The 2016 revision has begun to address the issues highlighted in this study. Students need transformative learning experiences through the exposure and exploration of technology and computational literacy. This can only be achieved if all stakeholders agree through best practices in the educational field. While gains have made since 2010, again the focus remains to be technology use as stated, "the plan includes examples of the transformation enabled by the effective use of technology." Recommendations are made and examples are given. However, there remain many decisions that states, universities, school districts, curriculum directors, schools, teachers, etc. must make without guidance on best practices.

The International Society of Technology Education is current association that has established Department of Education endorsed standards and funding is tied to those standards at

the federal level. However, these standards are vague and lack higher-order thinking skills such as computational thinking. They also don't include a curriculum or scope and sequence as other established standards have, like Common Core and the Next Generation Science Standards. The federal government has recognized the need for a technology assessment and they have created a National Assessment of Educational Progress (NAEP) in the area of Technology and Engineering Literacy. Technology and engineering are the newcomers and lack the established curriculum bases like reading, math, and science. Several other technology organizations offer their recommendations on curriculum yet there is not a federally endorsed curriculum or scope and sequence that outlines specific skills or concepts and best practice for teaching those skills and concepts.

A more recent spotlight has been placed on science, technology, engineering, and mathematics (STEM). Yet, it has not gained full momentum in the K-12 sector. Webb, Repenning, & Koh (2012) stated, "In spite of the recent national attention given to STEM education, computer science is rarely included as part of the national discourse" (p. 173). The National Research Council also supports this statement with a report they released in 2011 on STEM Education in K-12. They stated, "Research in technology and engineering education is less mature because those subjects are not as commonly taught in K-12 education" (National Research Council, 2011). This study will unearth what technology is being taught and how it is being taught.

Another factor that adds to the complexity of the issue is computer/technology classes tend to be electives, which students choose to study. Therefore, technology is competing with art, band, choir, drama, family and consumer science, etc. It is possible for a student to never take a technology course once they enter middle school/junior high school. This lack of

exposure to computational thinking, programming, and higher order thinking skills could impact his/her future career, college, and economic choices.

One topic that has a growing amount of literature surrounding it is computational thinking or computational literacy. Jeanette Wing coined the term "computational thinking" in 2006 and it is defined as "an approach to solving problems, designing systems and understanding human behavior that draws on concepts fundamental to computing" (Wing, 2006, p. 33). Jeannette Wing suggests that computational thinking combines elements of mathematics, engineering, and science. Computational thinking has appeared in the "Next Generation Science Standards" (2013) although only at the high school level and not at the middle school or elementary level.

There was also difficulty in locating accurate information on the topic of teaching technology. There are many terms that researchers use to identify technology in education. Another difficulty that arose was locating current information. It was found that researchers used a variety of search terms to identify technology in education and many different combinations of search terms were used to yield the literature that was needed for the review. The variety of search terms added to the ambiguity in attempting to exhaust all sources of information.

The dynamic nature of technology adds to the difficulty of locating current resources/information and its relevancy/validity. A great many articles stemmed from the 1990's to the 2000's. A major theme seemed to run throughout the bulk of the literature. It focused on technology skills or a "low-level" use of technology in the classroom, teacher beliefs about technology, or integration of technology rather than the knowledge needed to teach students technology. Within the existing literature on "low-level use", three main categories stood out:

teacher use, student use, and preservice teacher use. Significant literature exists for teacher technology use or integration in the classroom. "Technology use" was typically found to mean teachers effectively using their technology skills in the classroom. Also addressed in the teacher use literature are the barriers to teachers using technology in the classroom.

A second category was student technology skills. The skills were called many different names over the years: computer literacy, digital literacy, technology literacy, technology fluency, etc. A connected topic to student computer skills that was found in the literature was computer programming. Computer programming was only a small subset of the student computer skills literature. The third category in the literature focused on higher education and preservice teacher education. A majority of that literature focused on preparing preservice teachers to use technology in their future classrooms and measuring their personal technology skills.

A gap still exists in the current technology literature in the area of best practice in teaching technology skills and concepts to prepare students for 21st century college and career readiness.

CHAPTER 3 RESEARCH METHODS

Overview

The purpose of this study is to find out the status of technology education in a Midwest area that comprises of multiple public school districts and their curriculum directors as well as the universities that directly feed teachers into the area. To guide this study one main overarching question was designed with sub questions to gather more detail. The guiding questions in this research study are:

- What is the meaning of teaching technology for college of education professors, school district curriculum administrators, and classroom teachers in a Midwestern area to prepare students for college and career readiness?
    - What essential technology skills/knowledge/concepts do students need to learn?
    - Is there a consensus among the education field on technology skills/knowledge/concepts students should have?
    - How do college of education faculty, school district curriculum administrators, and teachers decide what technology skills/knowledge/concepts to teach?
    - How does college of education faculty, school district curriculum administrators, and teachers convey technology skills/knowledge/concepts?

For this study, a qualitative approach was necessary to gain detailed and descriptive data. Qualitative research requires the researcher to utilize multiple sources of data throughout their study as opposed to relying solely on one data set (Creswell, 2009). Schools are hierarchical in nature so this study collected data from three sources: teachers, school district curriculum directors, and college of education faculty from the university level.

In qualitative studies, "the intent is to explore the complex set of factors surrounding a central phenomenon and present the varied perspectives or meanings that participants hold" (Creswell, 2009). A total sample size of sixteen classroom teachers was selected from a population of teachers in a midwestern suburban area. Five teachers that taught fourth grade, six teachers that teach technology at the middle school/junior high level, and five teachers that teach technology at the high school level were interviewed, (see Appendix A – Teacher Interview Protocol). From the answers provided by the teachers, the study accumulated data on best

practices in lesson design, technology best practices, teacher preparation in technology, and teaching technology.

Five interviews were conducted with professors in the college of education at universities, which specifically taught education technology courses to preservice teachers in a midwestern suburban area. This study examined technology in the colleges of education and faculty beliefs/thoughts on technology through interviews, (see Appendix B – University Faculty Interview Protocol). From the answers provided by the university faculty, the study accumulated data on best practices in lesson design, technology best practices, teacher preparation in technology, and teaching teachers to teach technology.

The final round of interviews included five school district curriculum directors. District curriculum administrators were interviewed from school districts in a midwestern suburban area (see Appendix C – School District Curriculum Director Interview Protocol). From the answers provided by the curriculum directors, the study accumulated data on best practices in lesson design, technology best practices, teacher preparation in technology, and expectations of teachers teaching technology.

Data Sources and Collection Methods

Before data could be collected, the approval from the Internal Review Board was applied for through the University of Kansas in the summer/fall of 2015. The application process required a detailed description of the purpose, the risk to participants, location, communication with participants, and the methods for studying human research subjects. Once approval was secured, data collection began in the winter of 2015 and concluded in the fall of 2016.

The criteria for the type of participants need for this study was decided based the grade levels tested by the National Assessment of Educational Progress (NAEP) Technology and

Engineering Literacy Assessment. In this national test, grades 4, 8, and 12 are tested. Therefore, I searched for teachers of 4th grade, 8th grade, and 12th grade students. These teachers became the desired typical sample because they would be the teachers potentially chosen for the Technology and Engineering Literacy Assessment. Their teaching would have a direct impact on the results of that national assessment.

Determining whether the teachers were effective in teaching technology or not would not be a concern when students take the assessment since sampling for the assessment is based on "school location, minority enrollment, level of school achievement, and average income of the geographic area" (National Center for Education Statistics, 2010, p.8). Once the schools have been chosen, random students are selected to take the test (National Center for Education Statistics, 2010). Students participants in the national assessment are not chosen based on their teachers being determined "good" teachers or effective teachers. This would affect the validity of the data. Likewise in this study, the same idea is represented. Determining whether the teacher participants in this study were "good" teachers or effective teachers in teaching technology could potentially misrepresent the data therefore not allowing for the randomness of a student placed in a teacher's classroom and the teacher's knowledge/ability to teach technology.

Several strategies were used to locate participants. Convenience sampling based on location was used when identifying potential participants (Merriam, 2009). One strategy I employed to locate participants for this study was, "network sampling" (Merriam, 2009). Network sampling is a common form of purposeful sampling (Merriam, 2009, p. 98). According to Merriam (2009), "This strategy involves locating a few key participants who easily meet the

criteria you have established for participation in the study. As you interview these early key participants you ask each one to refer you to other participants" (p. 98).

Previous colleagues have moved on to other districts in the area and proved to be a great referral source for potential teacher participants. One colleague would lead me to a participant and then that participant knew a teacher in a different district that they would connect me to. Once I had the name of the next participant I could go to the school website and locate his/her email address to contact them about participating in the study.

Curriculum directors were substantially easier to locate as all their information is housed on the district websites. I emailed them directly and all but one responded.

University professors were much more difficult to locate. Not all universities post which courses professors teach. I began my search with the State Department of Education website. On the State Department of Education website it listed the professors in charge of teacher licensing. I emailed all professors in the selected midwestern area. Many never responded and I realized the list was out of date. I began to dig further. I went to each website and found the dean of education for each university. I emailed them and only a few responded. Next I researched which education technology courses were taught at each university. I emailed administrative assistants to find out the professors who taught those classes. This was a much more successful route. Two professors did not respond. I then looked for other professors to email that might understand the significance of the study and asked them for help in locating who taught education technology classes to preservice teachers. Finally all but one professor responded.

The overall location of the study occurred in a midwestern suburban area with access to several major school districts of varying sizes, which yielded enough variety in university

professors, curriculum directors, and teachers. Interviews were set up at locations that were convenient for all participants and of their choosing. Typically, the location was the teacher's classroom, the curriculum director's office, or the university professor's office. Some other locations were used for convenience of the participant such as local coffee shops, public library meeting rooms, a country club meeting room, and one participant's home.

Three main sources: college of education professors that taught education technology, school district curriculum directors, and public school teachers composed the data. Qualitative interviews were used for all participants. The interviews were conducted in a semi-structured manner that followed an interview protocol (Appendices A, B, and C) for each participant. All interviews began with the explanation of the Informed Consent Form (Appendix D) and the participant's signature signifies acceptance of the terms of the Informed Consent Form. All interviews were audio recorded and transcribed.

The interviews were comprised of ten questions (Appendices A, B, and C). The length of time varied for each interview. The interviews ranged from ten minutes to sixty minutes depending on how much detail was given by the participant. Elementary teachers tended to be quicker in their interviews while middle and high school teachers averaged around twenty to thirty minutes. Curriculum directors averaged around forty minutes while university professors ranged from twenty minutes to sixty minutes depending on whether they were adjunct or full professors. Adjunct professors typically yielded a short interview (15-20 minutes) while full tenured professors produced a longer interview (50 – 60 minutes).

Once all the interviews were complete, they were transcribed and each one was read to get a sense of the whole interview. All data from the interviews were coded in a qualitative format. The interviews were manually coded based on frequency of words that appeared. Codes

with similar themes were clustered together to create main categories also referred to as "axial coding or analytical coding" (Corbin & Strauss, 2007 referenced by Merriam, 2009, p. 229). The interviews of elementary teacher produced far less codes than all the other interviewees, while the curriculum directors and the university professors produced the most codes.

The data from the elementary teachers produced two main categories: Elementary Classroom Teachers Perceived Best Practices and Elementary Classroom Teachers Perceived Barriers. The middle school teachers produced three main categories: Middle School Computer Teachers Perceived Best Practices, Middle School Computer Teachers Perceived Barriers, and Middle School Computer Teachers Student Barriers. The high school teachers had three main categories: High School Computer Teachers Perceived Best Practices, High School Computer Teachers Perceived Student Barriers, and High School Computer Teachers Perceptions on Content Development and Professional Development.

District curriculum directors' interview data were split into three main categories: District Curriculum Directors Perceived Best Practices, District Curriculum Directors Perceived Barriers, and District Curriculum Beliefs about Computer Teachers. The data from the university professors of education technology were divided into two main categories: University Professors of Education Technology Courses for Preservice Teachers Perceived Best Practices and University Professors of Education Technology Courses for Preservice Teachers Perceived Barriers. Data from all three groups (teachers, curriculum directors, and university education technology professors) were coded for overlapping themes, opinions, beliefs, and attitudes thus triangulating the.

Limitations of the Data and Methodology

As with all research studies, there are limitations of the data and methodology. The data are limited to university professors, curriculum directors, and teachers in a Midwest suburban area, which could yield a more midwestern perspective. The Midwest may lack access to technology companies that drive computer science perceptions on the east and west coast. The middle school/junior high and high school teachers will be teachers of technology specifically and therefore may have their own bias when compared to the fourth grade teachers, which teach all subjects.

Another possible limitation is finances and number of participants. Each school district allocates their budgets differently so access to technology varies by district. The number of participants was a total of twenty-six from a possibility of thirty. One school district and two universities never replied to all efforts of communication. Another university was found to replace one of the two that didn't respond. However, more participants would add greater validity to the study as well.

Limitations of the data and methodology exist at the university level as well. Some of the professors were adjunct professors while others were full tenured professors. This may present different perceptions and views. Another possible limitation is private versus public universities. Professors working at private universities compared to professors working at public universities might have unknown bias. Financially universities divide their budgets differently so access to technology might be limited within a private or public institution.

Even with these limitations, the results of this study provided useful information for teachers, school districts, and colleges of education on how to better teach technology within each hierarchical level in school systems and better invest their technology money. This

research shined a light on the current status of technology curriculum and the teaching of technology to help policymakers and stakeholders make better economic and curricular decisions with regard to the teaching of technology in schools. In turn, this study hopes to create transformative educational opportunities for students.

CHAPTER 4 RESULTS

Overview

This chapter is divided into four sections. The four sections will be disaggregated based on the research questions and the data collected from the interviews. The data will be further divided into subsections based on the different interview groups. The first section will highlight the data collected from the interview participants on essential skills/knowledge/concepts students need to know. The second section will highlight the data collected answering the questions is there a consensus around the skills/knowledge/concepts students should have. The third section will be comprised of the data collected surrounding how the education field determines what skills/knowledge/concepts to teach. The final section will describe how university professors of education technology, school district curriculum directors, and teachers convey technology skills/knowledge/concepts.

Essential Technology Skills/Knowledge/Concepts Defined By Interview Participants

Overall, the interview participants had varied responses to questions targeting essential technology skills/knowledge/concepts. Many responses included keyboarding as a focus and specific software applications. These skills rate at the Remember level on Bloom's Taxonomy. A majority of responses also included technology integration and student engagement through

technology, which again rates low on the Bloom's Taxonomy scale. Very little emphasis was placed on higher-level thinking, hands-on learning, problem solving, student choice, or student creation.

The total number of teachers interviewed was sixteen and they come from a mixture of suburban and rural schools. There were five fourth grade teachers, six middle/junior high school computer teachers, and five high school computer teachers. Fourth grade teachers are responsible for teaching all subjects (English Language Arts, Math, Science, Social Studies) within the school day. However two core subjects, Math and English Language Arts, take up a majority of their day. The middle school and high school computer teachers focus on their particular subject, computer science, each class, which is a majority of their school day.

Elementary Teachers.

Data collected from the fourth grade elementary teachers were far less abundant than for any of the other groups. The total number of codes produced from the interviews was fifty-two. The elementary teachers codes were clustered into two main groups: Elementary Classroom Teachers Perceived Best Practices and Elementary Classroom Teachers Perceived Barrier. The Perceived Best Practices category had thirty-seven codes while the Perceived Barriers had fifteen codes.

The most frequent perceived best practice was the fourth grade teacher wanting students to learn to type, keyboard, or word process. According to Teacher O when asked, "How do you design technology lessons?" Teacher O explained, "I would say I use it daily a replacement for paper and pencil." Teacher O also stated, " We have a computer lab teacher. I do not have a technology curriculum in our classroom. I know in our computer lab, where they go ½ hour a

week, they have a curriculum they teach based on having to do obviously typing." Then when asked about which concepts should be taught in schools Teacher O replied,

> Well, I think obviously typing. I don't know how much technology is, but the fact of the matter is that our students now are learning to type with their thumbs. I mean, everything they do is on their iPads or their phones. While important, at this point in our lives, iPads may be the way of the future, but they're not the business future. You're still going to need to know how to use Word or a Word-type document, whether it's Apple or Microsoft. You're still going to need to know how to type. You're still going to have to be able to do those things. I feel like some of my kids – the iPads are hurting them because they know where the letters are, but they don't know how to type fast enough to be efficient. I still think that's going to be really important right now the way the world is. It will be really important. I think just the use of those basic technologies we have now, but why they may change and differ, still knowing how to open a Word document and center a document and bold face and that sort of stuff. I think that doesn't go away anytime soon because that's still a form of communication.

Later in the interview Teacher O reiterated this belief when asked about best practice in teaching technology, "Right now, at least in my district, a lot of that falls on the teacher because their computer lab class is desktops. It's stuff they still need to learn, but it's still how to use Word, how to use Excel, how to use that." Continuing to answer the question Teacher O commented,

> I would like to see, for us, maybe ½ hour a week of traditional technology, so to speak, where I'm going to learn to type, use Excel, center and type a document and do those things, and then time spent every week on, 'Here's these apps. Here's how they work.' Or maybe we need to train the teachers on that better so that we can teach the kids.

Another teacher responded in a similar fashion when asked about what concepts should be taught in schools, Teacher E stated,

> Well, typing skills for one. Keyboarding is huge, and I think that's hindering the kids a lot because they can't type. We talked to our computer teacher, and she's trying to do more with that. They're just – they're hunting and pecking, and especially with the tablets and the keyboards, it's hard. I think they need to learn Microsoft Word, Excel Spreadsheets whether Google or Microsoft; I think they need to learn spreadsheets and word processing. Those are the two big ones. Navigating and researching on the Internet is a big one, too. They want to ask Siri a question and have everything right there. I mean, seriously, I have a kid who won't stop doing that. 'It's just like typing it in.' I'm like, 'Okay, but lets type in key words and not ask Siri a question.' So, researching is a big one, too.

When asked who should teach this, Teacher E responded with, "Some of the basics especially Microsoft Word, can come from the computer teacher."

Teacher L responded to the question, "How do you design technology lessons?" stating, "Basically, when we use the technology a lot of times it would be for typing and language arts." In a separate question, "What technology concepts should be taught in schools?" Teacher L said,

> I think we definitely need to use the latest and greatest. Anything that's going to prepare them for the future and what they're going to use in the future would be really helpful, specifically learning how to type on the computer at a young age is going to be important so it's a basis for other things.

Teacher B was asked about best practices in teaching technology Teacher B stated, "We have computer teachers that help us, but that's only once a week maybe." Teacher B further

explained, “They do typing sometimes. One day a week, they do Type to Learn since state assessments are going to have a lot more written responses. They do typing.”

Typing, keyboarding, or word processing was referred to twenty-seven times within five different fourth grade teacher interviews. The next perceived best practice for the fourth grade teachers was providing a variety of assessments. Teacher O was asked, How do you know if your students met the outcomes for you lesson or activity? She responded stating,

> I do assessments. That may be a practice page. That may be me working with the kids. That may be an overall test at the end of a topic or theme, whatever it is, so just different assessments throughout to see. Then we have district assessments and state assessments.

Teacher O further explained the components she considers when designing her lessons,

> I always try to think about – and it depends on the subject. Math, you always want to make sure you have that built-in practice time. You always want to make sure that you have that individual time for kids who need that re-teaching. You want to make sure you get some cyclic review in there, some review of some sort or Common Core review in there. For reading, if it’s your whole group instruction, I plan that. I look at what I have to accomplish for the whole group, how I’m going to do that, if there’s a mentor text or something that can go with it. If it’s reading groups, you look at that particular reading group and what it needs compared to what a different group may need based on their abilities. Spelling, obviously, it just goes with what the lesson is for the week. Try to do it fun. I try to add movement with the spelling, so we do – we clap our spelling words. Social studies and science – science is obviously a lot more hands-on with the different activities you can do, depending on the topic that – bringing leaves in and looking at and

> identifying the leaves instead of just talking about it. Social studies, really just depends on the topic area. Obviously, there are some things that are easier to do more than less.

When asked about how Teacher O designs technology lessons she shared some examples of her assessments,

> Sometimes it's okay if you're making a food web just to use a pamphlet to make the food web. A lot of stuff, I'll put the technology in that way so they're using it every day. Instead of having them cut pictures out of a magazine or have them draw a food web, I'll have them search something on the internet and make a pamphlet for it or use the technology that way…. At the end, we did some research, and I was like, 'Okay, at the end you can make a Keynote. You can make an iMovie. You can share it this way'… I try, toward the end of the year, to be like, 'You can go where you want with this. I need you to have' – so we're doing carnivorous plants – 'I need to know where the plant was found, what they eat and how they kill their prey or how they get their food.' Give them some and then they can add whatever they want to it that's school appropriate. I feel it's hard to find the right balance of the right guidelines to give them without pushing them back into the 'Everything is going to be cookie cutter'.

When asked about best practices and assessments in lesson planning, Teacher O suggested,

> It seems to me that there needs to be either a class where some of these things are taught to them so that when they come in and I want to make Adobe Voice, it's not necessarily me teaching them that and what it is. I can say, 'Your choices for this are iMovie, Adobe Voice, this, this and this.' And they already know how to use all those things because I think that's where we get tripped up some.

Teacher A mentioned a variety of assessments as she is lesson planning, "I'll do formal or informal observations. I mean, sometimes, it'll be an activity or just a conversation with them, or it will be an actual test or assignment, so a variety." She shared an example of this,

> The kids can show their work on the Apple TV, too, which is nice, especially if I type our morning work. We'll do our morning work on there, or most of the kids do. I can jump off, and they can jump on and show how they did it. If we've got a multiplication problem and they've done it three different ways, then I can say, 'Okay, who did a break-apart method?' and they can jump up and pop up and show how they did it. Then they'll pop off, and, 'Who did the box method?' and they can pop up and show.

She also mentioned, "Now that we do have iPads, I feel like there are a variety of different ways they can go." Teacher A shared another example of different assessments,

> One of the things we do, too with our reading, we have the units. Each unit has six weeks. The first five weeks are different skills that are taught during then, and the sixth week is kind of an ending or wrap-up of that, and there's usually a technology-based project they can do. There are 4-5 different things they can choose from. I'll give them the different concepts or different activities they can do. Some of them can use technology; some of them don't. But really, I just say, 'Here you go. Which one do you want to do?' Sometimes, I'll have three different groups that are doing the same project and one kid wanting to do his own and two others that are working on this. They get to go through and design and decide what they want to use technology-wise or whatever they want to use. They could make it a poster or Keynote or anything, whatever they decided they wanted to do. I like this because I feel like it's having them use whatever they're comfortable with however they want to do it…Their choice, yeah, and really it's

> going through this process. Every piece includes research; every piece includes writing; every piece includes presenting, so however you want to go about that, you get to. But before that, we spend time talking about, 'These are the characteristics that we look for when writing informational text, and this is what we expect to see' They have to put all that together that sixth week when it comes, but it's their choice.

Teacher B shared that she knows if her students met the outcomes for her lesson or activity through,

> Different types of assessments. We have daily ones for math called assessment check-ins where maybe it's just a handful of problems and we check if they got that idea for the day, and then we have end of the unit summative assessments, and we also have cumulative check-in assessments so we see how they're retaining information. As far as reading, we have weekly tests that we check on progress and then unit tests where we check retention and just daily observation for monitoring, that sort of thing…. we also use MAP tests on the computer to kind of get us ready for state assessments and track all-over progress.

Teacher E explained that she tries to assess as much as she can on devices. She stated,

> We do a variety of different things. We will do a lot of writing and just have them write. We do a lot with Google Classroom, and they'll type in the answer to a question. We give them a content grade and a writing grade. Did they answer the question? How well did they write? We look at that. We use Google Docs or Google Forms for class and take a quiz. Homework quizzes are usually on Google Forms. MAP tests. Reading tests, we still have them written – multiple choice, short answer tests that we give them. Mainly, the formative or on-demand writing or quizzes.

Teacher E shared more examples of assessments when asked about how she uses technology in her lessons,

> We think about each of our units – social studies and science units per quarter, and we have some sort of culminating activity to incorporate all they've learned. I like to integrate technology with it, so I try to find out the best way to do that and enhance their learning. This one project they're doing now, they're writing PSAs for – they're choosing a cause, and I found Pow Tunes, which is easy to make a quick commercial on… We had a road trip project at the beginning of the year, which is all – it's actually a physical project, but they had to do a lot with Google Maps, trying to research a route and do different things.

Teacher L touched on a variety of assessments as well, she stated, "We have district assessments, check for understanding all the time. We have exit tickets and some formative assessments that we have about once a week." Different assessments and examples of assessments were mentioned twenty-three times within the five interviews.

The next perceived best practices were technology as student engagement and fourth grade teacher's main focus on integrating technology. These tied with a frequency of nineteen times within the five interviews. When asked about components of lesson planning Teacher B referred to student engagement. She stated,

> I consider what type of learners in have in my classroom, how I'm going to use technology, – I usually use a lot of PowerPoints to help me guide my lessons and keep them engaging. I think about timing. I think about who's going to be where, when, and then just kind of the flow of the lesson and the progression of thought process and kind of the leveling up with questions as we go.

Later Teacher B stated,

> We're given the textbooks to follow, and then you kind of use your teaching skills within that, so they all are – for reading and math – pretty scripted for the most part. Then if I think my kids need a little extra boost, I'll kind of add that in as we go.

When asked about how students learn best she referred to student engagement,

> I'm a very visual learner, and I like to make things kind of exciting and fun. I use a lot of music and videos and things to help kind of jog their memory throughout the day. I use brain breaks, stretching; I do a lot of that, and I just try to make it as visually appealing as possible so that they're with me, looking at the screen and focused.

Teacher B wishes for more technology, she said,

> I wish I had more technology. We share an iPad carts, and we share laptop carts. Mostly, I use this a lot. I'll use apps that I can put on the big screen. When I decide technology lessons, they're usually teacher-led because everything on here, I can get on the screen. I'll walk around – engagement is really high when I do it – I'll walk around and let them push the button and we'll play a game as a class. When I do use the iPads, I'll model on the board how to get into the app and how to start playing it, and then we go from there.

Thinking about best practices in teaching technology Teacher B spoke of student engagement,

> I think as much hands-on as possible is really important and kind of not just solving every problem for them. If there's an error message, 'Okay, what are you going to do?' And kind of letting them walk through it so you're not teaching them that you'll solve every problem on the computer, that they need to start learning how to be independent with it and just using it for every student responding type of opportunities, using it for maybe

> cooperative learning, maybe using it for independent work time. I think there are so many different ways if I had iPads and computers there for every kid. There are so many possibilities to use it for engagement. I think your student engagement would be sky-high.

Teacher E referred to student engagement in terms of motivating and interesting, she explained,

> I think they learn best when they are highly motivated and interested. Right now, we're doing an informational writing plan. They get to choose their animal. We'll do a lot with technology because they'll look at all the information online, and then they type it up on Google Docs. That's how we do our revising and editing – through Google Docs. Anything that they're interested in and that uses technology, that kind of motivates them to be more motivated.

When asked how Teacher E uses technology in her lessons she touched on student engagement as motivation and enhancement,

> You know, things that will use technology to kind of motivate them but not take away from what we already want them to do. We were using cause and effect charts versus a lucid chart. It's the same thing; just implementing technology. It's just a little bit more motivating to them – the Pow Tunes, recording music, and voiceovers. Anywhere I can bring in more technology to enhance the project we have…Again they're still doing that physical project…but they're enhancing it with more technology.

Teacher A commented on student engagement as well in finding new and different ways to teach concepts,

> Just because they're learning about 2-digit multiplication doesn't mean I'm going to go strictly by the book. If they're not getting it, I'm going to change and do what they're

> needing, whether that be something that's worked in the past or me finding something new for them to be able to understand it. Like I said, if I can make it hands-on for them, I will do that. If it's engaging – something that I find engaging – typically the kids will, too. I think just a regular old book is boring, so I don't think they're getting anything from that. But the more and more I teach, more I like finding hands-on through everything, not just science, but through reading and math and making it as hands-on as we can. They learn it better. They understand it better.

Teacher A also alluded to student engagement when asked about how she designs technology lessons, "I think the best way, which was the scariest way for me, was to just set them free and gice them 5-10 minutes." Also previously statedTeacher A spoke of different assessments she does on Apple TV however, this also exemplifies student engagement and is worth repeating in this section as student engagement. Teacher A explained,

> The kids can show their work on the Apple TV, too, which is nice, especially if I type our morning work. We'll do our morning work on there, or most of the kids do. I can jump off, and they can jump on and show how they did it. If we've got a multiplication problem and they've done it three different ways, then I can say, 'Okay, who did a break-apart method?' and they can jump up and pop up and show how they did it. Then they'll pop off, and, "Who did the box method?" and they can pop up and show.

Teacher A was very focused on student engagement through the idea of exploration, she mentioned several times that letting them explore was highly beneficial. She responded to the question of how technology should be taught with the following,

> Again, I think letting them explore for those 5-10 minutes and really sharing with each other versus me showing them step-by-step. Like I said, I wish I would have thought of

> that when I was teaching technology because I was like, 'Oh, my goodness, this is so much more pertinent to them.' And really, I feel like my role as a teacher has really changed. I feel like I used to have to be the one to give them all the information, and now my job is to guide them in the direction to find it and really helping them realize that I'm not always going to be there, so what can you do? How can you find this on your own?

Teacher A commented another time on exploration by stating, "And really letting them explore first."

Teacher L felt students learned best, "When they're engaged and they feel like they can take ownership of their learning and they're confident in what they're doing. Really engagement is 100%." She also mentions engagement as enhancement when asked how she develops technology lesson plans, "But we really try to see – kind of understand- what they're going to need in the future and hopefully prepare them small bits at a time to kind of enhance some of those lessons."

Teacher O talked about student engagement as fun, hands-on, or passion. She said she, "Try to do it fun…. bringing in leaves in and look at and identifying the leaves rather than just talking about it." Teacher O was going to try something new this year,

> One of the things I'm going to try this year is genius hour in my classroom because I think that we try to make our kids fit in a box. It's nobody's fault, but that's just the way our classrooms are designed. There's one of you and all of them. I don't know that we're teaching our kids to follow their passion or even to find their passion, what it really is.

Teacher O also wanted some professional development on different apps for student engagement for the end of the year,

> It's not part of our professional development on a regular basis...It's offered at Appy Hour once a quarter that we can go and learn different apps, but it's on your own time if you can get there…It sounded really good-how to keep the kids actively engaged in May.

As previously mentioned there was a tie between technology as student engagement and teacher main focus on integration. Evidence of the focus on integration is found from Teacher E's interview. She stated,

> We consider for each integrated unit, we try to come up with an essential question that is content-based in social studies and science and then we look at the different resources we have available as far as how many computers. We have BYOD – Bring your own device. Then we try to assess as much as we can on our devices and integrate technology into our writing, reading, anywhere we can.

Other evidence of Teacher's focus on integration includes a statement that was mentioned earlier providing evidence for the keyboarding focus and the variety of assessments and it also shows evidence of technology integration. "We do a lot with Google Classroom, and they'll type in the answer to a question…We use Google Docs or Google Forms for class and take a quiz. Homework quizzes are usually on Google Forms." Teacher E also explained her disposition on technology,

> I wrote a grant for an iPad a couple years back before the rest of us had iPads just to kind of dive in and see what we could do. I kind of am the one that just kind of – I leap before I look. I just like to try different things. We found different web-based programs and apps and different things. If I find it, I use it and see how it works. All these different things are kind of fun to see if they work for the kids. I just kind of trial and error.

She also mentioned that she used Reflector to make her whiteboard more interactive. Teacher E referred to Reflector a second time in the interview, "That's what is so great about having my iPad, my Reflector and being able to show and model for them how to do it and then let them do it.

In the interview, Teacher E's responses overlapped in categories but yet they are important statements to highlight as evidence of each category. When asked how she designs technology lesson she explained,

> We think about each of our units – social studies and science units per quarter, and we have some sort of culminating activity to incorporate all they've learned. I like to integrate technology with it, so I try to find out the best way to do that and enhance their learning…We were using cause and effect charts versus a lucid chart. It's the same thing; just implementing technology. It's just a little bit more motivating to them – the Pow Tunes, recording music, and voiceovers. Anywhere I can bring in more technology to enhance the project we have. We had a road trip project at the beginning of the year, which is all – it's actually a physical project, but they had to do a lot with Google Maps, trying to research a route and do different things. Again, they're still doing that physical project with maps, but they're enhancing it with more technology.

Her perspective on who should be teaching technology is summed up by her statement, "It's just going to have to be the more they use it, the more they learn. I think it needs to be a shared responsibility between everyone who can integrate technology."

Teacher O also referred to her focus on technology integration through the SAMR model (Substitution, Augmentation, Modification, and Redefinition). It is used as a scale used to

measure integration of technology into the classroom. When asked how she designs technology lessons she stated,

> We use the SAMR model. That's something they talk to us about a lot. I try to think about if it's above the line or replacement. One thing the district did really well was it doesn't all have to be above the line. That's just not possible. Sometimes it's okay if you're making a food web just to use a pamphlet to make the food web. A lot of stuff, I'll put the technology in that way so they're using it every day. Instead of having them cut pictures out of a magazine or have them draw a food web, I'll have them search something on the internet and make a pamphlet for it or use the technology that way. I would say I use it daily as a replacement for paper and pencil. When I try to think big picture – and I don't know if this is me being old enough, but it's new. I try to think big picture. We did a mythology unit, and we didn't necessarily use our technology every day, but they were going to research one of the Greek gods we learned about, and they were going to have to create an iMovie that time based on telling about their Greek character so they would be presenting it differently. Now, it's more technology, but it probably could have still been done in poster form.

She summed her focus on integration with this comment,

> I would think my use of technology ties into what my curriculum says, what I'm teaching, and I just tie it in to that, have them do some sort of presentation or create something based on what me curriculum is.

Teacher B alluded to her integration of technology when asked how students learn best, she replied,

> I'm a very visual learner, and I like to make things kind of exciting and fun. I use a lot of music and videos and things to help kind of jog their memory throughout the day. I use brain breaks, stretching; I do a lot of that, and I just try to make it as visually appealing as possible so that they're with me, looking at the screen and focused.

This answer was also used as evidence for student engagement as well in the previous section. As stated earlier some responses tended to overlap categories. This overlap occurred again when asked how she designs technology lessons. She revealed,

> I wish I had more technology. We share an iPad carts, and we share laptop carts. Mostly, I use this a lot. I'll use apps that I can put on the big screen. When I decide technology lessons, they're usually teacher-led because everything on here, I can get on the screen. I'll walk around – engagement is really high when I do it – I'll walk around and let them push the button and we'll play a game as a class. When I do use the iPads, I'll model on the board how to get into the app and how to start playing it, and then we go from there...But yeah, our textbook series has a whole online piece as well. They can log on, have a 'to do' list. It will pop up and have a whole week of reading. It will have weekly games and vocab words, stories if they're sick at home. Kids log on there every day during centers and do some 'to do' list things.

Teacher B summarized her view on teaching technology by stating, "I just kind of teach them how to find the tools and use them if they want them, I guess." She also added, "I think just trying to include it as much as you can in the daily curriculum." This statement ties in directly with technology integration as a focus in Teacher B's daily teaching.

Teacher A responded to the question about how she designed technology lessons with,

> I look at what it is that I want the kids to know, first of all, and then see if it will relate. If I look at straight up technology lessons, I don't really do any on the fundamentals of technology; it's more incorporating it into projects and things that we're doing…If we're introducing an app, then it's kind of, again, like my purpose or what I want them to get out of it.

Teacher A also referred to SAMR (Substitution, Augmentation, Modification, Redefinition). When asked if there were resources to teach technology she mentioned, "Not that I would really say. It's – well, I take that back. It's more looking at our lessons – we talked about the SAMR and try to design lessons like that." SAMR is a scale used to measure integration of technology into the classroom. Another resource that she mentioned in connection to technology integration was her "tech." Teacher A said,

> I can go to our tech and really say, 'Help me. How can we integrate this?' But when it really comes to just teaching technology, I don't feel like I just straight up teach the technology piece. I feel like it's all incorporated into what we're doing.

Later in the interview, she had an example of technology integration, which also was used previously as an example for student engagement and a variety of assessments. She shared,

> The kids can show their work on the Apple TV, too, which is nice, especially if I type our morning work. We'll do our morning work on there, or most of the kids do. I can jump off, and they can jump on and show how they did it. If we've got a multiplication problem and they've done it three different ways, then I can say, 'Okay, who did a break-apart method?' and they can jump up and pop up and show how they did it. Then they'll pop off, and, 'Who did the box method?' and they can pop up and show. The kids, I'd say, mainly have the iPads because we don't have any computers, any more desktop

> computers. There's one in the office, and that's it. They've all been taken. Then the teachers all have Macbooks and iPads. I would say as far as – I do both. If we're accessing anything on the web, I typically use my Macbook, and we'll airplay that, but if it's interactive, we're usually using their iPads. Then I'll show them.

When asked what technology concepts should be taught in schools Teacher A alluded to technology integration once again in her statement,

> I feel like it's so entwined with the things that we do to just - like, right now, there are times when I feel like I wish there was somebody who could have spent the time really teaching the kids how to use the program, how to use the app and how to access it so that I wouldn't have to spend that much time so that we could jump in to the projects when it comes to learning.

Teacher L was a little less forthcoming with information be specifically mentioned her college experience prepared her to teach technology. She asserted,

> We were taught a lot of integrating it into our lessons. We had a Mac class where we did Apple things…In our PC [class] it was kind of more integrating science. We did a lot of science technology with it.

When asked how she develops technology lessons she indicated,

> Basically, when we use the technology, a lot of times, it would be for typing and language arts. For math, we would use computer-based programs like IXL and that kind of thing. But we really try to see – kind of understand what they're going to need in the future and hopefully prepare them small bits at a time to kind of enhance some of those lessons.

This further illustrates the emphasis on technology integration in Teacher L's teaching.

Fourth grade teachers beliefs about best practices in technology includes, teaching typing/word processing, providing a variety of assessments, technology as student engagement, and a focus on integrating technology as shown on the table below. These top four perceived best practices rank very low on Bloom's Taxonomy scale. Keyboarding is a rote memory skill, which is at the Remember level. The other top three codes are associated with teachers using technology for assessments, student engagement, and integrating technology as they teach.

Table 2: 4th Grade Teachers Perceived Best Practices

4th Grade Teachers Perceived Best Practices	
Term	Frequency
Teacher wanting students to learn to type/word processing	27
Variety of Assessments	23
Technology as Student Engagement	19
Teacher Main Focus on Integration	19

Next, I will examine the perceived barriers by the fourth grade teachers. The top two perceived barriers with a frequency of twenty for each were limited or no access to someone trained in technology to teach technology and importance on core content over teaching technology. As previously stated, several comments overlap in categories but have been repeated in each separate category based on their significance and contribution to the research. Teacher O referred to the need for designated computer teachers frequently in her interview. Early in the interview she stated,

> We have a computer lab teacher. I do not have a technology curriculum in our classroom. I know in our computer lab, where they go ½ hour a week, they have a curriculum they teach based on having to do obviously typing. I know they learned Excel for the first time this year. I was talking to their computer lab teacher about her trying to teach them certain Excel formulas and stuff to go in there, and it's the first time they'd

> been exposed to that to see that. She was saying it was hard to get them to learn those formulas. I don't know the formulas. I can get my way through Excel, but I don't use it often enough to remember where everything is.

Later in her interview, Teacher O explained her opinion on the need for computer teachers and the inequality for students in different classrooms where teachers may or may not be comfortable with technology. Teacher O expressed,

> I like how we have a computer lab class, but it doesn't have any – the iPads don't go with them; it's all still desktop. It seems to me that there needs to be either the class where some of these things are taught to them so that when they come in and I want to make Adobe Voice, it's not necessarily me teaching them that and what it is. I can say, 'Your choices for this are iMovie, Adobe Voice, this, this and this.' And they already know how to use all those things because I think that's where we get tripped up some. Right now, at least in my district, a lot of that falls on the teacher because their computer lab class is desktops. It's stuff they still need to learn, but it's still how to use Word, how to use Excel, how to use that. I like technology, so I end up doing a lot of that, but one of my coworkers, she would do it, but she wasn't going to necessarily reach out and explore and find out how to do it. If I didn't, or since she didn't, if it wasn't for me, I'm not sure her students would be getting that the way my students would be getting that. Part of that is just there are so many – teachers are overwhelmed with the amount of things they have to do. Part of it might be age or they're afraid of technology, like some teachers are afraid of math and science. It's your comfort zone.

Teacher O further explained her perception on what the computer teacher should teach with this statement,

> I would like to see, for us, maybe ½ hour a week of traditional technology, so to speak, where I'm going to learn to type, use Excel, center and type a document and do those things, and then time spent every week on, 'Here's these apps. Here's how they work.' Or maybe we need to train the teachers on that better so that we can teach the kids. But right now, I think part of the issue is that before the kids can use the technology, we have to teach it to them in our classroom, which then takes more classroom time. It's just that vicious cycle of having only 30 minutes to teach a lesson, and if I'm going to spend 20 minutes teaching the technology part of it, is that worth using the technology when they could do something else instead.

Teacher O believed strongly in the need for a computer teacher not only to teach the students but to provide needed professional development for teachers. She voiced,

> I think we should have a computer teacher. I think we should have a designated computer teacher, but then I also think that part of your professional development should be those computer teachers teaching teachers because I feel like right now, for us, all of that stuff comes on our own time.

Teacher O again articulated her belief about the necessity for computer teachers with this comment, "I think the students should definitely be learning it from a computer lab teacher, but if the teachers are taught it, too, then we can be reinforcing that in our classroom." Teacher O worried about time allocation if the added responsibility of teaching technology was given to classroom teachers. She stated,

> If you had a computer lab or specific computer teacher to do it, then there's built-in time every week for that for the kids to get what they need from it and not taking away from my allocation for reading, math, social studies or whatever.

Teacher A voiced a similar opinion when she said,

> Selfishly, again, I wish we had technology teachers. I do because I feel like when I was a tech teacher, I felt like I could focus a lot more on just the technology piece, and I could give them more tips and more – yeah, tips, I guess I would say on how to use it and different things they could do to use it effectively; whereas, being a classroom teacher, in the long run, my goal is not to – I'm not looking at if they can use a Keynote; I'm looking at if they can show me they understood the variables and how they changed throughout the experiments they did. Now, with them showing me, yes, they can show me using Keynote, but that's not my end product of what I'm looking for. I wish that there was something that they had that solely would be devoted to that so they could be giving some of those kids who are more advanced and who – I know there are kids that are more advanced when it comes to the iPad than I am. We do utilize them. I feel like I utilize them, but I wish that there was a way they had something that they can utilize instead of just themselves or learning it on their own. I wish we had a technology teacher to be able to teach that and to be able to guide them and enrich them in it versus me, who I know the basics and it's me playing with it, but if I've looking at planning six different lessons, I'm not going to go play on the iPad; I'm going to be working on trying to do the math and that kind of stuff, so the core content.

Teacher B voiced her frustration about the infrequency of computer classes at her school when she stated, "We have computer teachers that help us, but that's only an hour a week maybe." Later she commented on the basic content they cover,

> They do typing sometimes. One day a week, they do Type to Learn since State Assessments are going to have a lot more written responses. They do typing. They also

> do some research projects sometimes in there. Then, kind of some curriculum-based things. But I wouldn't say – they do one week of programming, I know…I wouldn't say it's [the computer class] super computer-based.

Teacher E also echoed frustration on the little time that students have access to a computer teacher,

> I think it's got to be a whole group effort because they use them in library, computers, in here. I think that it's all of our responsibilities because the library teacher and media have them for one hour a week. It's just not enough. I think the more all of us are teaching it to them – sometimes they get frustrated and don't know how to do – they don't know how to tab, shift. There are little simple things they don't know how to do…some of the basics, especially in Microsoft Word, can come from the computer teacher.

Teacher L realized the importance of having a computer teacher and not having one meant that the responsibility would fall on the classroom teacher who would need training to teach it. She commented, "Well, it would be great if every school has a great technology teacher, but if they don't, it would be the classroom teacher that would have to have that availability and knowledge to do that."

As previously mentioned, the top two perceived barriers were limited or no access to someone trained in technology to teach technology and importance on core content over teaching technology. Teacher O focused on her content when she talked about lesson planning. She talked about each subject but neglecting to mention technology within her content realm. This quote was an overlapping quote for time constraints and variety of assessments. Teacher O explained,

> I always try to think about – and it depends on the subject. Math, you always want to make sure you have that built-in practice time. You always want to make sure that you have that individual time for kids who need that re-teaching. You want to make sure you get some cyclic review in there, some review of some sort or Common Core review in there. For reading, if it's your whole group instruction, I plan that. I look at what I have to accomplish for the whole group, how I'm going to do that, if there's a mentor text or something that can go with it. If it's reading groups, you look at that particular reading group and what it needs compared to what a different group may need based on their abilities. Spelling, obviously, it just goes with what the lesson is for the week. Try to do it fun. I try to add movement with the spelling, so we do – we clap our spelling words. Social studies and science – science is obviously a lot more hands-on with the different activities you can do, depending on the topic that – bringing leaves in and looking at and identifying the leaves instead of just talking about it. Social studies, really just depends on the topic area. Obviously, there are some things that are easier to do more than less. If we're being honest, science and social studies, not as much goes into the planning of those because there's just not as much time.

Teacher O communicated how she felt about the content, which again left out technology,

> I think that the content I teach is pretty good. There are obviously things you question. Reading is reading, and you have to look at things. Yes, there have been some changes throughout the years, like focus on text features; don't focus on text features, but when you really come down to it, they need to know the characters and the character traits and setting. I mean, some of that just doesn't change. Math, with Common Core, I feel like the kids are doing more earlier, like it's harder maybe, but I don't necessarily think it's a

> bad thing. I do wonder about the way they teach some of it and the way it's laid out in our books. I wish someone would explain to me why we're doing this. I'm not sure, but I think that the way the book that we use goes about teaching it isn't the way I would necessarily think, but then I just add my own stuff to it, kind of how I think it should go with that – teach that and then build on it, 'This is how you could use this.' I think that social studies is outdated the second the book is released, and yet it ends up being what we use as our social studies textbooks. Seven years is a long time for our social studies textbooks, so we're getting new ones this year. But think about how outdated that is the second it hits. And science, I like what I teach in science. It feels like for me, I wish our curriculum had more to it or something with it. I am not a scientist, so I look at the next generation science standards, and they scare me because somebody's going to have to teach me how to teach waves if they want them to learn about them. I haven't learned about that since I was in elementary school. I think that's probably – for me, I love science and the kids love it, but it's also one of the things that I'm like, 'I don't feel as confident because I don't feel like I know.' The coming up, future of that scares me a little bit because I feel so comfortable with what I know. I've done the research I know how to teach the science I am. Someone may need to teach my mitosis or whatever the other one is. I don't remember. I wouldn't know how to do it. I think that's probably scary for a lot of teachers when we get beyond our depth of knowledge, so that becomes hard. I like what I currently teach.

Finally, Teacher O referenced her focus on core content while excluding technology when she stated,

> If we're supposed to teach the technology, there are not enough minutes in our day. It's not allocated to our day with how many minutes on math, reading, transition, social studies. On paper, you can get to every subject every day, but in reality, you can't. Then, let's add technology on to that. How is that going to work? Plus, you're adding technology on to that for people who are not necessarily comfortable with all the technology. If you had a computer lab or specific computer teacher to do it, then there's built-in time every week for that for the kids to get what they need from it and not taking away from my allocation for reading, math, social studies or whatever.

Teacher A confirmed her focus on core content over technology several times throughout the interview. She reference core content and her opinion on making it hands-on,

> I think just a regular old book is boring, so I don't think they're getting anything from that. But the more and more I teach, more I like finding hands-on through everything, not just science, but through reading and math and making it as hands-on as we can. They learn it better. They understand it better.

Again, Teacher A referred to the "fundamentals" meaning core content in response to the question about her feelings on the content that she teaches. She stated,

> I feel like most of it is age appropriate. There are times when it's not, and that's frustrating because we have to back up, and I'm realizing that even though it's saying they should be doing this right now, they don't have some of those fundamentals, so we have to back up and really break it down. I think it's fairly rigorous, which I think is important.

Then when asked about the content she should teach she again explained her focus on the "basics" again referring to core content,

> There are times when I have to go back because I'm like, 'Oh, that's not part of our curriculum; they didn't get that. We didn't get basic facts, so we need to go back,' or, 'Oh, we're rounding, and we don't have a clue what we're doing, and we're going to go back and look at that instead of just moving on.' I think you're going to evaluate that when you're teaching anyway, and if your kids aren't getting it, hopefully you're going to change it and get those basics that they need to be able to move on.

Finally, Teacher A concludes her interview specifically talking about core content,

> Being a classroom teacher, in the long run, my goal is not to – I'm not looking at if they can use a Keynote; I'm looking at if they can show me they understood the variables and how they changed throughout the experiments they did. Now, with them showing me, yes, they can show me using Keynote, but that's not my end product of what I'm looking for… I wish we had a technology teacher to be able to teach that and to be able to guide them and enrich them in it versus me, who I know the basics and it's me playing with it, but if I've looking at planning six different lessons, I'm not going to go play on the iPad; I'm going to be working on trying to do the math and that kind of stuff, so the core content.

Teacher E explained her opinion on the content that she teaches,

> Being 3rd, 4th year of teaching Common Core standards, I feel a lot more confident in what I teach. I feel that standards themselves help us dig deeper into a better understanding of reading abilities, the content, whatever. I really think we're getting a better grasp on what we're teaching. Right now, I do feel like we're hitting the standards very well.

Teacher B also referenced the core content without acknowledgement of technology,

> We're given the textbooks to follow, and then you kind of use your teaching skills within that, so they all are – for reading and math – pretty scripted for the most part. Then if I think my kids need a little extra boost, I'll kind of add that in as we go. But then science and social studies are completely up to us where we just break apart the standards, decide as a team what skills we're going to hit in what quarters and kind of share lesson planning as a team.

Teacher L spoke of core content in the terms of district provided curriculum, which suggested core content based on her response. She indicated that she, "uses the district-provided standards and the materials they give us, and we plan based on that content." In a separate question, she was asked if there were technology standards that she uses, she stated, "No, I don't think so." Therefore indicating her focus on core content.

The second most frequent perceived barrier that appeared in the five interviews was time constraints. Teacher O voiced a variety of issues with time constraints when developing lessons, allocating minutes, and fitting everything in. She described her lesson planning and everything that is involved with her statement,

> I always try to think about – and it depends on the subject. Math, you always want to make sure you have that built-in practice time. You always want to make sure that you have that individual time for kids who need that re-teaching. You want to make sure you get some cyclic review in there, some review of some sort or Common Core review in there. For reading, if it's your whole group instruction, I plan that. I look at what I have to accomplish for the whole group, how I'm going to do that, if there's a mentor text or something that can go with it. If it's reading groups, you look at that particular reading group and what it needs compared to what a different group may need based on their

> abilities. Spelling, obviously, it just goes with what the lesson is for the week. Try to do it fun. I try to add movement with the spelling, so we do – we clap our spelling words. Social studies and science – science is obviously a lot more hands-on with the different activities you can do, depending on the topic that – bringing leaves in and looking at and identifying the leaves instead of just talking about it. Social studies, really just depends on the topic area. Obviously, there are some things that are easier to do more than less. If we're being honest, science and social studies, not as much goes into the planning of those because there's just not as much time.

Teacher O expressed concern for teacher accountability and what knowledge students need to be productive adults with regard to time. She declared,

> There are things we have to teach, and there are only so many minutes in our day. While we want them to have all this stuff, we have to also be held accountable for what is on our assessments and what we are supposed to be teaching them. If I don't teach them the state capitals, are they ever going to learn that? Then there's the question of if it's really the important in the grand scheme of things? You can look it up. I mean, there are certain things you need to know to be an intelligent person. When Superstorm Sandy hits New Jersey, you need to know where New Jersey is. But do you need to know that Trenton is the capital of New Jersey? I don't know. What adults really remember that? I think that is just a tricky thing, where we teach them these things and you hope some of it sinks in because in order to be an intelligent person in society, there are certain things of knowledge you need to know. Do I really need to teach them where every state is located? I don't know. Do they have to know where the states are when they're an adult and people are going to look at them like they're idiots when they don't know where [the

> state] is? Then, yeah. It's a hard thing to figure out what you cut to put more in or different things in.

Teacher O voiced a bit of exasperation over all the things a teacher has to juggle with her response to the question how do you believe technology should be taught to students. She said,

> Part of that is just there are so many – teachers are overwhelmed with the amount of things they have to do. Part of it might be age or they're afraid of technology, like some teachers are afraid of math and science. It's your comfort zone. Part of it is just the fact that there's so much out there that even just talking professionally with other teachers, 'What are you doing? What did you use? How can I do that?'

More frustration was detected when Teacher O explained,

> I think part of the issue is that before the kids can use the technology, we have to teach it to them in our classroom, which then takes more classroom time. It's just that vicious cycle of having only 30 minutes to teach a lesson, and if I'm going to spend 20 minutes teaching the technology part of it, is that worth using the technology when they could do something else instead.

Teacher O again expressed further irritation when considering allocating time to teaching technology,

> If we're supposed to teach the technology, there are not enough minutes in our day. It's not allocated to our day with how many minutes on math, reading, transition, social studies. On paper, you can get to every subject every day, but in reality, you can't. Then, let's add technology on to that. How is that going to work? Plus, you're adding technology on to that for people who are not necessarily comfortable with all the technology. If you had a computer lab or specific computer teacher to do it, then there's

> built-in time every week for that for the kids to get what they need from it and not taking away from my allocation for reading, math, social studies or whatever.

Teacher A also voiced annoyance with time,

> Right now, there are times when I feel like I wish there was somebody who could have spent the time really teaching the kids how to use the program, how to use the app and how to access it so that I wouldn't have to spend that much time so that we could jump in to the projects when it comes to learning.

Later Teacher A alluded to not having enough time with her statement,

> I wish we had a technology teacher to be able to teach that and to be able to guide them and enrich them in it versus me, who I know the basics and it's me playing with it, but if I've looking at planning six different lessons, I'm not going to go play on the iPad; I'm going to be working on trying to do the math and that kind of stuff, so the core content.

Teacher E affirmed her disappointment with not having more time with an analogy,

> I think if I had more time, more technology, all the things I wanted, it would run together a little more smoothly. We always compare it to building our airplane while we're flying it because we kind of got thrown the standards, lots of different materials, "Here, put it together and create a unit and do what you can do." I feel like if it was what I wanted to teach, we would have planned out assessments first and then geared our learning toward those assessments, had in mind a lot more, better-aligned resources. We kind of cut and paste wherever we could find things, so I think if there were more resources that were grade-level appropriate reading that taught the content, I feel we would have just a more fluid unit to be able to teach.

Teacher B said that she thinks about time constraints when she lesson plans,

> I consider what type of learners I have in my classroom, how I'm going to use technology…I think about timing. I think about who's going to be where, when, and then just kind of the flow of the lesson and the progression of thought process and kind of leveling up with questions as we go.

Teacher L slipped in the idea of time at the very end of her interview when she was thinking about the necessity of having a computer teacher. She acknowledged, "Well, it would be great if every school has a great technology teacher, but if they don't, it would be the classroom teacher that would have to have that availability and knowledge to do that…And time."

Finally the last most frequent perceived barrier was the teacher had to explore or self teach on own time about technology. This occurred with a frequency of fifteen times as is noted on Table 3. Teacher O reported,

> I'm old enough that I wasn't taught to teach technology. It was an overhead projector, and I did learn, I guess it would have been Apple. I did learn HyperStudio instead of PowerPoint, and then I remember starting my first teaching job and they had PowerPoint, and I was like, 'Oh, what's this?' I mean, they're similar, but they were still pretty different at that time. I took – there were certain things – I had to take a technology class, but part of that was learning to use the copy machine and the die cut machine. It wasn't just all – it wasn't actually what we consider technology now.

Further confirming she was self-taught, Teacher O expressed the differences among teachers and how that translates to student learning,

> I like technology, so I end up doing a lot of that, but one of my coworkers, she would do it, but she wasn't going to necessarily reach out and explore and find out how to do it. If I didn't, or since she didn't, if it wasn't for me, I'm not sure her students would be getting

> that the way my students would be getting that… Part of it is just the fact that there's so much out there that even just talking professionally with other teachers, 'What are you doing? What did you use? How can I do that?' One of my summer school teachers – I said, 'I'm frustrated my Airliner doesn't work the way I want it to work, and I can't figure out what I can on my iPad – what app to use that I can still pull up my math book, show it on the screen and point directly on it on the internet.' I don't remember what app she told me. She was like, 'Oh, this totally does that.' The thing is that how would I even know that? How do I find that? What do I even search to find it? I feel like I'm relatively pretty good at technology. I mean I don't know how to fix my computer when it's broken, but I'm not afraid to use it. I'm not afraid to use it with my kids, but I don't. Then when I put my Apple TV up there, it's not as big as everything else. I want it to be my full screen so I have plenty of room to write. So, for me, part of that is my hang-up, too – figuring out how to use that.

Finally, she talks about having to use her own time to learn things when she said,

> I think we should have a computer teacher. I think we should have a designated computer teacher, but then I also think that part of your professional development should be those computer teachers teaching teachers because I feel like right now, for us, all of that stuff comes on our own time.

Teacher B explained her experience at university and learning technology. She stated,

> I was always just taught to use the technology you have. I went to X University, so some people were student teaching with iPads and Smartboards, and some people were student teaching with overhead projectors. They kind of just taught you to use whatever is in your hands, to kind of problem-solve and figure it out…It's been a lot of trial and error.

Teacher E shared her personal view on technology,

> I have taken it upon myself to teach myself. I wrote a grant for an iPad a couple years back before the rest of us had iPads just to kind of dive in and see what we could do. I kind of am the one that just kind of – I leap before I look. I just like to try different things. We found different web-based programs and apps and different things. If I find it, I use it and see how it works. All these different things are kind of fun to see if they work for the kids. I just kind of trial and error.

Teacher A suggested that she goes and looks for her own resources especially when her students do not understand concepts or ideas,

> I think that those are kind of the fundamentals of it, but then I build upon them. Just because they're learning about 2-digit multiplication doesn't mean I'm going to go strictly by the book. If they're not getting it, I'm going to change and do what they're needing, whether that be something that's worked in the past or me finding something new for them to be able to understand it.

She also noted that she doesn't have time to being "playing" on the ipad looking for lessons,

> I wish we had a technology teacher to be able to teach that and to be able to guide them and enrich them in it versus me, who I know the basics and it's me playing with it, but if I've looking at planning six different lessons, I'm not going to go play on the iPad; I'm going to be working on trying to do the math and that kind of stuff, so the core content.

After interviewing the elementary teachers, it was evident that they had the least experience teaching technology. They perceived the most essential skill/knowledge/concept as keyboarding at the lowest taxonomic level on Bloom's Taxonomy. Their main barriers are the emphasis placed on teaching core content and no access to someone trained to teach technology. These

beliefs may reflect how schedules are designed at the elementary level. Table 3 summarizes the Perceived Barriers of the 4th grade teachers.

Table 3: 4th Grade Teachers Perceived Barriers

4th Grade Teachers Perceived Barriers	
Term	Frequency
Limited or No access to someone trained in tech to teach tech	20
Importance on Core Content over tech	20
Time Constraints	18
Exploratory/Self Taught Teacher (on own time)	15

Middle School Computer Teachers.

Data collected from the middle school teachers were greater than the elementary school teachers and the high school teachers but less than the curriculum directors and the university professors. The total number of codes produced from the six middle school interviews was ninety-nine. There are six interviews versus five interviews because I was able to access a middle school computer science teacher from the district that did not respond to me. The teacher agreed to meet based on confidentiality. This could contribute to the increased number of codes.

After examining the codes, it was evident that they fell into three categories: Middle School Computer Teachers Perceived Best Practices, Middle School Computer Teachers Perceived Barriers, and Middle School Computer Teachers Perceived Student Barriers. The first group with the most codes (58) was Middle School Computer Teacher Perceived Best Practices. The dominant code for the perceived best practices produced two codes with a frequency of twelve was that the middle school computer teachers believed that keyboarding is a focus or a priority and is a best practice. The second code that was produced with a frequency of twelve was the belief that technology needs to be integrated into core curriculum subjects. The next most common code with a frequency of eleven was students as users of technology. The

interviewees felt this was a positive best practice that students were users of technology. Conversely, this code will arise again as a perceived student barrier.

Teacher C referred to keyboarding several times throughout the interview. When asked how he knew if a student has met the outcome for the lesson or activity he responded with, "Keyboarding is easy to tell with scores but also technique: are they typing with the correct typing technique." Again later in the interview, he referenced the importance of keyboarding when asked what he felt he should be teaching he stated,

> I really think the coding and programming that is being emphasized now is really important for middle school and elementary kids especially…How do you expect a kid to program and type if he doesn't know how to type? You can get the card ahead of the horse.

When asked what technology concepts should be taught in schools Teacher C explained,

> I think there's always a need for students to type. I don't think that's ever going to change. You put two students side by side and give them the same project to do on the computer; one will have it done in ten minutes; the other will be still working on it an hour later. It's just so frustrating. Their skills for the future for job skills, they still need to learn how to type. Typing, office applications: Word, Excel, PowerPoint, Publisher – so software.

Teacher K also believed in the importance of keyboarding and this is evident because his entire answer comprised of only keyboarding. He answered the following to the question what technology concepts should be taught in schools,

> I think when it comes to technology; kids need to be able to effectively type. The way technology is now, you've got iPads, tablets and phones, and it's all swiping and texting.

> You put kids in front of a computer, and they don't know how to type a full sentence. I think typing is definitely one skill we need to continue to focus on as well as just their general ability to use software programs that they have access to. A lot of times, they don't need to have this amazing understanding of having used things like Google Docs to type a paper for their language arts class, but when it comes to more advanced things for them to do, as long as they're introduced and getting used to it now, when they have to do that stuff, especially in high school or college, they have access to all that and they feel more familiar with it.

Teacher K also explained his resources specifically to keyboarding when asked how he determines what he teaches, "As far as keyboarding goes, that one there's not much information out there, so it's a homemade curriculum." He also referenced word processing when asked how he felt about what he is currently teaching,

> I'm covering basic introductory stuff when it comes to Microsoft Office, technology, and stuff like that…They all use word processors for typing and they use presentation software for presentations for classes. It's really more of how to apply it and seeing why they are learning to do it and what they're going to use it for.

Teacher H referred to the importance of keyboarding when asked how he was taught to teach technology. He commented that, "I wasn't really taught to teach technology. We had a computer lab that kids could use for keyboarding skills, and that's fine because you have to have keyboards, especially now. They just really kind of use their keyboarding skills."

Teacher I mentioned word processing when asked about what concepts should be taught in schools. She stated, "I feel that Microsoft Office is very important because I don't know many businesses – and I feel that Google Docs is definitely a very big push."

Technology integration held the same importance as keyboarding for middle school computer teachers. Teacher I explained this when asked how she determines what to teach,

> Lately, what we've been doing is looking at what technology the teachers are using in their classroom and how we can better prepare our kids so that when they are in the classroom, they can worry about the curriculum and not so much the technology usage, meaning I love that they use technology, but they don't have to worry about, 'Not only do I not understand what's going on in science, but now I also don't know how to chart and graph in Excel.' We want them to already know how to do those things. That's the easy part. They just have to worry about the curriculum.

Teacher I later referenced technology integration when asked what components she considers when designing her lesson plans,

> But again, I will also look and see what they're doing in their core classes, so sometimes, if I know they're getting ready to chart, I will skip ahead and do Excel so they can take what they learned in computers and directly apply it outside of my classroom.

Teacher C alluded to technology integration in his interview when asked about what technology concepts should be taught in school. He stated,

> Typing, office applications: Word, Excel, PowerPoint, Publisher – so software. Then somehow, incorporate it into the real classroom – not the real classroom, but the other classrooms like science and social studies and how technology can help them in those subjects. There's a lot to learn.

Teacher C answered the question how should technology be taught with the following,

> I think it's an everyday thing. They have it every day in their lives. They're learning a lot on their own with their technology at home: their cell phones, tablets. They're

> learning things that they come and tell me that I didn't know. I'm learning through them. There's gaps in that learning. Maybe they know something works but they don't know why it works. That's kind of what we need to do. I think also, it needs to be an everyday occurrence. It's part of their lives. It's part of – it should be part of what we do here at school here, too.

Teacher C's response to who should teach technology, he concluded

> Very good question because it depends on what the teacher's focus is. If the teacher is teaching social studies, that's their focus. They may use technology to help them, but they may not know exactly how to use the technology to teach the kids to use it.

Teacher K's response to this same question of who should teach this also suggested technology integration as a focus,

> I think when it comes to technology; you want to have people that are comfortable with it. There is a stigma that those who are a little bit older who haven't necessarily been around technology as long as us who are in a younger generation, but at the same time, I think it's very easy for people to learn it. Those that feel comfortable with it and can really incorporate it definitely have them teaching that technology. Sometimes, I know we ask a lot of the teachers in our district. Suddenly, when you go 1-1, now you have to find a way to incorporate this awesome technology or else you're just giving them a very expensive pencil. Hopefully – you want teachers who are familiar with it and won't struggle with it and will know what to do with it. I think that's important to make sure they have the proper training and understanding to be able to mess around with it, too and learn that you can use this for this kind of class, or this is what you can do for this.

Teacher H also acknowledged technology integration when asked about how technology should be taught to students. He stated

> We need to make the technology tools. You can – and I've done this, too. Even when you say you use technology to change an assignment. That assignment is largely just the same assignment as it would have been on paper; you just use an app for it. It's a surface-level change. They haven't learned anything new. They're not changing the way they work or research.

Teacher P talked about technology integration when she was asked how she was taught to teach technology. She explained, "I was taught to teach students in a way where you bring technology into the classroom."

The other top best practice code was students as users of technology. Teacher J's beliefs about what technology concepts should be taught in schools were focused on students as users. She said,

> I think whether or not it's a concept, it should be teaching them how to use the technology as a tool. They know how to play games. They know how to get on and swipe and play the game. They don't know how to use it as a tool, how to create things that they want to say or do or present to the next level.

Teacher J also talked about student use when asked how she was taught to teach technology. She talked about her personal opinion with the statement, "I'm more of a practical than a theory person, so I want you to know how it works instead of why it works. Let's get in and really learn how to use all the components."

Teacher C referred to students as users in best practice when asked about who should teach technology, he explained

> I just think that they need someone who's gearing their subject matter to teaching software, hardware, technology that's out there in the world today – how to use it, how it applies to the real life, just focusing on the technology itself and not some other subject, focusing on the student using the technology.

Teacher K's comment on keyboarding was used previously as evidence for a keyboarding focus but also reflects an emphasis on students as users. He stated,

> I think typing is definitely one skill we need to continue to focus on as well as just their general ability to use software programs that they have access to. A lot of times, they don't need to have this amazing understanding of having used things like Google Docs to type a paper for their language arts class, but when it comes to more advanced things for them to do, as long as they're introduced and getting used to it now, when they have to do that stuff, especially in high school or college, they have access to all that and they feel more familiar with it.

When asked how he believed technology should be taught to students, Teacher K surmised

> I think the big thing about the technology is a lot of times, teachers sometimes forget that the kids don't always know what to do and how to use it, so you kind of have to put yourself in their shoes and figure out how to simplify it, how to help them find the information to be able to do it but also not showing them how to do it; let them mess around with it.

This shows the emphasis on students as users as a best practice. Teacher H talked about students as users when he answered the question who should teach technology he replied,

> Everybody needs to be teaching and not just, 'Okay, here's a cool app; let's use this to make our next presentation.' But, 'Let's figure out how to use the technology to work for

> you, to make it more efficient, to make the inefficient teacher – to make her kids better, more efficient students.' That's what it's for. I think everybody should.

Teacher I also talked about students as users when asked about how she felt about the content that she teaches. She explained,

> I've had kids ask about learning to do web design or write code. Again, I don't feel like that needs to be taught in middle school to help them be successful in high school. It could be a rotation for an exploratory class, absolutely. That's kind of where I'm torn because I know I'm an excellent class, but technology is – we definitely need to educate our kids in computer applications.

As highlighted in Table 4, keyboarding and technology integration are the main essential skills/knowledge/concepts perceived as best practices by middle school computer teachers. The other top code represented students using technology in the classroom. All three of these perceived best practices score low on Bloom's Taxonomy.

Table 4: Middle School Computer Teachers Perceived Best Practices

Middle School Computer Teachers Perceived Best Practices	
Term	Frequency
Typing/Keyboarding Priority	12
Integrate into core curriculum subjects	12
Students as users of tech	11

The second category that emerged from the middle school computer teacher interview data included several codes that became evident they were barriers for the teachers. There are twenty-nine codes that make up the Middle School Computer Teachers Perceived Barriers category. At the top end, the code that appeared most frequent was the teacher's freedom and choice with what to teach. This occurred with a frequency of eighteen. Teacher I was very straightforward about her freedom and choice, she expressed, "We don't really have any

resources. I design a majority of all our projects. I just type them up." Teacher C confirmed this idea as well, stating

> Much of it is through reading online, talking to other computer teachers, technology teachers, just trying to stay up with what's out there, the current state of technology and what kids need to know. So much of it is that there isn't – we don't have a handbook for this. It's trying to stay up to date with what they need, and a lot of it is listening to the kids, too. They'll come and tell you if they learned something new. If you listen to the kids, they'll tell you what they need in a lot of cases. Unless it's games.

Teacher P talked about her freedom when asked how she determines what to teach. She mentioned that the district gives her an outline but "You can kind of decide what the projects are." Later in the interview, Teacher P went into more detail about her freedom when asked how she designs lesson plans. She outlined her process for lesson planning,

> I feel like it's all going to Google and saying, 'Hey, what is a good lesson for Photoshop?' If I want to do something, I go to Google, search it and hopefully find something. I still ask the students, 'You want to do Photoshop. What do you want to do in Photoshop? Do you want to design your dream bedroom or the ultimate cheeseburger?' There are so many things they want to do, and you're covering the content because they need to learn how to use a program like Photoshop, but it's just kind of however they want to do it.

Teacher J also was in agreement about the topic of freedom and choice when asked about how she determines what she teaches. She said, "I determine what can be accomplished each semester by the ability of the students that come into me." Teacher J further explained this idea when asked how she designed lesson plans. She responded,

> I have redesigned that class, still keeping the general concepts intact. I've redesigned it so it's more hands-on and more cohesive versus each chapter is something different, each product is something different. I build upon each thing and it stays in one general theme all along.

In the previous section on best practices, Teacher K talked about his freedom in designing a keyboarding curriculum, which also fits into this barriers section on freedom. He stated, "As far as keyboarding goes, that one there's not as much information out there, so it's a homemade curriculum." Teacher K also talked about his freedom when explaining the components he considers when designing his lesson plans, he disclosed,

> When I design my lesson plans, I try to find things that segue and chunk things down. As we cover a chapter skill, we'll go back and forth between practicing the skill and taking notes on it. Then we practice and take notes on other stuff. Then I just try to come up with different projects or different types of assignments that show me they can apply that.

When asked about how he designs lesson plans he again talked about his freedom, he revealed

> So many students go into a class, whether it's math or science, and they're doing stuff, and sometimes they go out and don't know why they learned it. It's the one thing I try to do before we get into our lesson. I'll say, 'The reason we're learning how to format documents is to make them look more professional and not like middle school.' That's one of the big things I put in there. Besides that, I typically just use my own indicators or the reasons why we do it.

Teacher H explained the notion of freedom and choice within the context of a purchased program. In his school district, they purchased a program called Project Lead the Way and Teacher H expounded,

> How I determine is largely the classes that I teach are almost a prescribed curriculum or purchased curriculum. I have a lot of freedom within that. For the most part, I teach a program called Project Lead the Way. It's engineering – basically, I'm engineering preparation to get kids going into computer science and engineering, medical science in high school and college. It's kind of – the school districts that tech they pay for it. Teachers get trained, and they teach it. I have a lot of freedom in those – within the framework, within the goals of that program. I have a lot of freedom to mix and match or pick and choose what it is I do in my classes. My classes are one semester. I have a lot of freedom and choices.

When asked how did he know if his students met the outcome for his lesson or activity, he again referred to his freedom and choice by stating, "I create everything with a rubric, but it's all project-based." He further built on this idea of freedom and choice when answering the question about the components he considers when designing his lesson plans and how curriculum standards, indicators, benchmarks fit in, he clarified,

> We have some. They're not technically called benchmarks, but we have program goals the kids need to meet. They're really very vague and very broad. As long as I can support those goals, I can pretty much mix and match what I want.

The second most common code that emerged as a barrier was being self-taught or having to explore on their own time. This code emerged fourteen times. Teacher C detailed the issue of being self taught or having to explore on his own time when he answered the question on how he designs lesson plans. He explained,

> So much of it is online now. Just researching – some of it is just having the time to do it. Do I take time during my normal day at school, or do I do it at home on the weekends?

> So much of it is just time. There is so much out there, so many theories and ideas for teaching technology now. It just takes a lot of time to do a lot of reading. With the lesson planning and so forth, if other teachers are doing things you like, I try to incorporate things I see online that teachers are doing or other teachers in my district or my school. That's the key – just having time to figure it out.

Teacher C referred to being self-taught when asked how he determines what to teach. This answer also was found to fit into the freedom and choice code from earlier in this section. Teacher C stated,

> Much of it is through reading online, talking to other computer teachers, technology teachers, just trying to stay up with what's out there, the current state of technology and what kids need to know. So much of it is that there isn't – we don't have a handbook for this. It's trying to stay up to date with what they need, and a lot of it is listening to the kids, too. They'll come and tell you if they learned something new. If you listen to the kids, they'll tell you what they need in a lot of cases. Unless it's games.

He also referenced being self-taught when asked how does curriculum, standards, indicators, benchmarks fit into lesson planning. Teacher C answered,

> The world of technology – everything is constantly changing, so you're just trying to stay up with standards but also just observing and keeping up with technology that is out there and available for students and just determining what you think they're going to need in middle school, going on to high school and then on to college.

Teacher H also commented on being self taught when asked about resources that are available to him he acknowledge,

> There are lots of resources available and then just crowd source things that people make and put on YouTube. I started doing that some myself, making my own material and posting it online so my kids can access it anytime.

He further disclosed,

> I use Project Lead the Ways online resources. I use tons of YouTube for myself, especially for the 3D modeling class because the software we use is professional software. It's used to make aircraft parts. It's not just a dumbed-down thing for middle schools; it's professional. It's huge software, and I'm not an expert in it, so if a kid has a problem and I can't figure it out, my first thing after school is YouTube to figure out how to fix it or do it so I can teach it the next day. I find online resources just like I would in my personal life.

This details daily how much self teaching or researching on teacher's own time goes into teaching technology even though a district has purchased a packaged curriculum. Teacher P's comments on being self taught is evident through a quote that was used in the previous section to highlight freedom and choice but also alludes to being self-taught or researching on her own time. When asked about how she designs technology lessons she reflected

> I feel like it's all going to Google and saying, 'Hey, what is a good lesson for Photoshop?' If I want to do something, I go to Google, search it and hopefully find something. I still ask the students, 'You want to do Photoshop. What do you want to do in Photoshop? Do you want to design your dream bedroom or the ultimate cheeseburger?' There are so many things they want to do, and you're covering the content because they need to learn how to use a program like Photoshop, but it's just kind of however they want to do it.

Teacher I also referenced being self-taught when asked about how she designs technology lessons. Part of the quotation was used previously and referred to freedom and choice as noted above in the previous section. She reported,

> We don't really have resources. I design a majority of all our projects. I just type them up. I do have Microsoft Office 2008 book we use, but it's more idea-driven, or sometimes I'll teach out of the book and the kids will follow along. I order sample books and look and see kind of what they're doing and how I can expand on projects. No, we're not really given any resources.

Teacher J was very definitive when asked how she was taught to teach technology. She explained, "I did take some courses through XXXX or XX when I received my position 14 years ago, but a lot of my information is either district-taught or self-taught." Teacher K implied the idea of being self-taught when answering the question on how he designs lesson plans. He said, "Typically, own experience and understanding the purpose behind programs we're using."

To round out the top three, the code that appeared with a frequency of ten was constant change/trying to stay current as shown in Table 5 below. Teacher C focused significantly on the idea of constant change and trying to stay current. His thoughts were used in previous sections to highlight teacher freedom/choice and being self-taught. However, they are also relevant to staying current. When asked about how he determines what he teaches he stated,

> Much of it is through reading online, talking to other computer teachers, technology teachers, just trying to stay up with what's out there, the current state of technology and what kids need to know. So much of it is that there isn't – we don't have a handbook for this. It's trying to stay up to date with what they need, and a lot of it is listening to the

> kids, too. They'll come and tell you if they learned something new. If you listen to the kids, they'll tell you what they need in a lot of cases. Unless it's games.

Later when asked about how curriculum, standards, indicators, benchmarks fit into his lesson planning he explained,

> Well, there's national standards and state standards. We know what they are. We're aware of them, but they're constantly changing, too. The world of technology – everything is constantly changing, so you're just trying to stay up with standards but also just observing and keeping up with technology that is out there and available for students and just determining what you think they're going to need in middle school, going on to high school and then on to college.

Part of this quote was used in a previous section when referencing being self-taught; it meets the criteria for both. He addressed change again when asked about his opinion on what he should be teaching. He mentioned, "That's a hard one because what I fell like we should be teaching now, we're not able to and that can change in a few months or a year." When asked about what technology concepts should be taught in schools, he answered

> I think terminology is important, and I teach that in my class because the kids will hear things on commercials, 'What is that – RAM?' I think technology concepts are important. 'What's a megabyte compared to a gigabyte?' I think it's important that kids learn those terms. They're always changing.

Teacher H also remarked about change when asked how he thought technology should be taught in schools,

> I think in large part, as a teacher, when we have technology, we're so under the gun with time and to say with every new thing that comes out, 'Okay, I want you to use this, but

> you can't drop any of this other stuff you've been doing, either. You have to keep doing this, and I want you to use this.'

When asked about the resources available for Teacher H to use he referred to change with regard to school district size. He related his past experience,

> I moved from a smaller district. It's so huge and such a bureaucracy and moves so much slower than the smaller district. Moving from there to here, I really do see the benefits of a smaller organization. They can make changes faster. They can make things happen quicker. There are resources, but they're not as fresh as I would like them to be. Our kids are moving so fast, and our schools are moving so slow.

Teacher H also commented on change when asked about how he was taught to teach technology,

> My university experience wasn't at all because I came to teaching from another career, and when I started teaching, I got my license to teach elementary, and that was even 10-11 years ago. Technology itself has come so far in 10 years. Yeah, I think the iPhone is 8 years old, so when I started, iPhones weren't even a thing; Smartphones weren't even a thing. Now, every fourth grader has one. I wasn't really taught to teach technology.

Teacher J also alluded to trying to stay current when asked about the resources available to her,

> There are resources available. Some of them are a little on the outdated side in the fact that one of my classes is an 8th grade class but uses a book that was set aside for this class when we were in junior high. I don't even touch that book.

Table 5 outlines the top three perceived barriers for Middle School Computer Teachers. This includes teacher freedom/choice in what to teach, being self-taught/teacher explores on own time, and constant change/trying to stay current.

Table 5: Middle School Computer Teachers Perceived Barriers

Middle School Computer Teachers Perceived Barriers	
Term	Frequency
Teacher Freedom and Choice in what to teach	18
Self Taught/Teacher Explore on Own Time	14
Constant Change/Trying to Stay Current	10

The final category surfaced from the middle school computer teacher interviews was the Middle School Computer Teacher Perceived Student Barriers. This category has the fewest amount of codes of the three categories. It has twelve codes total. The top two most frequent student barriers were lack of students' ability to create/build technology with a frequency of eight and the technology class is an exploratory class which reduces access to all students with a frequency of seven mentions in the six interviews.

Evidence of the students' lack of ability as a barrier was arose from the interviews at various times. Teacher H felt very passionate about this topic. He expressed,

> I see so many other students as users of their technology, but they're not even really that adept users; they're surface-level users, but they have absolutely no understanding of how to build it themselves, how to operate or really make it work for them. I see that happening with the students, and I look at my kids, and I don't want my kids being the surface-level user. I want them to be the people using the technology to drive things forward. That's what I'm trying to get my students to do.

He voiced his concern again when asked about how technology should be taught to students,

> Well, like I said earlier, I think that we have – for example, we have so many of our students, the vast majority of them, are really weak, surface-level users of their technology. They don't have any idea how or why technology should work for them. I'll give an example of my kids with their Macbooks. Our kids have Macbooks - $900-

> $1,100 machines. 95% of them, all they know how to do is open them. They don't know how to do anything except open a web browser. They don't know how to save a file, send an email, check an email. I take that back, they can use Google Chrome and messaging. But they are the most surface-level users. I asked them to create and save a file, upload the file to my server so I could grade it. We're in the last week of the semester, and we still have kids that can't do that… I really think that we need to stress to kids to not just be users but creators and just understand even if you are going to be a user, it's okay, but to make the machine work for you instead of being an accessory – I guess that's what I'm getting at – really, we have – all these kids have a phone, and they have a laptop and many also have a tablet. To them, truly all they are, are accessories; they aren't tools.

Teacher J's response confirmed her agreement with the issue that students lack the ability to create. When asked about the content she would like to teach she reported,

> The content I would like to teach is, I would like to teach much higher-level technology to the students. What I do teach is somewhere in the middle. What I should be teaching goes back to what I said before. I'm finding that students are coming to me - as they get deeper into gadgets, they're coming to me technology-illiterate. They really do not understand technology as a tool; they see it as a game.

She expressed her concern again when asked what technology concepts should be taught in schools,

> They know how to play games. They know how to get on and swipe and play the game. They don't know how to use it as a tool, how to create things that they want to say or do or present to the next level.

Teacher J continued to address the issue of students lacking the ability to create when asked how she believed technology should be taught. She stated

> So many times, because they are gadget-smart, we expect them to know much more than they do when it comes to the aspect, as I said before, of producing. They don't know how to produce; so many times, we assume that they do.

Teacher P hinted at the same idea when asked about what technology concepts should be taught in schools. She said,

> I just feel like with technology, just having an open mind to learning new technology in any sense, and that's not a concept specifically, but they need to have an open mind about trying new things because I feel like my age students do not always.

Teacher C also indicated the lack of ability to create in students. When asked about how he believed technology should be taught to students, he concluded,

> They're learning a lot on their own with their technology at home: their cell phones, tablets. They're learning things that they come and tell me that I didn't know. I'm learning through them. There's gaps in that learning. Maybe they know something works but they don't know why it works.

Middle School Computer teachers were also concerned with the fact that their classes are exploratory, which reduces access to all students. Teacher J described this issue,

> I think a lot of it, in time, will go and attach to all the individual teachers, but they have to be strong, too. Obviously, it's going to fall back on me, but I only see about 20% of our building, so it can't be my sole purpose. But, as teachers have told me, you can tell who has had at least one of my classes because they're more comfortable, or they'll reach over

> and say, 'Did you know you can do this and this?' because I've shown them. It has to come with just time and with the need.

Teacher I was very concerned about being isolated. She explained her stance when she was asked about how she felt about the content that she teaches,

> I feel that the way we teach computers is in isolation. I feel that our content, maybe our skill set that we're teaching, is very relevant…When I think about if we could ever get our dream of going around to the classrooms or making us a required class where we're part of the core rotation, I think about some of those projects I would probably lose, but it doesn't really matter because I feel that, bottom line, technology isn't going away, and we really need to prepare our kids for high school and beyond. A lot of the things we're talking about in our district – we just formed a technology committee because we feel that we've really pushed technology, and so a lot of teachers are seeing that as apps. They think they're using a lot of technology, but we're concerned that it's not making our kids college and career ready.

At the end of the interview Teacher I addressed the issue again of being isolated when asked about how she believed technology should be taught, she explained,

> I don't feel it should be isolated to a computer teacher. I feel that it should be taught – and it doesn't have to be the math teacher teaching it, but it should be taught in the math room, so maybe the computer teacher comes into the math room and says, 'Today, we're going to be learning how to create formulas in Excel and make them look like percents and apply what you know about ratios and scatter plots. You've been studying them, so we're going to create them and evaluate them in Excel.' The math teacher is there to

> support the curriculum and support the kids, but you have the technology teacher there to troubleshoot.

Teacher P also commented on being an elective class,

> I mean, honestly, since it's an elective class and they're choosing to take it, I really do want it to be fun, but I also want them to obviously learn new skills, the skills that they're going to take on past middle school or if they're in 6th grade, skills that, if they never take my class again, they're going to know how to send an email and how to log in to an online class portal or something. I just really want them to know skills that they have the rest of their life.

Teacher H alluded to this issue when he was asked about what he should teach,

> I want them to be the people using the technology to drive things forward. That's what I'm trying to get my students to do. But, it's really hard to get the rest of the school on board. There are some other teachers that just aren't there with their line of thinking yet. That's what I need to see. I want to see more hands-on with technology, more independent research from kids, more project-based learning, more performance assessment.

When asked how he thought technology should be taught he again suggested the idea of lack of exposure,

> These kids, for some reason, haven't had the opportunity to learn how that technology can work for them and how it works. I had – granted, it was 7th graders, and if they haven't been exposed to computers, they might not know this, but I had kids that didn't know there was more than one operating system. They didn't know there was anything else except their Mac. They don't know that there's more.

Table 6 outlines the top two perceived student barriers. These include lack of students ability to create/build technology and the issue of the computer class being exploratory.

Table 6: Middle School Computer Teachers Perceived Student Barriers

Middle School Computer Teachers Perceived Student Barriers	
Term	Frequency
Lack of students ability to create/build technology	8
Exploratory Class - reduces access to all students	7

Overall middle school computer teachers also believed that keyboarding was the main essential skill/knowledge/concept to be taught, which also reflects a low taxonomic level. As for barriers, the middle school teachers perceived two types of barriers, barriers in their profession, and student barriers. While many teachers would welcome the freedom and choice, when paired with looking for lessons on their own time and trying to stay current it becomes overwhelming and a barrier for the middle school computer teachers. The middle school teachers also mentioned barriers in relationship to the students. They felt that the students lack the ability to create/build technology, which rates at the top of Bloom's taxonomy scale and since the computer classes are exploratory access to all students is limited.

High School Computer Teachers.

The data collected from the high school computer teachers produced a total of ninety codes. Three major themes emerged from the data: High School Computer Teachers Perceived Best Practices, High School Computer Teachers Perceived Barriers, and High School Computer Teachers Perceived Student Barriers. One teacher mentioned Project Lead the Way twenty-five times in the interview, which was the item with the most frequency. This may be considered an outlier because no other high school computer teacher mentioned this program within his or her interviews with regard to the classes they taught.

With the removal of the outlier, the top four codes produced from the high school computer teachers' perceived best practices include project based learning and teacher wants students to learn to problem solve. Both of these codes occurred with a frequency of twenty-one times. Teacher G spoke of project based learning when asked how he determines what to teach,

> I kind of create my projects and try to make the class as project-based as possible. I set out my objectives based on the curriculum and try to have my projects meet those objectives throughout each unit or chapter or whatever it is we're working on.

Teacher G again talks about projects when asked about how he knows when his students have met the outcome for his lesson or activity,

> Usually try to have pretty detailed rubrics at the end of my projects. If they're hitting all the rubric points, those are all directly correlated to our objectives. If they're doing a good job and they're getting a good grade on their projects, they're probably meeting the objectives.

When asked how he thought technology should be taught to students, he referred to project based learning. He said, "I think best practice is probably to make a technology course project-based. I really do believe in that and a lot of group work."

Teacher F described project based learning when she was asked how she knew her students have met the outcome for her lesson or activity. She explained,

> Assessments and mostly projects. … we do a lot of project-based items. For example, they'll write a program for me. Can they succeed in writing the code, debugging it, making it work and things like that? Then I also have assessments, which are the true and false questions and things like that, that pertain to vocabulary.

She answered the question, how do students learn best with a reference to projects. She explained,

> I think by doing. A lot of kids tell me they learn best by doing; they don't learn well by lecture and sitting and getting. I think with the projects and the more programs we write, I think the light comes on and they understand what's going on.

Teacher N referred to project based learning when he was asked how he determines what to teach. He stated,

> Project Lead the Way really tries to go with introducing materials first and then gradually working the student in the end into a complete problem-solving project-oriented item. Then it is completely their idea of getting the student to go and do something completely on their own, using what they learned in the earlier units and then being able to come up with their own scenario and answers and let them loose and let them solve it on their own. Some students do wonderful with that. You get beautiful projects. Other students want me to tell them what to do, make them do it, and that's not the purpose of Project Lead the Way. It's been frustrating for them.

He spoke of project based learning when asked how he knew if his students met the outcome for his lesson or activity,

> Sometimes in the beginning when we're first getting into it, we'll do more of the latter with myself helping. Then as they kind of begin to figure it out and see where this lesson is going, then they'll move off and more on their own, keeping in mind at the end, everything is all project-based at the end. The whole goal is to get them comfortable with the material and understand what these particular objectives are about so they can finally work independently on their own and actually be creative enough to do the final project.

> Then, you asked about how I evaluate it. There you are. It's a grade based upon how robust their project is, how direct it is in terms of the criteria. I have a rubric I grade.

Similar to other interviewees when asked about how students learned best, Teacher N mentioned project based learning within his answer. This is the portion of his answer that reflects project-based learning,

> My Visual Basic class that is a semester, which is an intro, I go real slow and show the kids. I do it in a demo, and then after I do it in the demo, I have them do it on the demo very similar. We work our way through those and say, 'Okay, now take those and jump a little bit more, and now you go apply it to some similar project and whatnot.' We stretch them and carry them more, trying to get them to do it what I call the old way. At the end, after you go through several of the different objectives in Visual Basic, then you can say, 'Okay, you guys take off and run with it, and you can go write me a larger project.' Some students do great with that; some students don't see the transition from one to the other. Having said that, Project Lead the Way is exactly the same way. Even though it's a newer standard, now, there is so much more project-based learning. That's the ultimate goal – to work with the students to see what the objectives are and pick up the learnings in the earlier units only to be driven down the road to use as a tool to be able to do this project and be able to explore and expand and explode on their own to be able to do this project and make it do what they want.

Teacher D also referred to project based learning in his answer to the question, how do you know if your students met the outcome for your lesson or activity? He shared,

> Web design, I have a paper and pencil test and projects. Computer graphics is mostly just projects. I don't give any tests, per se. So, basically, it's student work that's turned in and observation as they're working on the machines is how I grade them.

When asked how students learned best Teacher D believed, "Hands-on; the projects I give them, they apply what we talked about previously, and they apply that and show their creativity and take it and go with it." Teacher M mentioned projects when asked how she knew her students met the outcomes for her lesson or activity. She explained, "Oh I do several different types of assessments. I do projects and written tests." Teacher M went on to explain the different types of tests she gives, which did not contain information on projects.

The other best practice code that appeared with the same frequency as project based learning was teacher wants students to problem-solve. Both of these occurred with a frequency of twenty-one. Teacher N discussed the need for students to problem solve several times throughout his interview. He first spoke of it when asked how he determines what he teaches. This answer was also used above as evidence for project-based learning yet it is related to problem-solving as well. Teacher N believed,

> Project Lead the Way really tries to go with introducing materials first and then gradually working the student in the end into a complete problem-solving project-oriented item. Then it is completely their idea of getting the student to go and do something completely on their own, using what they learned in the earlier units and then being able to come up with their own scenario and answers and let them loose and let them solve it on their own. Some students do wonderful with that. You get beautiful projects. Other students want me to tell them what to do, make them do it, and that's not the purpose of Project Lead the Way. It's been frustrating for them.

Teacher N mentioned problem solving several times when he answered the question what technology concepts should be taught in schools. His thoughts were,

> Not sure where to go on that one. I'm trying to brace that question in a more generalized statement. If I were to pick one general single statement out of everything we can talk about, students need to be taught how to problem-solve. They need to be taught, 'Here's a problem; now, you go find, learn, do whatever, whatever the tools are that you need to be able to do that…'If I were to do anything differently, I would think the students need to learn how to problem-solve, but for me, I need to show them how they can go and search and problem-solve on their own, either using the Project Lead the Way curriculum or go out on the internet and go to an API, which is all the materials, and use that to learn how to solve their problem. Some students don't know how to read APIs yet, and they need to because that's the business way. Everybody goes and, if you will, steals each other's stuff because nobody – somebody knows that somebody has written it somewhere else. The problem-solving part is the key, knowing how to put that together, how to troubleshoot a problem, how to look at, 'Hey, this is not working; what do I need to change to make it work?...' Problem solving is the key essential that they need to learn to do along the way. How do you get to that? Everybody has been trying that for a very long time, and Project Lead the Way is the hot way to do it. Whether it's better or worse than another, I don't have that answer.

Teacher N again referred to problem solving when asked how he believed technology should be taught to students. He offered his opinion,

> Building off the problem-solving scenario that is the place where you want to attack. But having said that, the goal, then, is to provide them with an understanding of the tools.

> I'm going to call that programming tools – the different functions and methods and so on of how they work and show them how to assemble them properly to be able to get them to do something. That would be Step 1, and then Step 2, now that I know how the tool works, now, take the tools and use it in an application – something simple at first – and then gradually build on that to make your application become more robust, bigger, stronger… In my Visual Basic class, we have all kinds of colors and so on and so forth. I have so much trouble getting girls to be in my class. They just – programming is not cool for girls. Yet, when I have Visual Basic, there's the word "Visual" and lots of colors. The girls are – hands down; they kill the guys as far as making something look beautiful on the screen. Can they code as good as the guys? No, they don't problem solve as well, but they sure get the idea of output and GUI – Graphic User Interface – and all that gooey stuff.

When asked who should teach technology he cited problem-solving in his answer once again,

> I think as we talk here, the whole problem-solving idea needs to be done along the way. It's what I like about Project Lead the Way. I think you're going to see Project Lead the Way's curriculum evolve. I think they're trying to figure out where they want to go and how they do this. I think down in the launch area, I think it's a work in progress.

Teacher F agreed with the need for problem solving in a statement that was used previously about for project-based learning. It too fits in to the problem-solving category. When asked how she knew her students have met the outcome for lesson or activity, she stated,

> Assessments and mostly projects…we do a lot of project-based items. For example, they'll write a program for me. Can they succeed in writing the code, debugging it, making it work and things like that? Then I also have assessments, which are the true

> and false questions and things like that, that pertain to vocabulary. It will ask them questions about if a code is correct and if it's not, they have to fix it. It's things like that where they have to figure out and problem solve.

Teacher F mentioned problem-solving again when she was asked how do students learn best. Part of her answer included this statement, "Again, I think learn by doing. I think they learn more when just trying to work through a problem or something like that." In a portion of her answer, she describes a scenario, which included problem solving when asked how she believed technology should be taught,

> It's to the point where I guess the use of technology and what they're going to be using it for, I wish that there were a few more controls that we had. For example, I could lock them out of – for example, if I only want their attention on the board for now, their screens go black. I know the software is out there because I've used it before, and also, I could take over a kid's screen if he was having problems – just shoot it on the other screens and be able to show and tell that to students to problem-solve, to get them to understand, 'You may not have had this error, but here's an error that might happen to you.' I wish there were a few more control things that we could do.

The second most frequent code that surfaced was real world/real life applications, which occurred seventeen times. Teacher G conveyed his ideas on real world applications when answering the question what technology concepts should be taught in school,

> I think they just need to understand how the internet works and how, when you put something out on the internet, it goes to a server and doesn't really go away and understanding all of that so they can make better informed decisions on what they put out there, better – know better how to protect themselves as far as giving out emails and

> spam email – giving out your information to an email to something that looks legit and it's really not. Those are some concepts that I think as far as real life and moving on from high school to college and having your own stuff, I just think that those are important for kids to really understand how the internet works, not just be able to surf the web but really understand how it works and where you could potentially get yourself into trouble if you're not smart.

Teacher G expressed his opinion about how collaborating in teams reflects real life and is a best practice when asked how he thought technology should be taught to students,

> I think technology, as far as teaching it to students, just teaching them how to be smart with using technology. I think best practice is probably to make a technology course project-based. I mean, I really do believe in that and a lot of group work…My biggest reason for that is that I can't come up with a single job where you don't work with people. You need to know how to coexist. When I'm teaching technology and my classes, I always try to use a few different strategies for grouping them…When I group them, first, I let them pick their partner because I know they're going to pick their buddy in the class. And that's good; you need to learn how to work with your best friends because sometimes they're also your best distractions. So, be able to work with your best friend and still be productive. The next one I always do is try to match a high and a low, so try to pull those two to the middle and even allow the high person an opportunity to teach this content as well. They've learned it, but now, let's teach it and show that you truly have a deeper understanding of that content. The third way that I group students together is pick them myself, so maybe have them work with somebody they don't talk to, not necessarily friends with. Not that they're enemies, but they're not friends with

> because that's a huge part of working in the real world is being able to get along and coexist with people that you don't necessarily have a lot in common with or that you're not friends with. That's a huge part as well.

He also relayed his belief in having people from the real world teach technology when he was asked who should teach technology,

> I would like to see – in a perfect world, people that are really professionals at technology, so not just teachers or not just someone who is an expert in technology… It's people who have that real-world experience of working out in the industry and knowing how things work. They can bring that knowledge back in as teachers. Now, that doesn't mean – that's not to say that just anyone can teach because that is certainly not true. You have to have some personality and some teaching skills, some classroom management and stuff like that. But I really think professionals that have experience that then come back into the classroom are some of the real good candidates for positions like that.

Teacher M referred to real-world applications when she was asked how students learned best,

> I always think they learn best when they're actually doing something and learning to apply it – more real world application rather than just looking in a book and memorizing vocabulary words. I'd like them to be able to create something.

She also explained a little more about real world applications as a best practice when she answered the question about how she felt about the content she teaches, the content she wants to teach, and the content she should teach,

> In my content area, I'm more geared to Microsoft Office because I feel that's what they're going to need…They just get a little taste of it because that's what they're going to see if they get a job in the real world… I don't know. I guess I'm too strict. My

> expectations are, but when you get in the working world, that's what your employer expects – I just feel like we're doing a big disservice – some parents are doing a big disservice to these kids who expect to go out and think they don't have to do anything. I'm trying to instill in them that this is your job while you're here. You may not like it, but there are things my employer asks me to do that I don't like but I do it. I guess all those working skills.

Teacher M's answer to the question how do you believe technology should be taught to students included a reference to real-life application,

> Well, I think that you should give them an opportunity, obviously, to practice and drill and create and do more – the more they can do hands-on, the better they're going to be at finding things out. But, I've also done units where I let them present and share because again, it goes back to your speaking ability and letting somebody else do it for you. If they need in there, they have their hand in it. I think they learn more if they have to turn around and teach it to the person sitting next to them. That makes it more real to them. And just showing them, having guest speakers come in and saying, 'This is real world. This is what you're going to need to know how to do' because a lot of times, 'We don't need to know this.' I'm like, 'Well, yeah, you do.'

Teacher N referenced real world application when he answered the question, how do students learn best? He answered it extensively but this is just a portion of his answer that directly related to best practice of real life application,

> We actually went into the industry. There's all these different names of ways to design code: Waterfall and all these different names of ways that I hear that companies use, and we try to simulate that in the classroom the best we can so that they are familiar with

> those terms and how they work and what they do. That's another part of the coding process. You get them to not just think, "I can go work in a little bitty bubble." Anymore now – in fact, when we go talk with companies, the number one thing they say is if the student – the employee – cannot communicate effectively in a group, they won't make it.

Also when asked about his feelings on the content he teaches, the content he wants to teach, and the content he should teach, part of Teacher N's response included real world application,

> Project Lead the Way, sometimes I think they end up making it harder than they do. I think that's a real mistake. To me, they should be – they want to accomplish the objectives and to accomplish the objectives, to me, they took the hard way there. We really want to – we want the kids to really learn this, so if we're going to climb this mountain, let's go up the toughest north face that we can. Let's not walk around to the other side and go up the cute little trails. But both of them get us to the top. They want us to really hit it hard and struggle, and they want them to battle so they know what it's like. Well, some of that is good, but you lose too many kids along the way. You still want to challenge the kids who can go up the north face, but you still need to take it easy on some of them because in the end, what you really want is for them to understand the objectives. Well, they're also part of – the objective is not just learning the material; it's also how you battle to get to that place. They're teaching them a concept of what it's like to be an engineer in the real world and solve it when you don't know the answer. An easy way I could explain it would be you'll have students who try it once and won't get it, and then they're frustrated and want to quit. 'What are you doing? This is why you're

here. It's okay to not get it the first time. It's okay to not get it the third time. Go back and try again.'

Teacher F mentioned real life when she referenced employers and their expectations in her answer to the question how does curriculum, standards, indicators, benchmarks fit into lesson planning. She explained,

> They used to be a little bit more well-defined, and now they're so broad that it's like, 'Okay, how do I go about solving this or getting this competency done?' Well, for example, they try to work with those competencies more in a business or client and employee or whatever contract work and stuff like that, so are you meeting the employers' demands? Are you giving the client what they need and want and so forth? It's really hard to kind of develop specific lesson plans. I try to, again, teach them how to program because they're going to be developing that program for their client or for their employer, so communication skills – I have the students work together. They can help each other debug programs, so also being able to use cooperative learning and things like that, too.

Project based learning, teacher wanting students to problem solve, and real world applications are all items that rate high on Bloom's Taxonomy. These are highlighted in Table 7.

Table 7: High School Computer Teachers Perceived Best Practices

High School Computer Teachers Perceived Best Practices	
Term	Frequency
Project Lead the Way - solely mentioned by 1 teacher	25
Project Based Learning	21
Teacher wants students to problem solve	21
Real World Applications/Real- Life	17

The next theme that emerged from the data taken from high school computer teachers was their perceived barriers. This theme produced fifteen codes with a frequency range of 1-17 times during the five interviews. The top two codes most frequently mentioned were teacher has freedom and choice to choose technology projects and teacher explores on own time/self – taught/needs time to research new lessons. These two barriers occurred with a frequency of seventeen and thirteen respectively shown in Table 8 at the end of this section.

Teacher N explained his freedom as a teacher within a predetermined curriculum computer science program called Project Lead the Way when asked how he determines what to teach,

> Project Lead the Way has a predetermined curriculum, so it is – it identifies all the different objectives. It identifies – it does not identify, really, the tests and so on, but it does identify the outcomes of what you're supposed to accomplish but leaves the rest of the part of how you accomplish it to the teacher. They're wanting you to cover this material, and you can go through their specific lesson in a variety of different ways as far as presenting it, but the materials are very specific that come directly from Project Lead the Way, and they want you to cover these objectives and 'Here's how you can cover these objectives with the material.' Of course, if you're teaching it for the first year ever, you have a tendency, of course, to stick very closely to the curriculum and try things out. I can tell you next year, I'll do things different. Along with that is, well, I – Project Lead the Way has an awful lot of material. They have purposely filled it with more material than you really need to cover the objectives, and so for me as the first year doing computer science engineering, it's a bit difficult to decide how far to go, where to cut it off, how long I go to cover that particular objective to feel like I've done it well enough.

He mentioned his freedom/choice again when he was asked how he felt about the content he teaches, the content he wants to teach, and the content he should teach,

> I sometimes feel that Project Lead the Way – again, keep in mind that I'm piloting, so I'm holding on to it, and what I would like to do is to try to be able to feel comfortable that I could let go more. I want to try to concentrate more on the objectives and not necessarily on a rigid curriculum. The students like that better.

When asked about the resources available to him, Teacher N referred to his freedom/choice,

> I mentioned earlier, it gives you more material than you need, so there always – when you go through the lessons, as I read the teacher materials, they say, 'If you want to, you can go look at this,' or, 'If you want to, you can go look at this,' or, 'Send the kids off and go do this extra.' They give you all those items.

Teacher F spoke of her freedom within the state's guidelines when she answered the question on how she determines what she teaches. She described,

> The Computer Science 2 class, it's again something that our state department with current tech education where they are requesting and requiring us to meet certain competencies for the students. As long as the software we use meets those competencies, then we can kind of pick and choose our own. That's why I let the kids kind of have free reign of the programs they use because there's freebies out there. The software we're using now is Game Maker, and it's a lot of drag-and-drop right now, but then the kids can get even further to the language and adjusting code and stuff like that.

She referred to her freedom as a barrier when asked about how curriculum, standards, indicators, benchmarks fit into lesson planning, "They used to be a little bit more well-defined and now they're so broad that it's like, "Okay, how do I go about solving this or getting this competency

done?" Teacher F hints at her freedom/choice when expressing her opinion on the content that she teaches,

> A lot of it, I've developed through just doing and changing and modifying. Since it's not a core subject, I don't have to go specifically by state-mandated things. A lot of what I teach, again, I've developed. I've developed lesson plans. I've developed curriculum and stuff like that. What I'm teaching, I enjoy teaching. If I don't like it, I change it, or if the kids don't like it, I change it…I always wonder if there's something more out there. So, just having to research it.

Teacher G has freedom/choice as well while operating within some school district guidelines. When asked how he determines what to teach he responded,

> I go based off state standards and the curriculum given to me by the G School District. From there, I kind of create my projects and try to make the class as project-based as possible. I set out my objectives based on the curriculum and try to have my projects meet those objectives throughout each unit or chapter or whatever it is we're working on.

He described his freedom/choice in his lesson planning process and how curriculum, standards, indicators, benchmarks fit in,

> When I sit down and kind of plan out the semester, I always look at the curriculum, benchmarks, standards – all that – first. I always draw those into my lesson plans each and every single day to make sure I'm meeting those first of all because that's part of my job to meet all of those. Then from there, if there is maybe some extra skills I can add into it, I try to add a few extra skills into it on top of that, but those standards are the base. That's where I start, and I expand from there, and I check each chapter in our textbook to see what it is that those textbooks – their objectives and those goals are and see if they

> correlate with our standards, with our curriculum. If there is anything they don't cover that I'm supposed to cover, I try to add stuff in for those as well.

Teacher M mentioned her freedom/choice when asked about the components that she considered when designing her lesson plans. She said, "Well, we have an advisory committee with meetings twice a year, but again, that's something the state mandates. Then based on their suggestions, we come up with a plan and try to add new curriculum."

The second perceived barrier was teacher explores on own time or is self-taught or needs time to research new lessons. This occurred with a frequency of thirteen. Teacher M shared her journey on being self-taught when she was asked how she was taught to teach technology,

> I've pretty much evolved and had to go back and teach and relearn and have to take classes as I went along. It's just what you did for the job. And it was – well, you went from electric typewriters, electronic typewriters to then your computers. It's been – learned how to do Word Perfect. Thought I was going to die when I had to learn something new. But it's always something new coming out.

She alluded to the idea of being self-taught in preparation for the upcoming school year when asked if there are resources for her to teach technology,

> Oh, well, something new that I never got into yet was Microsoft Academy. We're learning about certifying these kids in Microsoft, Excel, and there's this website called Imagine – Microsoft Imagine Academy. I haven't used it yet, but I'm going to get into that before next year. That's kind of what – in the Computer Applications class, my Business Programming class, we'll go a little more toward that so these kids can be certified. I'm scared because I haven't done it myself, but again, something new.

Teacher M's answer to the question who should teach technology included some frustration about having to learn new technologies,

> Because I tell you what, two years ago when we got these [Macbooks], we got them issued to us on the first day, and there was no training at all. I was in tears just because of my age and you're asking me to learn plus trying to get ready for school to start, and here you're throwing this thing in front of me, and I had no clue how to do it. We weren't really happy with that. Now, they did take the time to send the outside people in to help. That was much better. Then, it helped us feel more confident with it, but that should have been done the very first day. That was not fun. So, I suppose teaching technology would be the people who are selling their wares need to come in and show you how to do it, but then I think teachers - like I say, I've had to teach myself. It's time-consuming. Ultimately, you're responsible for it, so you've got to do it.

Teacher F detailed her experience with regard to being self-taught when asked about her opinion on the content that she teaches and the content she wants to teach,

> A lot of it, I've developed through just doing and changing and modifying. Since it's not a core subject, I don't have to go specifically by state-mandated things. A lot of what I teach, again, I've developed. I've developed lesson plans. I've developed curriculum and stuff like that. What I'm teaching, I enjoy teaching. If I don't like it, I change it, or if the kids don't like it, I change it…I always wonder if there's something more out there. So, just having to research it. We go to enough Career Tech-Ed workshops and meetings that I try to pull information from other people. 'What programs are you using?' and things like that, which is a very good place to get the information from because we can feed off each other.

Part of the previous quote was used for the other teacher perceived barrier of teacher freedom and choice. It overlaps in both categories. Teacher F mentions again very explicitly the idea of being self-taught when she was asked about how she was taught to teach technology,

> I'm old. I wasn't taught. I learned by doing. I had one programming class – one credit hour – on an Apple 2E 37 years ago. Yeah, I – the very first time I taught programming, that's all I knew. I learned so much from those students that had – must have been a younger teacher even than me because he was more of a computer geek; I guess you could call him. Those kids were very good, and I learned so much from those kids those first two years of teaching in Iowa, of all places. I mean, every program I have picked up, I have taught myself or gone to a workshop or professional development, something like that. I learned to type on a manual typewriter.

Teacher G had similar thoughts when asked about how he was taught to teach technology, he said, "When I went through and got my undergrad, I didn't even have any programming background, so this is all stuff that I'm learning new." Teacher D implied he was self-taught as well when asked how he was taught to teach technology,

> I got my master's from XXXXX State in business and computer ed. A lot of those were online classes. I got that in '99, I think, so at that point, it was all pretty new. Since that point, it's been hard to keep up and change with all the new stuff coming out.

Table 8 summarizes the information from the interviews of the high school computer teachers and their perceived barriers. The main two barriers were teacher has freedom/choice to choose projects and teacher explores on own time or is self-taught or needs time to research. These are considered barriers due to the amount of time outside of the contract day this requires of the teacher.

Table 8: High School Computer Teachers Perceived Barriers

High School Computer Teachers Perceived Barriers	
Term	Frequency
Teacher has freedom and choice to choose tech projects	17
Teacher explores on own time/Self Taught/needs time to research new lessons	13

The final theme that emerged from the high school computer teacher data are perceived barriers related to students. Eight codes were discovered to create this theme. The range of frequency was between 2-9 times during the five interviews. The barrier that occurred most often with a frequency of nine was students have trouble working in groups. Other barriers that appeared included students want directions broken down into steps and students with poor reading ability struggle in technology class. These are represented on Table 9 at the end of this section.

Teacher N was very passionate about the trouble students have working in groups. He explained how he would improve this for next year when asked how he felt students learned best,

> Another item that happened with Project Lead the Way – one student is stronger than another, so one student gets left behind because this kid was all, 'Cool,' and they're in; their fingers are flying. They're taking off, and the other student is like, 'Whoa.' Now, one item I didn't do well this year that I'm going to do better next year is they recommend that you switch. In other words, one person is the driver. If you will, they have two computers sitting in front of them. One student has the curriculum open telling them what to do. The other student on the other computer doesn't have the curriculum, but he's got the software open, and he's the one doing the typing. Well, it's good to have the kids switch every day or every other day. That drove the students who were stronger absolutely ballistic because they didn't want to have to wait on their other guy. It was

> healthy for the students. It's a great workplace environment, relying on other people. But there were tempers that flared. Some kids are more mature than others. Of course, I'm always having to sit back there and put out fires, and this person comes in tears if it's a girl, or if it's a guy, they're all ticked off and want to hit the kid. Or they come to me quietly and politely and say, 'I cannot work with them anymore,' stuff like that, that went on over and over again. So part of – of course, Project Lead the Way knows this, so they tell you that you have to work on your engineering skills. Every day when we walk in, the students have to stand up, look each other in the eye, shake hands, 'Hey, how you doing?' We didn't quite do it every day, but there was a lot of every day having to get them to work on their interpersonal skills. I mean, computer science people, engineers, are notorious for being nerds. You and I are teachers, and we know how to communicate. These guys are – they're not so good at it, so they wrestle with that. Some students are comfortable; other students, not so that's where that part comes in.

When asked how he thought technology should be taught to students, Teacher G talked about pushing them out of their comfort zone, he alluded to the fact that students have to coexist and that seemed to be a little difficult because he has to make them work in teams,

> When I group them, first, I let them pick their partner because I know they're going to pick their buddy in the class. And that's good; you need to learn how to work with your best friends because sometimes they're also your best distractions. So, be able to work with your best friend and still be productive. The next one I always do is try to match a high and a low, so try to pull those two to the middle and even allow the high person an opportunity to teach this content as well. They've learned it, but now, let's teach it and show that you truly have a deeper understanding of that content. The third way that I

> group students together is pick them myself, so maybe have them work with somebody they don't talk to, not necessarily friends with. Not that they're enemies, but they're not friends with because that's a huge part of working in the real world is being able to get along and coexist with people that you don't necessarily have a lot in common with or that you're not friends with. That's a huge part as well. I try to use those three grouping strategies when teaching all of this technology stuff, making them work in groups, maybe pushing the limits of their comfort zone and then allowing, as group work, each other to teach each other a little bit and bounce ideas and be creative.

Teacher G's answer was used previously as an example of real world application. It fits into both groups as a best practice and a barrier.

Teacher M talked about working in teams but from a slightly different angle when she was asked what technology concepts should be taught to students. She believed the student was wanting to get out of work by asking to work in groups, which she saw as a barrier to teaching and working in a group situation. Teacher M stated,

> We do work in teams sometimes. It seems like they – at the middle school, they work in teams quite a bit…They get up here [high school] and it's like, 'Can I work with somebody?' I'm like, 'Not on this one. I want to see what you know, your ideas,' because you get those people that just – they don't – they can get somebody else to do the work, and they're going to do that. There are some things they need to do themselves.

There were two student barrier codes that occurred at the same frequency, students want directions broken down into steps and students with poor reading ability struggle in tech classes. Teacher N felt strongly about students wanting directions broken down for them when he was asked how he determines what to teach,

> Project Lead the Way really tries to go with introducing materials first and then gradually working the student in the end into a complete problem-solving project-oriented item. Then it is completely their idea of getting the student to go and do something completely on their own, using what they learned in the earlier units and then being able to come up with their own scenario and answers and let them loose and let them solve it on their own. Some students do wonderful with that. You get beautiful projects. Other students want me to tell them what to do, make them do it, and that's not the purpose of Project Lead the Way. It's been frustrating for them.

This quote was used in previous sections to highlight two other best practices project based learning and teacher wants students to problem solve. It also fits into the student barrier category with the ending part about students wanting the teacher to break down the lesson into steps. Teacher N also referred to students wanting lessons or activities broken down another time when he was asked about how he was taught to teach technology,

> Kids learn in different ways. I keep trying to find a balance of this. When one student gets it and somebody else doesn't, you have to switch back and forth in terms of this partnership thing, doing demos. That's why I mentioned for me – teacher-led – in the beginning, I tried to do it all with student-led. 'Okay, you students, with your partners, go read this and do it.' That was wrong. So, the students said, 'We've got to have something different. Help me here,' because we weren't doing well. They wanted more teacher-led. So, then I started doing short demos and they do a little bit, and then they'd go read and answer questions, and then I'd go read a do a little bit, especially when they got to the Python coding. Well, that was more like what we did back with AP, and they did better with that, so I'll probably go in that direction, but someplace along the line,

> you have to let go of the reigns and let them take off. Some students are ready for that, and some students just want you to tell them and go along.

Teacher N also referenced the other student barrier code, the difficulty students had in his technology class due to low reading ability when he was asked how he felt about the content that he teaches, the content that he wants to teach, and the content he should teach. Part of his answer was devoted completely to the difficulty low level readers have in his class,

> You know, I'll throw this out there right now while we're talking about the curriculum. One of the items in the project that I didn't really think through is – you're talking about engineering-type content, and the reading level of some students that I've had come into my class had been very poor. They cannot survive in this. It does not work. Lexile scores – it's the one item I've gone back to the junior high and warned them, 'Whoever you're going to have enroll in 9th grade, please be sure the Lexile score is high. If it's not, don't have them do it yet. It's way over their head, and they need to get farther.' I had a couple freshmen students come in with Lexile scores low, and they were miserable, blown away, frustrated. If they worked with someone else who could read the material – the vocabulary and level of reading is high. It's way up top purposely. They're trying to go there. You try to work with them on the vocabulary and what's there, but still.

Teacher G insinuated a similar issue when he was asked how students learn best, a portion of his answer contained the idea of low students, which the researcher took as low reading and math levels and constituted a student barrier. He described the situation when putting groups of students together,

> I believe that you have to define the groups as well instead of just randomly picking the groups or setting one of your high students up with the low students – because a lot of

cases, if you're not monitoring that or if they don't have defined roles, they're probably going to have one that does a majority of the work and one that kind of slides by.

Unlike the elementary and middle school teachers, high school computer teachers are not interested in keyboarding as the essential skill/knowledge/concept. They are focused on project based learning where the students are problem solving which has real life application purposes. Similarly to the middle school teachers, high school teachers have the freedom to choose what to teach but they must look for their resources on their own time, which made this a barrier rather than a best practice. Finally, high school computer teachers have student barriers as well. Students have trouble working in groups, they want directions broken down for them, and those with poor reading ability ten to struggle in technology classes. Table 9 outlines the high school computer teachers perceived student barriers.

Table 9: High School Computer Teachers Perceived Student Barriers

High School Computer Teachers Perceived Student Barriers	
Term	Frequency
Students have trouble working in groups	9
Students want directions broken down into steps	5
Students with poor reading ability struggle in tech classes	5

School District Curriculum Directors.

The next set of interviews collected data from the School District Curriculum Directors. These interviews yielded a total of one hundred nineteen codes with a frequency range of 1-17. Three themes emerged from the codes. They were District Curriculum Directors Perceived Best Practices, District Curriculum Directors Perceived Barriers, and District Curriculum Directors Perceptions about Computer Teachers

The group that produced the largest and most varied codes was the perceived best practices codes with ninety-eight codes in total. The perceived essential skill/knowledge/concept that appeared the most at a frequency of seventeen is the integration of technology. School District Curriculum Director A spoke of technology integration when she responded to the question, what was the school district's expectation for teachers when they design technology lessons? She explained,

> Well, I think right now, a struggle that we have – we talked a lot about that – we don't want technology to be something separate if I'm talking about a regular education classroom. If we're talking about when the content of the class is learning technology, it's kind of different. I'm going to answer the core part first. With that, I think it, again, has to be very authentic. I think it has to be relevant to what the standards are and how it aligns to those learning targets that we talked about and that the technology should only infuse, supplement, help them engage, help support. It's supplementary to those standards.

When asked about best practices in lesson planning and how technology should be taught by their teachers to students, School District Curriculum Director A replied,

> We've done some PD, and it's one of the things I think we need to come back and visit again, is that SAMR model where we're really understanding the levels of what the teacher is trying to do in the classroom.

School District Curriculum Director B referenced technology integration when she was asked what she knew about teaching technology,

> I was a middle school principal or assistant principal for 26 years prior to that. I opened a new building during that time. At the time, it was – it had all the latest technology that

> was smart technology and document cameras and all those kinds of things. It was 2004 when we opened. We were built and opened to be a technology school. People who were hired to help open this school and teachers also had to have a passion for technology. And then of course, it changes so rapidly – the tides of technology. But that was a constant in that building that teachers integrated technology into their instruction and integrated rather than replaced something – lots of ways to use technology in the classroom but more than saying, 'Yeah, we use technology; our kids type papers on the computer all the time.' … In the district I'm in currently, they, too, have placed an emphasis on technology in the classroom. It's been – they're doing a little bit of catching up because there wasn't any one until the last year that they have designated to really oversee that. And, so they're doing a little bit of catching up, trying to purchase technology. They spent – before I became part of the district they spent a lot of money on the infrastructure to support the technology and WiFi, so that's been helpful, but right now, there is a lot of BYOD, which I mean, it's a method of integrating technology, but it's also very challenging.

When asked about her school district's expectations for teachers designing technology lessons, School District Curriculum Director B shared,

> I would say that there has been, and we will continue to emphasize, the SAMR model. So, the expectation is there…. But I think my expectation, as I become more a part of the district and lead, is that the teachers recognize that it is an expectation, that it's not something that they can do once in a while, that – and if they need assistance with instruction or professional development, then they need to communicate that and make that happen.

School District Curriculum Director C alluded to technology integration when she responded to the question, what did she know about teaching technology,

> I actually was in partnership with the 21st Century trainer. I actually got in on the ground floor of that and came back and stayed here and did a bunch of workshops and different things on what are the 21st Century skills, how do you – and what you do. I've kind of got this one. The biggest thing in a nutshell was teaching that technology has to be intentional and purposeful; it can't be an add-on. It has to be something that you're doing for a reason, not just because it's the toy of the month. You don't design a lesson because you have a box of grapes. You don't do that. You design a lesson because it's the correct tool to hit. But you have to – and I should back up. It's not necessarily the technology that's intentional and purposeful; it's the 21st Century skills – back that up a little bit – it's the skills that should be intentional and purposeful. You are trying to teach collaboration, communication, and those things. Then the tools become just what you pick because it's the right thing to do. But you have to teach the skills. It's becoming more and more second nature. I don't think people are worried about it as much because they can do these things. You find what you need to teach, and you let the tools be in the lesson. Just because you have Macbooks, you shouldn't be doing something just because you have them; it should be because they serve a purpose of being.

When asked the follow up question was the emphasis on incorporating technology on the devices or the concepts she answered,

> We started back before we even got the devices, and I did a thing called Teaching Down the Line, so teach above the age. Substitution, augmentation – that's all fine. Apple does a really great survey to get reviews, and we had to take it before we got the devices, and

> we have to take it at the end of every school year now. Teachers self-select where they are. They were asked if in a year they could move to another level. Not everything can be re-definition, and we understand that and tell them that, but we need to see that they're making some progress and moving toward redefinition. We asked them as we rolled it out, 'Wherever you are this semester, you have to do one project one level up.' Just show a little at a time. Most of them just ran. Just a little bit of time. I think it's more about the concepts. An iMovie may be the way to do it. Maybe it's podcasts and letting the kids select what it is to illustrate their learning, giving them more of a choice.

When asked who should be responsible for teaching technology School District Curriculum Director C replied,

> I think it's a combo. I know some of our elementary instructional coaches will go into rooms and do things and show them not necessarily teaching the tech, but maybe showing how to use it in the science lab or something that they're seeing the tech being used. It's not, 'Sit down; turn it on; do this and that.' It's, 'I'm going to use the monitor that's attached to the iPad and measure these things and watch what happens on here,' or take the iPad out and do a nature walk, taking pictures and coming back in and sharing them on Apple TV. Each kid can share it up there, 'Look what I found,' and stuff like that. Just modeling it and showing how it can be used.

School District Curriculum Director D spoke of technology integration as a best practice when she was asked what she knew about teaching technology. She stated,

> I know that technology should be integrated into the content that is being taught. Technology shouldn't be used as a replacement for a task. For technology to be impactful for learning, technology should have a purpose that enhances or even takes

> learning to a level that wasn't possible without the technology being there. We follow the SAMR model, and that is tied to our roll-out with the 1-1 initiative that we're in year two of so that all teachers can identify a lesson, develop a lesson and be able to articulate what level of SAMR that lesson will speak to the technology task of learning.

When asked the follow up question was the emphasis more on incorporating the devices or the concepts she replied, "I think in the first year of the digital learning initiative, it was incorporating the devices. Now, we're moving into higher levels of integration." School District Curriculum Director D answered the question what was the school district's expectation for teachers when they design technology lessons with a variety of topics. She discussed data privacy of students thirteen and under then explained,

> One of the other big expectations we have with designing technology lessons is any time we can integrate and weave in the concepts of digital citizenship, the responsibility on the learner, we want to do so, so that digital citizenship isn't just a lesson we teach at the beginning of every year and then forget about it. We're constantly cycling back to why that is important in all of our behaviors with learners. Then going back to SAMR, I think the expectation is certainly that we're not using technology for technology's sake, but we're using it to enhance learning opportunities for students. We have instructional coaches that work with our teachers to try to challenge that thought process and help us to move to higher levels of learning.

When asked about what kind of technology is available to her teachers, School District Curriculum Director D addressed technology integration once again,

> Our teachers all have laptops, so they had iPads and Macbook Airs the spring before the 1-1 initiative rolled out, and then they had three days of intensive training on the devices

> – two days on the devices, one day on the integration as a starting point before the kids came back and received their devices. In addition to that, we use Apple TV technology so that you don't have to be tethered to project. It's also really nice because students and teachers can get on the projectors or the flat panels in the classrooms to project out and collaborate. Really, with the technology that we have, some of the other ancillary pieces like the document cameras and the clickers that we would have used for response systems are no longer needed. It has really changed that, and then the continuation of the app development has really changed the way and resources that we use.

School District Curriculum Director D explicitly referred to technology integration when asked who should be responsible for teaching technology to the students. She indicated,

> I think it absolutely has to be a component of the responsibility of the classroom teacher. It has to be – it should be integrated. That's the world outside the classroom, and if we're really preparing kids to be career ready, I think college always comes first in terms of college and career, but I think really we need to focus on career readiness. Kids will go to college, but I think teachers have to provide those opportunities for kids, whether they're the ones directly instructing or whether they're an alternative piece within the students' work. They're the ones that provide those opportunities.

School District Curriculum Directors E1 and E2 were interviewed together. One is the Director of Secondary Educational Services (E1) and the other is the Director of Elementary Educational Services (E2). When asked what the school district's expectation for teachers when they design technology lessons School District Curriculum Director E2 revealed,

> As far as the school district expectations, I don't know necessarily that there is a district expectation that we have when teachers design technology lessons. I think if it is the best

> resource for them to be able to use and especially at the elementary, if it reinforces the concepts they're teaching, so if that's accessing the websites – there are a variety of different resources we can access. But I don't think there is a specificity from the school district perspective or expectation that they design them a certain way. I think as long as it meets the standards that the teachers are teaching and there is a link to it with that current learning that they're teaching, then they've already fulfilled the district expectation that needs to occur.

School District Curriculum Director E1 responded to the question how should technology be taught by your teachers to students, he referred to technology integration. He shared, "So helping set the stage for why you need to be able to do this, so showing them the real-life application and again, using, modeling what you want them to learn by using it in the instruction." Again referring to the emphasis on technology integration this school district hired a technology integration specialist. School District Curriculum Director E1 explained, "That is the largest part of her job-to provide professional development individually, to groups, about how to utilize and incorporate technology into instruction.

The second most frequent code was student engagement with a frequency of fourteen. School District Curriculum Director A spoke directly of student engagement when asked what are the components she expected her teachers to consider when designing their lesson plans,

> I think there are a lot of things. We want to have student engagement. Instruction technology is a great way to have kids engaged. I don't want technology to be used a something completely different or an add-on, but I think it needs to be authentic in use and also having students engaged.

She referred to student engagement through what she called the "discovery model" when she was asked what she knew about teaching technology. She described,

> For me, I think a big part of technology is that discovery model where there's that freedom to get in if we're sharing something that's instructionally based that we have time to play. I think pacing has to be at an individual level. There's nothing worse than being a learner with technology when the instructor is often gone, and you don't know if there's a technical glitch or you're just not clicking along as fast as everybody else. I think where it's directed, it's pacing appropriate based on the individual needs where we can play and we're not going to break everything. Information gets saved. I guess those are kind of some of the initial thoughts when you talk about thinking about teaching technology.

She spoke of student engagement again when she was asked what the district expectations were for teachers when they design technology lessons,

> Well, I think right now, a struggle that we have – we talked a lot about that – we don't want technology to be something separate if I'm talking about a regular education classroom. If we're talking about when the content of the class is learning technology, it's kind of different. I'm going to answer the core part first. With that, I think it, again, has to be very authentic. I think it has to be relevant to what the standards are and how it aligns to those learning targets that we talked about and that the technology should only infuse, supplement, help them engage, help support. It's supplementary to those standards.

This answer was used previously as evidence for technology integration and it also referred to student engagement.

School District Curriculum Director D referred to student engagement through several different examples. When asked what the school district's expectation for teachers when they design lesson plans part of her answer included an example of student engagement,

> We have instructional coaches that work with our teachers to try to challenge that thought process and help us to move to higher levels of learning. Those coaches are helping the teachers with a resource of maybe a connector, so we have a lot of Genius Hour projects that are happening now. The coaches are the connectors to help students once they develop the concept or topic for research, and they get that fully developed out if there's an expert we can Skype with, make contact with or gather data from. Then, the coaches are helping make those contacts so that the teachers can still stay focused on teaching and the kids still have those connections outside of the classroom.

When asked about what kind of technology was available to teachers she shared another story about having 3D printers in the robotics courses. The story she shared illustrated student engagement,

> …We just had an incident happen this year that in the robotics and automation course, I think it was a battery cover on one of the robotic components that broke, and so the kids that were in design and modeling actually partnered up, and they had a functional project, so the students that weren't able to solve the problem with the replacement battery cover went to the students – and this is middle school student-to-student – and so then the teacher took it and gave them a design challenge. 'You know what? Work in teams. Who can design the best, suitable and functional replacement?' And then they pitched their designs to the teacher, and then the team that came up with the best design 3D printed and phototyped it and the robots were running again.

School District Curriculum Director D shared another story that related to student engagement when she was asked how technology should be taught by teachers to students. She shared,

> I think that you have to have a flexible notion because sometimes it's our students that teach it to our teachers. So, I think technology should never be taught in isolation. What I've learned from even our youngest learners at the elementary level is we had one school early on that identified a tech team, and that notion spread, so we have tech teams and tech leaders that are our students that are upper grade students – maybe 5th and 6th graders – where our schools became very savvy, and through that tech team, they would research apps and would learn about apps, and they would go into the classrooms and teach the app to the whole class, the teacher included. Then the teacher would go on with the lesson. What they found with that is using the students to help teach the technology, it alleviated a lot of anxiety on the part of the teachers, and the teachers picked it up along with the kids, but the kids could problem-solve through it with enough information, led by their peers, to get them to the content.

School District Curriculum Director E1 spoke of student engagement when asked how students learn best,

> It depends on the student. Some frankly may not need a human being teacher; they are more – they want to go through something that is web-based that they can pause and rewind or watch as many times as they want or skip through the different section. Other students need to have somebody right there that could answer personal questions in the sense that this is how they understand it or don't understand it. They need that interaction, or there are some that need the interaction with peers, the constant feedback

> of peers or teachers. That's a loaded question. I think it depends on the student. Every student is going to be different.

He talked about student engagement again when he was asked what are the expectations for teachers when they design technology lessons. He mentioned,

> The minimum expectation is just what we would have in any classroom: lessons are engaging, all those things that you would say about any classroom when it comes to asking questions from different levels whether it's Bloom's Taxonomy or time on task, engagement, varying activities on an appropriate time frame.

When asked about best practices in teaching technology he explained,

> In regards to how it should be taught, I think you need to model. If you're talking about word processor, you shouldn't be doing it from a book. You need to have them doing. Again, that just goes back to best practices. Kids need to see how it's going to be applicable to their lives, so even typing for a 3rd grader may be hard to understand without some explanation why they need to know the skill if they have their phone.

He also shared that he felt, "Students have an obligation. They shouldn't expect somebody to spoon-feed them everything they need to know about technology. They're not expecting it. They're driven to find stuff out."

School District Curriculum Director C pointed out in a portion of her answer that students are naturally engaged with technology when asked about the school district's expectation for teachers when they design technology lessons,

> Because they're so interested by the time they're sixth graders, it's just second nature for them to be using it. So, they do have the courses where they're taught to do PowerPoints and all those things in the elementary. That's all taught to them how to create one, so it's

> second nature to kids now anyway. They don't even listen to you; they just start doing it. It's intuitive. They've done it at home, or they've done something. But we do have that at the elementary level on some of the tech standards that we've embedded in there that you have to know PowerPoint and you have to know to do this and that so by the time they get to 6th grade, they're kind of off and running.

School District Curriculum Director C spoke about their 1:1 roll out when she was asked how teachers should teach technology to students. She outlined the items teachers went over with students when they received their device. A portion of her answer related to student engagement,

> So, we had little things for them to do, 'Okay, I want you to go to Pages and you are going to change your background, and you are going to do this and save it,' and they walk through a list so they know how to use that. I think that's probably just the ground level of what they were doing. Then the teachers would come up and show them, 'This is the action,' and kids just kind of took off running. Once they had it, they had no fear. We gave them time built in to play at the end of each segment, so we had a Pages segment, a numbers segment, a presentation segment, and then time to play.

Her answer to the question who should be responsible for teaching technology to students indicated student engagement as well as technology integration. So it has been used in both sections. She explained,

> I think it's a combo. I know some of our elementary instructional coaches will go into rooms and do things and show them not necessarily teaching the tech, but maybe showing how to use it in the science lab or something that they're seeing the tech being used. It's not, 'Sit down; turn it on; do this and that.' It's, 'I'm going to use the monitor

> that's attached to the iPad and measure these things and watch what happens on here,' or take the iPad out and do a nature walk, taking pictures and coming back in and sharing them on Apple TV. Each kid can share it up there, 'Look what I found,' and stuff like that. Just modeling it and showing how it can be used.

The final two perceived best practices both came in with a frequency of thirteen. These two codes were Cyber Safety/Online Safety and Technology Use. School District Curriculum Director D spoke about Cyber Safety/Online Safety when asked about the school district's expectations for teachers when they design technology lessons,

> Right now, a big topic is on data privacy. If you're working with students 13 and under, there are a lot of really awesome resources and sites out, but if they start to require a student to have an individual account, we need to make sure we're following the terms of the use for the site and keeping our kids safe and also keeping our parents informed and allowing them to be part of the process, a necessary part of the process to give their permission for their child to interact with the technology in those ways. That is first and foremost: making sure we're actually adhering to the law with students 13 and under.
>
> One of the other big expectations we have with designing technology lessons is any time we can integrate and weave in the concepts of digital citizenship, the responsibility on the learner, we want to do so, so that digital citizenship isn't just a lesson we teach at the beginning of every year and then forget about it. We're constantly cycling back to why that is important in all of our behaviors with learners…

She also mentioned digital citizenship when asked about what technology skills/concepts should be taught in schools,

> I think that's a big debate that we're having right now. I think certainly, there needs to be attention to functions of the productivity tools. I think the old way to do things was to focus on Microsoft Word or Excel, and I think now there are so many different resources at the fingertips of our kids that they need to have functionality. An internal debate we're having is we have a lot of beliefs that we still need to be teaching Office because it's what the workforce is going to require of the kids. I can see some of that. Through advisory committees, that is some of the feedback we get from business partners, but I think having transferrable skills and problem solving or knowing, 'Here's the tool, but there are different tools that will accomplish the same task.' I think they have to have the critical mindset of understanding what tool would fit what need, which is kind of where the ISTE standards were taking us. I absolutely think digital citizenship and continue to focus on that respect. Responsible use of technology is absolutely key as well.

When asked if these same skills/concepts should be taught to the teachers, she responded,

> I think absolutely. I think the conversation we had earlier about data privacy – I don't think a lot of teachers are aware of the component with 13 and under, and to me, that's a new literacy. When copyright became a concern and we all learned about fair use and educational domain that was a big deal for us to really know and make sure that we were following the law. This is just a new literacy that I think is a functional literacy for teachers now.

School District Curriculum Director C also believed in safety online when she was asked what technology skills/concepts should be taught in schools,

> Always safety online; we teach that way young and all the way up. That's one of the main things with the computers. That's a big part of the day. Then the day we had

> everybody hand them out, all faculty at the high school each had a section of kids, and I worked on a huge presentation for everybody, and they all delivered across the building at the same time in their room with their kids. It was on internet safety and stupidity and dos and don'ts. Kids all had to do it before they would get their computer. Honestly, I don't know if that many kids had their computers taken away.

When asked about best practices in lesson planning and how technology should be taught by her teachers to students she referenced the safety aspect again,

> Like I said, I think that's almost now relatively younger, and it may be even 6th grade. What they're having to teach them because they have the device 24/7 is a safety that must be taught to them, to deal with their machine and not break it. Here's another smart thing we did: we bought the indestructible cases. Number one rule is it does not ever come out of the case. We have seen them fall off cars, and they're fine. They're not plastic. We teach them how to care – again, we're going to do this lesson, and you can do whatever you know how to use the iPad. Make sure you know how to make a podcast. A lot of that comes in 6th grade just when they are getting their devices.

School District Curriculum Director A commented on online safety with regard to digital citizenship when asked what technology skills/concepts should be taught in schools,

> Well, in my mind, it's digital citizenship, and I think that probably more than anything versus having a face-to-face conversation where we're smiling at each other versus would you say something to me this way that maybe you wouldn't? I feel like when we get behind a screen, it's a lot easier to say mean things or do that kind of thing. That citizenship part all the way to, 'I really want you to think about if you're going to post that picture because colleges, jobs are now going back to look into it, and once you're out

> there, you're out there.' Then all of those – that cyber safety piece comes to mind, too. Some of technology and what needs to be taught first are those basic fundamentals, you know, those ground rules.

School District Curriculum Director B also talked about digital citizenship when asked what technology skills/concepts should be taught in schools. However, she misspoke and called it data citizenship but she asked for the correct term from the researcher,

> I think one of the first things – and this really isn't a computer science concept, but it is part of using technology in the classroom – is data citizenship – is that the term?
>
> DIGITAL CITIZENSHIP, YES. – (Researcher's comment)
>
> Thank you, digital citizenship. I think that is a critical piece to be taught, especially when we're putting technology in the hands of kids who – and again, my world was middle school for so long, and I have seen cell phones develop, and they're not mature enough to understand the impact that it has later in their lives. I think that's an important piece. I don't know that I am familiar enough with computer science to determine what is best practice.

School District Curriculum Directors E1 and E2 referred to online safety/cyber safety several times throughout the interview. It first appeared when they were asked what do you know about teaching technology. School District Curriculum Director E1 had been discussing topics at the high school level so School District Curriculum Director E2 jumped in,

> I think at the elementary level – you kind of gave an example at the high school level. I think at the elementary level, it's more about how to stay safe on the computer, how to access appropriate websites, how to know what is an appropriate website and what isn't an appropriate website and how to do research, giving them those foundational skills, too.

> That's not really technology, but it's how to use it appropriately and in the right forms and capacity.

Next when the two school district curriculum directors were asked about what technology skills/concepts should be taught in schools they listed several items. School District Curriculum Directory E1 focused on high school topics mainly but added in, "Presentation software, appropriate use, social – appropriate work on social sites." Hearing this School District Curriculum Director E2 agreed and commented, "And I think just helping students and teachers understand what an appropriate website and an inappropriate one and is it vetted? Does it come from a reputable source?" School District Curriculum Director E1 followed up with, "What is it – digital citizenry? Keyboarding – second and third grade level, how to access databases for research, finding resources or credible sources. That's probably good enough." The researcher then went on to ask, should these same skills/concepts be taught to teachers? School District Curriculum Director E1 responded,

> If you're not teaching the class, then a lot of that stuff, no. But back to what she said about appropriate vetting and resources and what is valid and social – it is digital citizenry. That stuff, yes. Maybe word-processing; they use word processors.

When asked how should technology be taught by their teachers to students, School District Curriculum Director E2 shared,

> I definitely think that especially digital citizenship and finding credible resources online has to be taught by teachers, but I think many times, students come to us now with a skill set as well, too. So, sometimes, teachers can rely on students to be able to teach us those skill sets that maybe we're not as comfortable with or not as knowledgeable about.

School District Curriculum Directors E1 and E2 agreed together that parents also have a responsibility in teaching online safety. School District Curriculum Director E2 made the statement, "Parents need to take responsibility for it." School District Curriculum Director E1 agreed and said, "I think parents, especially when it comes to the social networking part of things, need to make sure they are doing it appropriately."

Two codes that appeared with the same frequency were online safety/cyber safety and technology use. School District Curriculum Director C referenced technology use frequently. She spoke of technology as a tool when asked about what she knew about teaching technology,

> I actually was in partnership with the 21st Century trainer. I actually got in on the ground floor of that and came back and stayed here and did a bunch of workshops and different things on what are the 21st Century skills, how do you – and what you do. I've kind of got this one. The biggest thing in a nutshell was teaching that technology has to be intentional and purposeful; it can't be an add-on. It has to be something that you're doing for a reason, not just because it's the toy of the month. You don't design a lesson because you have a box of grapes. You don't do that. You design a lesson because it's the correct tool to hit. But you have to – and I should back up. It's not necessarily the technology that's intentional and purposeful; it's the 21st Century skills – back that up a little bit – it's the skills that should be intentional and purposeful. You are trying to teach collaboration, communication, and those things. Then the tools become just what you pick because it's the right thing to do. But you have to teach the skills. It's becoming more and more second nature. I don't think people are worried about it as much because they can do these things. You find what you need to teach, and you let the tools be in the

> lesson. Just because you have Macbooks, you shouldn't be doing something just because you have them; it should be because they serve a purpose of being.

This answer was also used previous to indicate her focus on technology integration but it is also relevant to technology use. When asked what is the school district's expectation for teachers when they design technology lessons, School District Curriculum Director C stated,

> Kind of like what I was saying that it's a given that it's there, so consistency, and it's an expectation that the kids are using it. I don't think there's even an issue about that. I mean, the kids have their computers with them. They haul them home, bring them in. One of the things we really talk about is if a kid doesn't have a device, what happens? It's not like they're not going to learn for the rest of the day. You've got to go on. It's a tool. It's not a be-all, end-all holy grail of all learning, but you have to treat it as a tool. Kids all had to go through training on it first. That was all embedded. There was training on how to use it. They got little mini courses. Sixth graders or new kids coming in to the district, they get trained on them so they know the rules. They sign off on them. Parents had to come to a workshop, an evening workshop, to learn all the rules, expectations. They had to sign a thing that says their child could have one. If they didn't sign it, they didn't get one. We did have some families that did not want their kids to have one. We made it clear that they will be using one at school. It's not an option that they don't have one. They don't have to take it home, but they will come in and check one out in the media center. They'll have it for the day and check it in before they leave. They need to learn to use the technology.

She referred to using technology when asked about resources that are available. Part of her answered contained an example of a discussion she was apart of,

> What's nice now – and we had a big discussion – is we really don't want to be teaching Word. We don't want to be teaching Word; we want to teach word processing. The kids can go, and there are Pages on their computers. The kids' computers all have Pages. They have Word, and they also have Google Docs. Everything is available, and they can multi-platform in whatever works the best. You can't just teach one thing because they only know how to do one thing, but they're so intuitive now, even me, if I'm looking at the same thing, it's word processing with a few tweaks.

Again, she referenced technology use when she was asked what technology skills/concepts should be taught in schools. Her answer included using tools,

> Kind of like what we were talking about, that they know how to use a basic spreadsheet, know the functions of word processing, just know how to make presentations and adapt them to any platform that you're working on or anything that your college or employer tells you that you need to have. Those are some of the basic ones.

A quote used previously as evidence for student engagement is also connected to technology use. She stated,

> So, we had little things for them to do, 'Okay, I want you to go to Pages and you are going to change your background, and you are going to do this and save it,' and they walk through a list so they know how to use that. I think that's probably just the ground level of what they were doing. Then the teachers would come up and show them, 'This is the action,' and kids just kind of took off running. Once they had it, they had no fear. We gave them time built in to play at the end of each segment, so we had a Pages segment, a numbers segment, a presentation segment, and then time to play.

Another quote that was used previously for technology integration and student engagement also is associated with technology use. School District Curriculum Director C answered the question, who should be responsible for teaching technology to the students,

> I think it's a combo. I know some of our elementary instructional coaches will go into rooms and do things and show them not necessarily teaching the tech, but maybe showing how to use it in the science lab or something that they're seeing the tech being used. It's not, 'Sit down; turn it on; do this and that.' It's, 'I'm going to use the monitor that's attached to the iPad and measure these things and watch what happens on here,' or take the iPad out and do a nature walk, taking pictures and coming back in and sharing them on Apple TV. Each kid can share it up there, 'Look what I found,' and stuff like that. Just modeling it and showing how it can be used.

It is evident by her responses to the various interview questions that she was very focused on technology use.

School District Curriculum Director E1 seemed to focus on technology use as well when he answered the question what do you know about teaching technology,

> There's a lot to read in to your question. I still don't know that I know, so I'm just going to share with you. I taught technology classes. I was a computer teacher at the high school. Obviously, instruction related to technology, like teaching students how to use Office products or teaching students how to design websites, that has drastically changed, even the last 10-15 years, because that is a really basic skill at this point. It's a very basic skill that probably should be done in fourth or fifth grade or even earlier maybe versus 10 years ago, we were teaching that to freshmen. I would hate to teach that to freshmen now because they would laugh. For now, we're shifting what we've taught or what we teach

> to things that are more applicable like you and I talked about. Now, it's moved to teaching our high school students about networking and still about web design and about advanced graphic design and architecture. To me, it's far more sophisticated material we're teaching them, which I think is great.

School District Curriculum Director E2 jumped in and added,

> I think at the elementary level – you kind of gave an example at the high school level. I think at the elementary level, it's more about how to stay safe on the computer, how to access appropriate websites, how to know what is an appropriate website and what isn't an appropriate website and how to do research, giving them those foundational skills, too. That's not really technology, but it's how to use it appropriately and in the right forms and capacity.

This answer was seen previously when examining online safety/cyber safety.

When asked what technology skills/concepts should be taught in schools a portion of School District Curriculum Director E1's answer talked about technology use. He said, "So helping set the stage for why you need to be able to do this, so showing them the real-life application and again, using, modeling what you want them to learn by using it in the instruction."

School District Curriculum Director D touched on technology use when she answered the question what technology skills/concepts should be taught in schools,

> I think that's a big debate that we're having right now. I think certainly, there needs to be attention to functions of the productivity tools. I think the old way to do things was to focus on Microsoft Word or Excel, and I think now there are so many different resources at the fingertips of our kids that they need to have functionality. An internal debate we're

> having is we have a lot of beliefs that we still need to be teaching Office because it's what the workforce is going to require of the kids. I can see some of that. Through advisory committees, that is some of the feedback we get from business partners, but I think having transferrable skills and problem solving or knowing, 'Here's the tool, but there are different tools that will accomplish the same task.' I think they have to have the critical mindset of understanding what tool would fit what need, which is kind of where the ISTE standards were taking us. I absolutely think digital citizenship and continue to focus on that respect. Responsible use of technology is absolutely key as well.

This answer was used previously to highlight the connection to cyber safety/online safety yet it is relevant to technology use as well.

School District Curriculum Director B referred to students seeing everyone in the school using technology and that should be the culture of the school. She believed,

> Well, I think it should be a culture, an environment, but the classroom teacher is going to have the direct content and do the instruction. But I do think it's a culture in a building so kids know that it's their classroom teacher, but if they go in to see the school counselor, they are familiar with technology and are using technology, or the building administrator is using technology. It's just a way of life.

School District Curriculum Director A alluded to technology use when she was asked what resources were available to teach technology. She explained,

> When you get into all those vast tools that are available on the internet (some of them are free; some aren't), all those things come to mind. The iPad is nice because the days of the old airliners now is done with Apple TV. Then I think Skyping, I always want to talk about those free web 2.0 tools that we already have. Let's get into that. We don't have to

spend millions. There are all kinds of things we can get into for kids. I think all of those kinds of things are available.

These essential skills/knowledge/concepts rate low on Bloom's Taxonomy. Integration of technology by teachers into their lessons and teachers using technology as student engagement would not register on Bloom's Taxonomy since the teachers are using the technology in their instruction. Cyber Safety/Online Safety concepts has the potential to rate between the Remember and the Apply taxonomic levels depending on how they are taught but they are still on the lower half of the scale. Technology use by the students, depending on the activity, rates between the Understand level to the Apply taxonomic level. These perceived best practices are summarized in Table 10.

Table 10: School District Curriculum Directors Perceived Best Practices

School District Curriculum Directors Perceived Best Practices	
Term	Frequency
Integration of tech	17
Student Engagement	14
Cyber Safety/Online Safety	13
Technology use	13

The next theme that emerged with six codes is the Curriculum Directors Perceived Barriers. All of these codes had a frequency between 1-2. Those codes with a frequency of two were technology changes rapidly, need to have a technology culture, and financial issues with trying to add more technology. School District Curriculum Director B spoke of the constant changes when asked about what she knew about teaching technology. A portion of her answer cited a personal example in her previous position as a principal. These answer was also used the preceding section on technology integration but it also illustrated the issue of constant change. She said,

> I was a middle school principal or assistant principal for 26 years prior to that. I opened a new building during that time. At the time, it was – it had all the latest technology that was smart technology and document cameras and all those kinds of things. It was 2004 when we opened. We were built and opened to be a technology school. People who were hired to help open this school and teachers also had to have a passion for technology. And then of course, it changes so rapidly – the tides of technology. But that was a constant in that building that teachers integrated technology into their instruction and integrated rather than replaced something…

Later during the interview when asked about what technology skills/concepts should be taught in schools, she hinted at the perceived barrier of constant change. She explained,

> … I think the challenge is when we're talking about a middle school or even a high school kid, 1) where do we find people who can teach those? Again, thinking ahead and not just what is current, but who knows what? And then, providing that ongoing – addressing the change that is going to continually occur.

Another barrier that was referenced was the idea of having to have a technology culture, School District Curriculum B believed this to be a necessity. The researcher marked this as a perceived barrier because without it difficulties arise in adoption. When asked who should be responsible for teaching it to the students she stated,

> Well, I think it should be a culture, an environment, but the classroom teacher is going to have the direct content and do the instruction. But I do think it's a culture in a building so kids know that it's their classroom teacher, but if they go in to see the school counselor, they are familiar with technology and are using technology, or the building administrator is using technology. It's just a way of life.

This answer was used previously to illustrate the perceived best practice of technology use but it also exemplifies the barrier of needing a technology culture.

School District Curriculum Director B also spoke of the perceived barrier of financial issues associated with technology when asked what she knew about teaching technology and a follow up question on computer science concepts. A portion of her answer included a reference to finances. She explained,

> Interesting that you should ask that question because one of the things – at the middle school, they have an option to take a computer class. At the high school, there are some computer classes, but again, we are right now looking at high school curriculum and what we need to be teaching so that kids five years from now will have what they need rather than – had a conversation recently and a student was asking if we could include Java in curriculum, which is great, but Java has been around for a while, and there's a lot more out there and a lot more coming. That's kind of where we are right now. And of course, with [the state's] finances right now, it's difficult to add anything. That's what – we're really looking toward the future and what we need to be doing for it. There are some things in place but not – I would say it's still developing.

Later in the interview she mentioned finance issues again. This instance occurred when she was asked how technology should be taught to her teachers so they can teach it to students. In part of her answer she commented,

> Well, in the flipped classroom conference, I went with some teachers from our district, and again, the sessions that were most valuable were the sessions that were taught by teachers who were utilizing this in their classroom. Then, I think – and what we've done as a district is we can send so many people because of finances. Well, then they're

coming back and putting some things into place because they're comfortable with it, but then they're training other teachers. That trainer of the trainer model, I think, is the best in education.

Perceived barriers were very minimally referred to in the interviews of School District Curriculum Directors but the researcher believed they were a reflection of the current state of technology from the district perspective and could cause ambiguity when teaching technology. These perceived barriers are highlighted in Table 11.

Table 11: School District Curriculum Directors Perceived Barriers

School District Curriculum Directors Perceived Barriers	
Term	Frequency
Technology changes rapidly	2
Need to have a tech culture	2
Financial issues associated with technology	2

The final theme from the interviews of district curriculum directors was their perceptions about teachers. Fifteen codes were produced and created this theme. They have a range of frequency of 1-5. At the top of the theme there were two codes that were mentioned five times within the five interviews; small group professional development for teachers and teachers own responsibility to learn technology on their own time.

School District Curriculum Director A referred to small group professional development when she was asked how should technology be taught by your teachers to students. Part of her answer included small group professional development. She said,

I think that providing – I don't like to do technology training in a room with 200 people because I think really only about 10% will stay with a person the entire time. I think that's where the smaller group where it's less threatening, where I get to ask questions along the way; people can sit and help each other, that pacing piece where the teacher has

it up and the student learner can follow along and see that. I think having that up and we're pointing and talking and, 'Now, do this,' – this may be my perspective, but I also like when directions or pictures are along with it. So, that's – when I'm learning technology and you want me to stick with you and tell me you did the lesson, those are the kinds of things you can do for me.

School District Curriculum Director D shared the way her district trains teachers. She explained,

We start out with some initial directed professional development, and that was around the devices and getting familiar with IOS and OS operating system and tools. And then, we identified – we called them our tech leadership cadre of 135 teachers, so there were two at every elementary school. Then our middles school and high school, we identified more just because of the numbers and staff, we though it to be more appropriate. Those were teacher leaders that were then subbed out when we rolled out all the devices, so four times a year, they got targeted professional development for a full day around projects like project-based learning – challenge-based learning is the way we phrased it – literacy projects in the classroom with technology, math and science and then exposure to all of the iLife, iWork tools… That was the targeted professional development that we started with. This year, we shifted our model a little bit. Instead of pulling people out and then going back in to the buildings to provide support this year, we went to an instructional coaching model. We have 18 coaches right now in the district that go out and provide that site-based support for teachers. That's been successful, but what we're finding is they're getting pulled in a million different directions, and it's not always technology-specific, but it's supporting instruction, which I think is okay… The coaches themselves

> come together every Friday for their own PD and sharing, so there is their network, getting resources spread… That's how we train our teachers.

School District Curriculum Director C had a similar answer to the question of who should teach these skills/concepts to the teachers. She shared,

> We use the trainer's trainer thing, and I have an instructional coach – two at the high school, two at the middle school and one in each elementary. They've kind of been my vanguard. Actually, in Apple world, that's what they're called. Apple, when you do Vanguard training, sends – you pick 20 teachers at your building who are your movers and shakers and early adopters, and when they came in – we didn't hand out the devices until January, but in August, teachers started their training. All teachers did an intensive workshop on Apple in August and then were given their devices. Vanguard's 20 then – and this is coaches involved in there – they had an additional 12 hours until the time that they were handed out. So, they had way more background on how to teach with it, how to troubleshoot, how to do everything. Those 20 people are embedded in your faculty. We made sure they were in every department and all of that. They're on the ground, and I think teachers listen to other teachers well, but then we also bring Apple people back.

School District Curriculum Directors E1 and E2 spoke of small group professional development in terms of differentiation. They answered the question how are your teachers prepared to teach technology to their teachers. School District Curriculum Director E2 explained,

> Another thing we do as a district, especially for this year, is when we rolled out the Google Apps for Education, at least kindergarten through 4th grade, we provided differentiated technology opportunities for them to come over, and they kind of walked with their feet as far as where their expertise was. So, did they want to learn more about

> Gmail, about Google Docs, Google Drive? Then we even had the additional piece of Google Classroom because lots of teachers were interested in that. So, just providing that professional development to staff.

School District Curriculum Director E1 also spoke up about their Technology Integration Specialist at the high school. He said, "That is the largest part of her job – to provide professional development individually, to groups about how to utilize and incorporate technology into instruction." This quote was used previously to emphasize the perceived best practice of technology integration yet it also shows the focus of professional development on small groups. School District Curriculum Director B referenced small group professional development when she was asked who should be responsible for teaching it to the teachers. She explained,

> I think – I don't think there's one person. I think T&L division should be a part of that, although I do think that probably the building administrator has obviously daily contact and knows individual teachers best. I think they are critical. I also – we always had a technology committee in our building of teachers, and they were always the go-to people. They had different strengths and different skills related to different types of technology and programs, and that was always communicated at the beginning of the year. 'If you need help with this, here's your go-to person.' But we also met regularly to talk about PD or what we might be pursuing to include in the buildings.

The next belief about teachers that came to light with the same frequency as small group professional development was teachers' own responsibility to learn technology on their own. School District Curriculum Directors E1 and E2 clearly stated this belief when they were asked who should be responsible for teaching it to the students. School District Curriculum Director

E2 immediately responded, "Part of it is professional responsibility; I'm sorry." School District Curriculum Director E1 agreed,

> Yes, because everybody – 95% of the people who buy these are not standing there going, 'Where is my professional development for how to use this?' They go home and if they really can't figure it out because you still have to look for some of it, you get on YouTube or do a search and find out how to fix it. You don't rely on someone else to tell you how to do it.

School District Curriculum Director E1 continued his thoughts,

> Yes, so they absolutely have a professional responsibility to keep up with it because their time does not allow us to do it all, and it's moving too rapidly and a lot of individual interest in these different things. We would never be able to teach every teacher everything they want to know… A lot of it is the teachers' professional responsibility.

School District Curriculum Director D spoke of teachers learning on their own time in terms of PLN (Personal Learning Networks) when she was asked the question who should be responsible for teaching technology to the teachers. She believed,

> We have a lot of teachers – really, with technology, a lot of our teachers, I find, are on social media. I use Twitter exclusively for professional purposes, and it is amazing to me the Twitter chats and the ongoing PD and the networking and the PLN that can develop through that. I love it – we have a lot of teachers who have bought into that, so that's how we tell our story. Throughout the day or maybe right after school, we'll see people jump on and they're sharing the cool projects from their classroom, but then in the evening or on weekends, I'll see those same people that are on the chats and hashtagging, and then we can back-channel and follow and learn from each other.

School District Curriculum Director A briefly touched on the teachers own responsibility when asked the follow up question, should these same skills/concepts be taught to teachers she explained,

> I think it needs to be something we do even in my level through our IRT's [Instructional Resource Teachers] and curriculum coordinators so that we're modeling different ways technology can be used even teaching teachers, whether it's explicit or not, that they are continual learners in technology.

Later when she was asked who should be responsible for teaching technology to the teachers she said, "I think it's both. I think teachers need to be learners. I think that's our feel; that's what we do. But I also think school districts need to won a critical piece of that as well." School District Curriculum Director C alluded to teachers using their own time when she was asked how were her teachers prepared to teach technology to their students. She shared,

> There was a lot of uncertainty at first, but now, I think it's so second nature. They've been doing a lot more, but we were really working on the 21st Century stuff up to having all these great plans in the district when we were right to the point where kids needed to have their own devices. You could only do so much. Without the kids each having a device, there's not much you can do. We were right at that point, and that's when Common Core came, so that kind of blew all professional development time out of the water and realigned the standards and all this. So, we were way back anticipating this, and we were looking at it. We had it all laid out, and then we got sidetracked. We kind of got back on that and kind of going down that point now. I think because we've done it for years, I don't think we were as bad as we thought, especially since they had that whole semester to play, knowing the expectations. I can't say everybody had the utmost

understanding. Some are going way above; some are just surviving until they retire, doing what they need to do.

These two beliefs about teachers, small group professional development and teachers own responsibility to learn technology on their own, have been outlined in Table 12. While the codes weren't as numerous as in perceived best practices, these two beliefs add to the ambiguity surrounding teaching technology.

Table 12: District Curriculum Director Beliefs about Computer Teachers

District Curriculum Directors Beliefs about Computer Teachers	
Term	Frequency
Small group Professional Development for Teachers	5
Teachers own responsibility to learn tech on their own	5

Overall, the District Curriculum Directors believed that the best practices for teaching technology included technology integration and student engagement by the teachers. Other best practices included Cyber Safety/Online Safety and technology use by the students. Very little emphasis was on high-level taxonomic levels such as Evaluate or Create. They highlighted barriers such as rapid changes in technology, needing to have a tech culture, and financial issues concerning purchasing technology. Finally, they also had very specific beliefs about computer teachers. Strangely, they stated that small group professional development was important but computer teachers needed to do it on their own time.

University Professors of Education Technology Courses for Preservice Teachers.

The final section of data collected were from interviews of five university professors that teach education technology. These professors created one hundred twenty-three codes. This group created more codes than any other group that was interviewed. The codes that emerged

were divided into two groups University Professors of Education Technology Courses for Preservice Teachers Perceived Best Practices and University Professors of Education Technology Courses for Preservice Teachers Perceived Barriers.

The group that was examined first was University Professors of Education Technology Courses for Preservice Teachers Perceived Best Practices. This group had a frequency range from 1-31. Similarly to the district curriculum directors, there were many and varied responses at the lower frequency ranges. The top code by far with a frequency of thirty-one times it was mentioned throughout the five interviews of university professors of education technology courses was technology-use. The next two codes have a frequency of fourteen were integrating technology as the focus of the course and preservice teachers learn by doing. The final code in the top third of the codes with a frequency of thirteen was project-based learning as shown in Table 13 at the end of this section.

University Professor A referred to her focus of technology use several times throughout her interview. When asked, what are the components you consider when designing your lessons plans, she declared,

> It has to be practically used in the classroom, being used by real teachers out there in the classrooms someplace. It might not be right here in [the state]. In my travels – I travel and do professional development all over the country – so who knows where I've seen it, but I've seen it. I also read tons of teacher blogs and websites, and I pay strict attention to what they're talking about that they're doing in their classrooms. That's kind of how I start to structure my lesson. My class, sadly, is only a 1-hour course. They're supposed to know everything they need to know about integrating technology into their classroom in a 1-hour class.

University Professor A also spoke of technology use in part of her answer when asked how students learn best,

> I ask them to tell me what their two favorite tools were that we use – two favorite apps. We're using iPads dominantly, so I want to know the two apps they use that they love the most. Usually, there's a choice of apps. Once in a while, I don't give them a choice because some app is so awesome that they need to know it. But that really gives me a direction for the next semester, what they liked and what they didn't like and how they thought about using that in their own classroom. That's the key. Whatever we use, they have to come up with a way to use it in their own classroom. It's hard for them in the beginning of their teacher education, but it gets them started down that road of thinking about how they're going to put it into a lesson. We do the lesson. I create the lesson as if they're my third graders or ninth graders, whatever they are. Then they do the same thing. That's kind of how I plan.

When asked how do you design your technology lessons, University Professor A responded,

> I'm going to show them how to do it. I'm going to show them some demonstration projects. We're going to brainstorm ideas for how they could us it in their classroom because it would be wonderful if students were divided by elementary and secondary. But they're not, they're all mixed. We will talk about how it could be used in a social studies classroom, in an English classroom. We'll go through all the different content areas of quite a few of them and then brainstorm out loud what they could do. Then, I kind of put them on it and tell them to make a project.

University Professor A shared a situation that illustrates her emphasis on technology use as best practice. When she was asked what technology is available to her students she relayed,

> Oh, everything. Last year, at the end of the year, we had some money that was called One Time Classroom Money. I had some things – I had two of them myself that I purchased on my own called The Osmo. It's a really neat game you do with the iPad. I would share it in class, but I had two of them and 40 students. I planned all kinds of other things with all these stations where you did all this kind of stuff so they could rotate through. It was really a stressful day for me to try to plan enough stuff to keep them all busy to get their turn on the Osmo because really, the point was the Osmo. We had this one-time classroom money and I applied for it, so now, I have a classroom set of them. You only need one per two students. You don't need one for everybody. So I have a classroom set of them, and I really am only going to use them once in a semester. I'm going to show them to them, "This is what they are, what they can do, how you can use them in a classroom," and then they're moving on.

Next she was asked who should be responsible for teaching the preservice teachers how to teach technology and within her answer she spoke of the need for a university course to teach how to use tools correctly. She stated,

> If we teach kids how to do it correctly – like, if the only thing they ever know is to post to Facebook, they don't know anything about technology. They need to have a lesson in how to post to Facebook correctly. The other thing – email. We need to be giving kindergarteners email, and we need to teach them how to use it. Ever year in school, we should up the ante for learning to use email. I don't think email as a way of communication is going away anytime soon…But I think we need to teach kids how to use email correctly and safely and with purpose. They can start out by emailing mom and dad an email about what they did in school today. How many standards does that

> meet if you start counting them? It's a book because they're writing. They have to write complete sentences, have to use punctuation. There's an English lesson there. We used to teach letter writing. We don't teach it anymore. Now, let's teach email letter writing if we're not going to teach real letter-writing. We should teach real letter writing, but we all know the reality of that, too. Let's teach them to use email correctly. Let's teach them how to do a proper search. We could spend hours looking for information.

University Professor B talked about technology use when she was asked the comparison question of how do you feel about the content you teach, the content you want to teach, and the content you should teach. She answered the question about what she would want to teach,

> I feel really comfortable and confident about the content I'm going to teach because like I said, I'm good at it, and I feel like teaching it is also about being confident to teach them because I can explain well to the students how this technology is good for teaching, or you can just make the good use of it. I feel very comfortable and confident about it.

When asked what do you think about what you should teach, she shared,

> I think it's more theoretical stuff because I need to combine the theories and the technology together to let them know this is good for teaching because sometimes the students are really confused about why they're learning it. Sometimes they feel like it's silly to learn it, but they realize that it's a good technology they can use in their future teaching. I may have spent more time on the theoretical stuff to make it – to integrate into teaching technology, to make the students realize you're not just doing this course; you're learning some type of technology for you to use in your future teaching.

Next when she was asked how did she teach her students to teach technology to their future students, she explained,

> Like I just said, I tell them they can use it and also tell them why they can use it. Just make – allow the students to make lesson plans integrating the technology they're going to learn in the class. It's not just that I teach them how to use this; I'm going to teach them how to – how you're going to use this technology to teach the students.

When asked a follow up question about is the focus on incorporating devices or the skills/concepts, she replied, "Everything, how to use the technology and how the concept of technology."

University Professor C commented the most on technology use throughout her interview. The first reference was made when asked how she determines what to teach in your content area. She disclosed,

> There are a number of things we look at. I looked at various texts although; I don't use the text for the class. I just do it online. Determine the needs of the student – the graduates that go out in their surveys about what's needed in technology. We've gone to Google Forms and all the forms of Google, various websites that run enhanced curriculum. Because I'm a reading teacher myself, I'm pretty familiar with things that can be used in the classroom that are productive for students and not just silly things. That's how it's determined.

When asked how she knew if her students met the outcome for her lesson or activity, she shared,

> The class I teach is an online class. I have to see the product, whether it's a review of an item or actual usage of something. For instance, whatever that they've actually been on it and done it; I have to see evidence that they've been on it.

University Professor C also answered in terms of technology use when she was asked, what are the components you consider when designing your lesson plans. She stated,

> Usefulness for a teacher, a whole section on proper use of the Internet, how to determine whether websites are legit or not. We do a section on Cyber bullying. Basically, it's usefulness to a teacher and how they best use whatever it is. If it's something that's too hard to use or costs too much money, we don't bother with it. What's the point?

Next University Professor C was asked the comparison question, how did she feel about the content she teaches, the content she wants to teach, and the content she should teach. Her response to the initial question was,

> I think they hired me to teach it just because I was using a lot of technology in the classroom. When this class started, they wanted somebody who had practical knowledge and not just – who's been in a classroom, who's used it in a classroom, who's used it to supplement both in the practice way and also a production way and creative way. That's what I try to do.

When asked the question about the content she would want to teach, she said,

> It's a 1-hour class. I have to be careful because you can't load them down with too many things. Cover the hot spots, like I was talking about before. It's a new topic. We do – they did want to make it a half semester, but I insisted on a full semester because I think we need that many separate hits with the various things. We do a week of websites and all kinds of classroom tools, a week of iPad apps where they have to view and go over how they would use it and what they would do in the classroom. You can't do too much of that all at once or it loses its impact.

The next question was about how did she teach her students to teach technology to their future students and she responded,

> Again, because it's an online class, they have to do a lot of things. I give them things that they need to look at. The only way to learn to teach technology is to use technology because it changes. Well, you know. I could teach them how to set up a Google Doc and Google form and all of that, and within a year, Google is going to do something different. All you can teach them when you're teaching a technology class is to instill in them the need to teach themselves because it just changes too much. That's why I don't use a textbook and why I have to, at the beginning of every semester, go back and recheck my links. I still had a broken link mid-semester this year.

University Professor C acknowledged technology use clearly when asked how she designed her technology lesson plans,

> Again, they offered to buy me a textbook. I mean they're out of date before you've even used them, and to read about technology is not the same as to use technology. And I'm a reading teacher, for pete's sake, and I'm all about reading, but not in this particular class, not how I view it. Things may change. They may start saying that I have to do this, this and this or whatever. I'll make my case for what I do. The final in this class is where they design a website that acts as a portfolio for things they've done both in the tech class and various things they've created through this as well as an opportunity for lesson plans, but they can use it to show an employer. It's not the same kind of – it's not a final that stops.

When asked if there was any technology available for her to use at her university she spoke of technology use. She described,

> The technology I have available to me I have available to me because I'm a teacher here. The technology – because it's not online, I have no need for it. It's not like I have to go

> over there – I know they have a Smartboard. I know they have some things like that over there to use with the kids, but because that's not the way this class is taught – when we first started doing it, it was in-house, and we all came together. There's really no need, not for what I want them to do…We talk about it, go over it, and show them the uses of it. It's interesting because in the years I've taught it – and I've taught this for six years now, I've watched as the kids who are taking the class knew a lot about the Smartboard now. But when I first started, they'd never seen it before. They thought it was the coolest thing since sliced bread. It's amusing to watch as the districts have them more now than when we did back when I was there.

Her last reference to technology use as a best practice occurred when she answered the question, how do you believe preservice teachers should be prepared to teach technology to their students. She declared,

> I think they should be prepared to use it by using it, to create something, to do something. We have them do a creative website with at least four pages, and one of them has to be a blog page and stuff like that. They have to have – they have to feel like they made something. Knowledge is great and fun, but if you're not going to use it for something, don't use it. Use something else. I guess the best way I would like to see them is maybe use it all over the classrooms for at least one lesson. You're going to have access to this. You're going to have to use it. Use it. Don't write me these boring lesson plans that are 18 pages long and the only time you use it is when you show the YouTube video at the beginning of the lesson as their preset. Sorry, that's not it.

University Professor D spoke of technology use when she was asked how did she know if her students met the outcome for her lesson or activity. She shared,

> Well, it depends. Everything I do is hands-on. We don't have a typical test, so everything is hands-on. There's a lot of group projects. There is a reflection for everything that they do. I use it to guide my instruction, because it's based on educational technology for the classroom, of why I would be using this, how I would use it and what purpose it's going to serve. I try to keep the productivity instead of the consumable piece of the educational technology. Does that answer your question? I think that their outcome is based on, 'Did they get it?' I will even use that piece for part of a rubric in terms of if they got it. We'll do an activity based on how they might teach in the classroom, and that's how they learn the tool. We don't do the old, 'Click there, click here, and click here.' We do, 'Here is it. This is the outcome we want.' For example, if I wanted them to learn some of the Google apps, whether Docs, Slides, spreadsheet, I used – it changes every semester so far, but I used the political campaigning. They were not given a choice of what candidate they had to support nor who they worked with. There was a lot of uneasiness, but that was where we wanted them to go – to have a little disruptive learning piece. Through that, they learned collaboration and what all Google Docs can have. They did a collaborative piece whole class on the slides, and then we did our debate, and they had to stand and support their candidate, which they probably didn't want to do. That was a lot more powerful for them to learn how to use those tools, and it gave almost a little example of how they would take it into the classroom.

When asked what are the components she considers when designing your lesson plans, she explained her process, which included technology use,

> We have elementary and secondary students; I get both in my classroom. Plus, I'll have some gen Ed students in my classroom as well. They can take this class. It's generally elementary and secondary education folks. So, absolutely I have to know what is driving that, but I also try to get what's most current and what I feel is most relevant. That is going out into those districts and seeing what is going on. I still stay in contact with a lot of districts to know what they're expecting the preservice or new teachers coming into the field to know, to find out what they're using. That's a lot of the guides that we use. We always fill curriculum first, always instruction first. Then if the technology works, it works. If not, then it's not worth using.

University Professor D expressed her opinion on best practice and teaching her students to teach technology to their future students in terms of technology use. She stated,

> It's by experience and modeling, so what we do in the classroom – and we talk a lot about how they would use it. Everything goes back to, 'And how would you use this?' And that's where we have a lot of discussion afterwards. I use their feedback, and we do a lot – when I say they synthesize or evaluate and reflect at the end – so, it was, 'What did you learn? Was it purposeful? Would you use this in the future? How do you see yourself using it?' A lot of it is, 'How do you see yourself using it?'

She shared an example when she answered the question how do you design your technology lessons. A portion of her response was related to technology use,

> I'll give you an example. I have gotten to become – we call each other colleagues – with the person who developed – the co-developer of Quiziz. It's a formative assessment tool similar to Kahoot. He's in India, and he wants the feedback of educators and even preservice teachers. We have connected on a base where he comes into our classroom

> virtually, and I will teach that educational resource. We'll use it so they know how to use it, and then we will use it within, and they will fire off questions. Sure, learning the tool is important. Formative assessment is really, really important for them to get that skill down, but it's as important to me that they learn that their voice matters, and these educational resources that are being – and that he really listens to what they want and just to know they have that voice is important as future educators.

When asked about the technology available for her to use as a teacher at the university, part of her answer spoke to using technology everyday,

> Students can bring their own devices, but that could be all over the place. We have Smartboards, whether they're mobile or in the wall. We have carts of iPads, carts of Chromebooks. We have carts of laptops that I can reserve. I reserve - usually the Chromebook and iPad is just constantly reserved for me, but a lot of our other teachers are using them, too. At least, that's pretty much what I use, and we use a device every day that they're in class. We do have – I let them bring their phones in. We use phones, their Smartphones. If they have their own device, they can use it, but if we're doing something specific – let's say Chromebook because so many schools right now are dealing with Chromebooks – then I want them to use a Chromebook. I try not to be – I like a lot of choice because I would hope that the perfect K-12 would be if there were all those different devices and students could choose which device best fit their needs. I like to do that piece, whether it's right or wrong, but I really like for them to be able to do that. There are some specialized pieces. We want to do some experiments and some hands-on, and so whether that's the Makey-Makey or Google Cardboard. I can't have enough for a 1-1 on those, but I have enough that we'll do some experiments with those.

> Again, those will be really open-ended. 'Here it is.' 'Well, how do we use it?' 'I don't know how you use it. Figure it out.' So, there's not a lot of spoon-fed, which I would hope that they're doing that as well with their students, that they're letting them explore and be creative. It's really fun to watch the creativity when it's that. XXXXXXX has been really great with making those resources available to us.

The final time she spoke of technology use was in her response to the question of who should be responsible for teaching the preservice teachers how to teach technology. She voiced,

> At the university level, I would say that in the College of Technology, each one of us should be responsible for that. That's being done through modeling. It's not that I'm teaching you something; I'm showing you. I'm using it. That's what I really think. Then I think we can go into it. My course – Technology for the Classroom – I can go to different levels there. This probably doesn't make sense, but I think it would be okay for our preservice students to teach those instructors that haven't been using technology in the classrooms to maybe make suggestions. I think the technology – it's a lot of give and take of being open to, 'Hey, can we use this?' I think our faculty in the College of Ed here at XXXXXX is a very collaborative group, so we talked a lot about restructuring where we're in exploration together, so the technology for the classroom – because they've already seen there's a lot that comes from the Technology for the Classroom course that when they bring up things, 'Oh, yes, you can use that,' and being more open to student choice of things they've been exposed to, the same as if they need something from me, I am more than willing to go into – if I'm free and not teaching class – to go in and talk about a specific resource that might be helpful in what that professor is teaching. I will still say that it's all our responsibility because technology is not a novelty anymore;

> it's what it is here. How do we teach kids? I don't think it's one person's responsibility to do that.

University Professor E implied technology use when she described the components she considers when designing her lesson plans,

> Okay, so what we do here is our technology courses are aligned with our sequence courses, so we work very closely with the sequence course instructors. We see what their projects are and what their content is that they're covering, and we try to align that with various technologies that can support their projects that they do in their courses. For instance, when they are learning how to develop concept maps to structure their units, we would expose students to various programs that allow for concept mapping. We would – if they are learning about how to incorporate a hook or an anticipatory set, in my class, we focus on using and finding video that's engaging and then using softwares that alter the video to make it more student-interactive. Popcorn is now gone, but we used to use Popcorn as software. Now, we use a software, which is through YouTube. So, we try to align our tech course with whatever is occurring in the actual sequence course to help it be somewhat embedded.

She talked specifically about technology use when she was asked how she taught her students to teach technology to their future students. She explained,

> I think we've really worked hard to take it away from this idea of professors using technology and recognizing it needs to be our students using technology and then to also help our students see that it's not just about them using technology; it's about them designing their learning environments to allow their future students to use technology. We talk a lot about the SAMR framework, and that's what we really focus on in

> Sequence 1 Tech, just helping them understand what the levels of integration are and what effective levels of integration look like or the various levels of integration so that just the idea of being good stewards of our resources and how – at the substitution level, is that really the intention of these multi-million dollar projects that districts are using to purchase technology. If we stay at the substitution level, is that a good – are we utilizing those resources like we should? Are we being good stewards of that funding? That's kind of how we try to frame the first sequence. That lays the foundation for the rest of the sequences.

University Professor E spoke of technology use when asked what resources are available to her for teaching technology,

> In my course, I'm specifically teaching different types of programs, but what we're trying to do is, with the faculty, 'When you have a project, here's a list of options you could provide your students with.' If they want to add to that list, if they know of something even better, we can expand that list. Students could possibly say, 'Hey, I know of an app that does that same thing that I like to use, so could I use that one instead?' 'Sure, you could use that one possibly for the project,' and then we would add it to our list. I think student input on our list of various resources and technologies works as well. They come to us with a lot of tech savvy. What they don't have is the framework to think pedagogically about how to use that to foster student learning. That's where we see our job as teacher educators.

When asked what resources are available to the students, University Professor E explained the access and use of Smartboards (interactive whiteboard). She shared,

> They use our Smartboards. They'll use any other resources we have. While our Smartboards are used as projectors and interactive learning, they're all trained in the use of that so they can maybe use it in the future as a classroom teacher.

The last time University Professor E referred to technology use was when she was asked how she believed preservice teachers should be prepared to teach technology to their future students. She explained,

> We don't have a technology teaching certification right now. We're getting that. We approach it that they may not be teaching technology. Is this where you're going with that? They're teaching content and using technology to support their content. That may look a little different.

The next two codes that arrived at the same frequency of fourteen were technology integration and preservice teachers learn best by doing. University Professor B spoke specifically of technology integration in several parts of her interview. When asked the comparison question on how she felt about the content she teaches, the content she wants to teach, and the content she should teach, she referred to technology integration,

> I think it's more theoretical stuff because I need to combine the theories and the technology together to let them know this is good for teaching because sometimes the students are really confused about why they're learning it. Sometimes they feel like it's silly to learn it, but they realize that it's a good technology they can use in their future teaching. I may have spent more time on the theoretical stuff to make it – to integrate into teaching technology, to make the students realize you're not just doing this course; you're learning some type of technology for you to use in your future teaching.

This answer was also used as evidence of technology use in the previous section but yet it also counts toward the technology integration code. University Professor B answered the question of how did she teach her students to teach technology to their future students in terms of technology integration. She explained,

> Like I just said, I tell them they can use it and also tell them why they can use it. Just make – allow the students to make lesson plans integrating the technology they're going to learn in the class. It's not just that I teach them how to use this; I'm going to teach them how to – how you're going to use this technology to teach the students.

This answer was also used as evidence of technology use as a best practice however; it is also considered technology integration by the researcher. She spoke of technology integration and interactive whiteboards,

> I think Promethean Board is really a good one, Activinspire software because every classroom can integrate it in every class, every lesson and can integrate it for teaching every kid. They can collaborate together. It's a great collaboration tool. I think the iPad is really popular right now and maybe Mac if the school can afford those. Those are good.

Next when asked about how she believed preservice teachers should be prepared to teach technology to their future students, she responded,

> They have to do the activities. They have to have problem-solving skills and do some project-based learning. They should do that. They cannot just stay in a classroom and listen to the teacher. They have to collaborate. They have to integrate into the teaching and learning. It's two ways. It's not just one way to integrate information. You have to respond to the instructor how you react to the learning.

University Professor E hinted at technology integration when she was asked about what components she considers when designing her lesson plans. She shared an example of how they embed technology into their program,

> Okay, so what we do here is our technology courses are aligned with our sequence courses, so we work very closely with the sequence course instructors. We see what their projects are and what their content is that they're covering, and we try to align that with various technologies that can support their projects that they do in their courses. For instance, when they are learning how to develop concept maps to structure their units, we would expose students to various programs that allow for concept mapping. We would – if they are learning about how to incorporate a hook or an anticipatory set, in my class, we focus on using and finding video that's engaging and then using softwares that alter the video to make it more student-interactive. Popcorn is now gone, but we used to use Popcorn as software. Now, we use a software, which is through YouTube. So, we try to align our tech course with whatever is occurring in the actual sequence course to help it be somewhat embedded.

This answer has also used when discussing technology use in the previous section yet it also speaks to the idea of technology integration. When asked the comparison on how she felt about the content she teaches, the content she wants to teach, and the content she should teach, University Professor E talked about her overall opinion of her program, which pointed directly at overall technology integration. She revealed,

> I think we have a lot of autonomy to look at what the expectations are and then figure out strategies to do it, just the idea that we're supposed to be experts in our field. A couple of philosophical issues I have are with what we do with the standards to the actual practice.

> The idea of technology being this additional course that the candidates have to take – so while we're trying to have it be somewhat embedded, and we're working with the professors to try to have it be seamless, it still is disjointed, I believe. I think it may have been in the design of the course. I think it's almost somewhat archaic to have separate technology courses. My belief is that technology is an environment, not an add-on. Therefore, as professors in our regular or our sequence or math method courses, we should be embedding it within those courses instead of having this add-on course that may or may not align with one another. I think also, when you do that, the professors have the idea that they don't necessarily need to teach technology because we have a technology instructor who will take care of the technology and they can just teach their courses instead of realizing that it needs to be embedded. That seems to be a philosophical debate that we have continually. Another technology instructor and I are really trying to encourage the faculty or department to look at how we have that currently designed and maybe rethink that a little bit.

University Professor E shared how she taught her students to teach technology to their future students through SAMR, the scale used to measure technology integration. She explained,

> We talk a lot about the SAMR framework, and that's what we really focus on in Sequence 1 Tech, just helping them understand what the levels of integration are and what effective levels of integration look like or the various levels of integration so that just the idea of being good stewards of our resources and how – at the substitution level, is that really the intention of these multi-million dollar projects that districts are using to purchase technology. If we stay at the substitution level, is that a good – are we utilizing those resources like we should? Are we being good stewards of that funding? That's

> kind of how we try to frame the first sequence. That lays the foundation for the rest of the sequences.

When asked who should be responsible for teaching the preservice teachers technology, she referred again to embedding it in the program,

> I would love to see even – I know most professors wouldn't want to take away courses, but I would love to see technology embedded in every course such that we don't have three technology courses align. Maybe we have a foundational course to teach the framework; however, I think technology is best embedded through all coursework and not seen as this add-on in the curriculum.

It seemed that this professor used the term embed, which the researcher inferred to mean integrate based on the answers that were provided.

University Professor A spoke of technology integration in two different examples. The first example was used in the previous section on technology use however it also illustrated technology integration. She answered the question how do students learn best and part of her answer hinted at technology integration,

> I ask them to tell me what their two favorite tools were that we use – two favorite apps. We're using iPads dominantly, so I want to know the two apps they use that they love the most. Usually, there's a choice of apps. Once in a while, I don't give them a choice because some app is so awesome that they need to know it. But that really gives me a direction for the next semester, what they liked and what they didn't like and how they thought about using that in their own classroom. That's the key. Whatever we use, they have to come up with a way to use it in their own classroom. It's hard for them in the

> beginning of their teacher education, but it gets them started down that road of thinking about how they're going to put it into a lesson.

The second example she gave was an answer to the question, who should be responsible for teaching the preservice teachers how to teach technology to their future students. She shared,

> I give my students a choice sometimes of what app to use for whatever assignment. Sometimes, there are 10-12 apps, and sometimes, they find an app I didn't even know about. It's okay. You're going to teach kindergarteners; he's going to teach high school physics. The same app probably isn't going to work. Use the suggestions. But by giving them suggestions, now I've given them a direction of what to look for when they're looking on their own. I think choices are always a good thing. I think the days of having to run to Walmart and get a piece of poster board so my kids can make a poster are gone because now I can do that with all kinds of digital tools that aren't going to cost me any money. I hear school districts say that they can't go 1-1 because they can't afford it. I can't really say my answer to that on tape, but that's just a load of hooey. It's in how you spend your budget. Budgets can be restructured because ultimately, it's going to save you money. Think about the cost of a textbook. How much money do we waste on textbooks that we don't use? They just take the textbook money and start buying digital textbooks and put them on our devices. How many teachers really use textbooks much anymore? There are a few. I'm always mortified when I walk into a teacher's classroom and she's got the teacher's guide in her hand, walking around the room – that spiral version of it and she's spouting it to the letter. Not that there isn't great information in those; there is. But you need to adapt it to the 30 kiddos in your classroom because those textbooks are written for everybody being this perfect kid, and we know that's not the

case. But that's where technology can help us in the classroom. I remember years ago early in my teaching career, we started talking about how eventually every kid would have an individual IEP. I can remember being panicked about that, thinking, 'Oh my lord, how are we going to do that?' But that whole idea doesn't panic me so much anymore because of technology. I can individualize and differentiate instruction because of technology much easier than I could before technology. I can customize it. I mean, I teach in a classroom with people that are going to be everything from kindergarten teachers to high school physics teachers. I'm differentiating on the fly all the time. But it's not that hard to do. I don't even realize I'm doing it most of the time. It can be done. You've just got to think outside the box a little bit, don't follow the list and guide… But I think the mistake that the school districts are making is they don't provide any professional development. I mean, if they do, it's an hour here or there, and they just expect you to go do it. That's not going to cut it. I don't know how much professional development was done in your world, but if it was just the one day I know about, I'm worried because I think more is needed. They're starting in the middle of the year, which I don't think is a bad thing. This spring, not a lot will be done with it. It will just be the kids having fun with them, and the teachers will kind of get to know them. But there needs to be a boatload of professional development over the summer next year for these teachers to figure out how to get it integrated into the course work because they don't have time to change their whole course right now for the spring. They're going to do a few things with it. Most of them will be looking up things on the internet. And that's the reality of it. But it can happen, and it can be super successful. But I don't think it will

> ever be successful without professional development, and not just a day; they need to invest in it.

University Professor D also referred to technology integration when asked about the components she considers when designing lesson plans,

> We have elementary and secondary students; I get both in my classroom. Plus, I'll have some gen Ed students in my classroom as well. They can take this class. It's generally elementary and secondary education folks. So, absolutely I have to know what is driving that, but I also try to get what's most current and what I feel is most relevant. That is going out into those districts and seeing what is going on. I still stay in contact with a lot of districts to know what they're expecting the preservice or new teachers coming into the field to know, to find out what they're using. That's a lot of the guides that we use. We always fill curriculum first, always instruction first. Then if the technology works, it works. If not, then it's not worth using.

This quote was also used as evidence previously for technology use yet it also implies technology integration.

She also spoke specifically of technology integration when she answered the question, how do you believe preservice teachers should be prepared to teach technology to their future students. She indicated,

> I will tell you that when the students come in to my course, because they're education majors, they have not gone through the lesson planning process. The first time I taught this as adjunct, I covered lesson plans, and I realized really quick – and again, it's 16 weeks to do that – there was no way to do an efficient job of best practice of lesson plans. I know most universities have their own structure of doing lesson plans and different

> theories. I would always refer back to the ISTE lesson plans because I think it covers everything so well when you're wanting to make sure you integrate technology and crossover and even through the differentiation or – so, I guess to answer your question, technology needs to be the last thing that's put into a lesson plan. It's got to be the standards you're wanting to meet, the goals and objectives you want your students to learn and if technology makes sense to that. If I was able – and again, if I had the class, once they got out in the schools and I could see the lesson plan or objective or standard they were going for, you could have those richer, deeper discussions about if technology would make a difference, or would pencil and paper – we do a lot of comparison if we're just replacing – we talk a little on the SAMR model because these are sophomores. They don't – they haven't experienced that. I'm not sure I answered that question sufficiently enough because I don't do lesson planning. We talk about it. We touch on it. We don't dive deep because they haven't – my course is not the introductory course, and we don't go deep at all into lesson planning.

University Professor D also focused on technology integration when she explained her answer to who should be responsible for teaching the preservice teachers how to teach technology. She said,

> At the university level, I would say that in the College of Technology, each one of us should be responsible for that. That's being done through modeling. It's not that I'm teaching you something; I'm showing you. I'm using it. That's what I really think. Then I think we can go into it. My course – Technology for the Classroom – I can go to different levels there. This probably doesn't make sense, but I think it would be okay for our preservice students to teach those instructors that haven't been using technology in

> the classrooms to maybe make suggestions. I think the technology – it's a lot of give and take of being open to, 'Hey, can we use this?' I think our faculty in the College of Ed here at XXXXXX is a very collaborative group, so we talked a lot about restructuring where we're in exploration together, so the technology for the classroom – because they've already seen there's a lot that comes from the Technology for the Classroom course that when they bring up things, 'Oh, yes, you can use that,' and being more open to student choice of things they've been exposed to, the same as if they need something from me, I am more than willing to go into – if I'm free and not teaching class – to go in and talk about a specific resource that might be helpful in what that professor is teaching. I will still say that it's all our responsibility because technology is not a novelty anymore; it's what it is here. How do we teach kids? I don't think it's one person's responsibility to do that.

This answer was used previously as evidence of technology use yet also exemplifies technology integration.

As stated earlier, two codes occurred with the same frequency. Technology integration and preservice teachers learn by doing appeared fourteen times. University Professor D referred to learning by doing the most frequently in her interview. When she answered the question how do you know if your students met the outcome for your lesson or activity, she shared, "Well, it depends. Everything I do is hands-on. We don't have a typical test, so everything is hands-on. There's a lot of group projects. There is a reflection for everything that they do…" She referenced this idea again when she was asked how preservice teachers learn best, "Hands-on, applied learning. I think they – I think also we do a lot of discussion boards. Those discussion boards are a through campus; that's our learning management system…" The next time the idea

of learning by doing appeared was when she was asked the comparison question on how she felt about the content she teaches, the content she wants to teach, and the content she should teach. She commented on wanting to do more hands-on activities in her answer. The professor stated,

> I think there's a little bit of a balance of what I think is working well and what I want to do. I want to push more and get a lot more into some coding, a lot more into that. We're doing some experiments this next time, but I'd like to get hands-on, but those hands-on pieces sometimes cost more money than – and I really don't want students to have to purchase those types of things.

University Professor D touched on students needing to experience situations when answering the question how did she teach her students to teach technology to their future students. She explained,

> I really don't want to just teach them a tool because they can go, and the internet has made the world flat, but they can go and look up anything on the internet and learn anything. I don't have any magic bullets that are going to give them the answer, but if they can experience it the way it would be if they were in a K-12 classroom, then I think we've done a good job.

Another instance of University Professor D expressing the idea of learning by doing was when she answered the question is there technology for you to use as a teacher at your university. She explained,

> I like a lot of choice because I would hope that the perfect K-12 would be if there were all those different devices and students could choose which device best fit their needs. I like to do that piece, whether it's right or wrong, but I really like for them to be able to do that. There are some specialized pieces. We want to do some experiments and some

> hands-on, and so whether that's the Makey-Makey or Google Cardboard. I can't have enough for a 1-1 on those, but I have enough that we'll do some experiments with those. Again, those will be really open-ended. 'Here it is.' 'Well, how do we use it?' 'I don't know how you use it. Figure it out.' So, there's not a lot of spoon-fed, which I would hope that they're doing that as well with their students, that they're letting them explore and be creative. It's really fun to watch the creativity when it's that. XXXXXXX has been really great with making those resources available to us.

This answer was also used as evidence for technology integration but it also figured into the learning by doing code as well. When asked what technology concepts should be taught in preservice teaching programs so they can teach their future students, University Professor D replied,

> We need to prepare them for what's out there and for us to be, I guess, naïve to think that anyone has all the answers of what it's going to be without constantly looking and changing, we've just – we've got to be aware. Information literacy is huge. Google Docs, Google apps for education – everybody seems to be going to that platform, so students do need to be aware, and a lot of students aren't aware of that. So, whereas an institution of higher ed might be totally using Office products that I love, we also need to expose them to something else. I guess we need to prepare them for not what we feel because we don't have all the answers, and we need to prepare them for everything as well as we can that's out there. For us at a higher ed level, we need to get out there in K-12. We can't sit in four walls and assume we know what K-12 needs. We can read about it, but we need to be – we need to be out with the folks doing it and understanding and seeing it. Then that's what we need. Those are the skills we need.

University Professor A spoke about learning by doing when asked how she felt preservice teachers learned best,

> By doing it. Sitting there listening to me doing it and having me show them how to do it is valuable because some kids need to be shown how to do it. They can't figure it out themselves. Or they don't have enough confidence to figure it out themselves. I have every confidence; they just don't have the confidence. People say, 'Oh, those college students, they must know how to do everything.' They're really good as social media, but that's about it. But once they get into it and realize that, 'This really isn't all that hard. I can do this.'

When asked the question on how she felt about the content she should teach, she added,

> The whole Chromebook idea, not that it's a lot different from a computer, but it's so Internet-based that I really think there are some things they need to know about that. I bring one in one day and kind of show them, but again, you're back to the teacher lecture, sit and get, and I don't like to do it that way. I would prefer for them to have one that they do hands-on. If it isn't hands-on, it's less than effective. That would be the one thing I would change.

University Professor A focused primarily on learning by doing when answering the question, how do you teach your students to teach technology to their future students. She described,

> By doing it. They have to demonstrate that they can do it. They're out there looking for examples. They're seeing examples of it being done. They're reading teacher blogs and websites. They have to do that every single week so that they're getting some firsthand information from somebody besides just me. Sometimes, they'll look at me, and I know they're thinking, 'This woman is loony tunes.' But then they start reading these teacher

> blogs, and I have lists of them that they choose from. They begin – it takes them a while in the semester, but by the time they get to the end of the semester, they realize that, 'Wow, everybody is doing this. I better get myself in gear and figure out how to do it.' I don't think any of them are going to truly figure out how to do it until they get into a classroom and have to do it. I hate to say it's 'fly by the seat of your pants time' but it is. Until they actually have to do it with a room full of thirty third graders staring at them or 8th graders or high schoolers, you can plan until you're blue in the face; it doesn't mean anything until you have to actually do it for real. What I'm trying to do is give them the skills so they can do it.

She spoke of learning by doing again in her answer to the question, what technology concepts should be taught in preservice teaching programs so they can teach their future students.

> I think the key is doing it. It's got to be hands-on. We've got to let kids make things. I mean, if we stop and think about all these robotics programs – look at Legos. Look at the success of Legos. Why are Legos so successful? Because kids are doing things with their hands. I think that's the key. We have to let them do it. We can't just tell them about it. They have to do it.

University Professor E spoke of learning by doing when she was asked the question of how preservice teachers learn best. She reasoned,

> I think they learn by doing best. I guess that's probably my paradigm. I was a science teacher before. That's what we do. We pose a problem at the beginning of class. We talk about a concept with technology, and then the students do the rest of the hour practicing. I focus a lot on the idea that they need to experience it, so they need to experience the frustrations of figuring technology out. I do not ever take them

> specifically through something step by step to show them because I talk about the need for them to be adaptive experts because that technology I could show them today changes tomorrow. We provide them with – I always provide them with several different options to complete their project, and then they choose the option that's most fluid for them or what they find to be the easiest. Then the next class period, they talk about which one they chose and why they chose it, what the benefits were for – like for instance, if they chose Yogio over – what's the other one we use – Screen Castomatic – why they would make that choice.

University Professor B voiced her thoughts on learning by doing when asked how did she believe preservice teachers should be prepared to teach technology to their future students. She said,

> They have to do the activities. They have to have problem-solving skills and do some project-based learning. They should do that. They cannot just stay in a classroom and listen to the teacher. They have to collaborate. They have to integrate into the teaching and learning. It's two ways. It's not just one way to integrate information. You have to respond to the instructor how you react to the learning.

This answer was also used as evidence of technology integration yet it also talked about learning by doing. Frequently codes can overlap as we have seen in many of the previous sections. University Professor C talked about learning by doing when asked the same question on how preservice teachers learned best. She quipped,

> Depends on the student. You know that! I don't think there's any one best way for any student. I think for some, being online is helpful, and using a computer. For others, touching it and doing it, building it is better. I've worked with too many kiddos through

> the years of teaching when I was in the classroom. There's no one way. You have to hit it all. You can't just sit them in front of a computer. It's nice and helpful, and it can do some nice things, but that's not going to teach them anything.

The final perceived best practice was project-based learning. University Professor A spoke of project-based learning when she was asked how do you know if your students met the outcome form your lesson or activity. She responded,

> Every project we do in class gets posted to their website. If they can get it done and get it posted to the website, they probably have learned how to do it; they've accomplished it.
>
> The evaluation comes from the finished product. It's project-based learning times 100.

When asked how she designs her technology lessons she shared about her projects,

> I'm going to show them how to do it. I'm going to show them some demonstration projects. We're going to brainstorm ideas for how they could us it in their classroom because it would be wonderful if students were divided by elementary and secondary. But they're not, they're all mixed. We will talk about how it could be used in a social studies classroom, in an English classroom. We'll go through all the different content areas of quite a few of them and then brainstorm out loud what they could do. Then, I kind of put them on it and tell them to make a project.

This quote was also used as evidence in the previous section for technology use as well as evidence for project-based learning.

University Professor E touched on project based learning when she responded to the question about what components she considers when designing her lesson plans. She explained,

> Okay, so what we do here is our technology courses are aligned with our sequence courses, so we work very closely with the sequence course instructors. We see what their

> projects are and what their content is that they're covering, and we try to align that with various technologies that can support their projects that they do in their courses. For instance, when they are learning how to develop concept maps to structure their units, we would expose students to various programs that allow for concept mapping. We would – if they are learning about how to incorporate a hook or an anticipatory set, in my class, we focus on using and finding video that's engaging and then using softwares that alter the video to make it more student-interactive. Popcorn is now gone, but we used to use Popcorn as software. Now, we use a software, which is through YouTube. So, we try to align our tech course with whatever is occurring in the actual sequence course to help it be somewhat embedded.

This quote was also used previously to exemplify technology use and technology integration as well as project-based learning. It overlapped all three codes. University Professor E mentioned project based learning a second time when asked how preservice teachers learn best,

> I think they learn by doing best. I guess that's probably my paradigm. I was a science teacher before. That's what we do. We pose a problem at the beginning of class. We talk about a concept with technology, and then the students do the rest of the hour practicing. I focus a lot on the idea that they need to experience it, so they need to experience the frustrations of figuring technology out. I do not ever take them specifically through something step by step to show them because I talk about the need for them to be adaptive experts because that technology I could show them today changes tomorrow. We provide them with – I always provide them with several different options to complete their project, and then they choose the option that's most fluid for them or what they find to be the easiest. Then the next class period, they talk about which one

> they chose and why they chose it, what the benefits were for – like for instance, if they chose Yogio over – what's the other one we use – Screen Castomatic – why they would make that choice.

Again, this quote was used in the previous section to highlight students learn by doing but it also shows the use of projects in the courses.

University Professor B talks frequently about project based learning, albeit briefly though. When asked how do you know if your students met the outcome for your lesson or activity, she replied,

> Actually, I just gave out some assessments for how they're going to do the project and also quizzes and exams – quizzes; I didn't give any exams because it's a technology class, so we give them the credits based on the outcome of their project…Yes, class performance and also the outcome of the projects.

Next when asked how preservice teachers learn best she suggested,

> Through the class attendance or performance, I can tell which one is engaged in learning and which one is not. Also, I can just tell from their projects how they do if it is a project based on my requirements.

She also conveyed her opinion on how she believed she should teach her students to teach technology to their future students. The professor shared, "I ask them to create a lesson plan or create a project and how you're going to teach in the classroom." Next, she was asked if there was technology available for her to use as a teacher at the university. She replied,

> I teach two classes. One is entry-level technology. It's Instructional Technology for Educators. Another one is Advanced IT for Educators. In the Advanced IT, I used Mac system, so we use Macbooks and the iPads. There is some software installed on the Mac

> – Apple Movie, Apple software. We use that, too, for projects, so students making their own movies using iMovie and creating their digital storybooks like iBooks.

She referred again to project-based learning when asked how she believed preservice teachers should be prepared to teach technology to their students,

> They have to do the activities. They have to have problem-solving skills and do some project-based learning. They should do that. They cannot just stay in a classroom and listen to the teacher. They have to collaborate. They have to integrate into the teaching and learning. It's two ways. It's not just one way to integrate information. You have to respond to the instructor how you react to the learning.

This answer was in as previously as evidence for technology integration and students learn by doing but it also reflects project-based learning. It overlaps all three codes.

University Professor D spoke of project-based learning one time when she answered the question, how do you know if your students met the outcome for your lesson or activity. She answered,

> Well, it depends. Everything I do is hands-on. We don't have a typical test, so everything is hands-on. There's a lot of group projects. There is a reflection for everything that they do. I use it to guide my instruction.

This answer was also used previously as evidence for technology use.

Table 13 below compiles the codes and outlines the frequency of the top three perceived best practices for University Professors of Education Technology Courses in Preservice Teaching Programs from universities in a midwestern area.

Table 13: University Professors of Education Technology Courses Perceived Best Practices

University Professors of Education Technology Courses Perceived Best Practices	
Term	Frequency
Technology- Use	31
Integrating Technology is focus of course	14
Preservice teachers learn by doing	14
Project based	13

The next theme that was drawn out of the data were the University Professors of Education Technology Courses for Preservice Teachers Perceived Barriers. Within this theme there are twenty-five codes ranging from 1-13 shown in Table 14. The top code with a frequency of thirteen was technology changes rapidly. University Professor D referred to technology changing rapidly as trying to stay current and relevant. When she was asked how do you determine what she taught, she explained,

> The first thing that I look at is current trends and innovation trends. Then I have been out in districts so my main focus would be preservice teachers. I see what they're going out to, and I talk to those teachers and administrators that are out in districts and what their needs are. We can send our preservice teachers out to do a lot of different things, but we need to make sure we're staying as current – and I have found that a lot of K-12s can sometimes be more current in what's going on because they can, because they have had to, because they're the feet on the ground, the boots on the ground.

She then spoke of relevancy and currency when she was asked about the components she considers when designing her lesson plans,

> We have elementary and secondary students; I get both in my classroom. Plus, I'll have some gen Ed students in my classroom as well. They can take this class. It's generally

> elementary and secondary education folks. So, absolutely I have to know what is driving that, but I also try to get what's most current and what I feel is most relevant. That is going out into those districts and seeing what is going on. I still stay in contact with a lot of districts to know what they're expecting the preservice or new teachers coming into the field to know, to find out what they're using. That's a lot of the guides that we use. We always fill curriculum first, always instruction first. Then if the technology works, it works. If not, then it's not worth using.

This quote overlaps several codes, it was seen previously in the technology use section and the technology integration section.

University Professor D answered the question how do you design your technology lessons with references to constant change. She stated,

> We touch on things that are beyond just the use of a tool because I want them to be able to be whatever they consider a 21st century learner to be now. It seems like that's old phrase to me. But they will collaborate; they will communicate; they will connect, and it's not all about just a device and how to use the device in the classroom. Absolutely, I look at those standards, and I have goals and objectives for what they get out of it. That's always the back end of their reflection. I always tie that back in. 'Is this what you learned?' I'm very open. I think I said this before: I'm student-driven. If I get enough comments back – and I really push for honesty on this from them – that if it was something that didn't make sense or didn't work, because it is technology and there is a little more flexibility, I either redo it or move on to something else. I don't want to repeat that. It's constantly changing, so I feel like I'm constantly changing with it.

When asked if there was technology for her to use as a teacher at her university, she spoke of the different technology that was available to her but then she tied in the changing of technology into the transformation of the public school classroom. She shared,

> Something that we also really work hard at is changing that learning environment to – we really want to – we really – I think something – and this may tie back into what I would wish and want – is that we could have a learning environment that looks like a classroom they're going to walk into in the future, and that would be constantly changing, too. They could be sitting on the floor. They could be wherever they could be most comfortable learning because that seems to be now as big of a push as the device that they're using.

She again addressed constant change and staying current when she was asked what technology concepts should be taught in preservice teaching programs so they can teach their future students,

> Though I spend time on what I feel is important that they know, I want to make sure that it is something they're going to see out in those K-12 districts because most of the K-12 administrators I've talked to are assuming they're going to come out with those skills already. We need to prepare them for what's out there and for us to be, I guess, naïve to think that anyone has all the answers of what it's going to be without constantly looking and changing, we've just – we've got to be aware… there's something that we do at the beginning, and it's, 'In the year 2020, would you be considered illiterate if you didn't know how to look up information correctly?' We have a big discussion, and students get pretty worked up about it. Bottom line is if you can't look up and discern what's real on the information that's been fed to you – and so we do examples of that – then that might

be the same as being illiterate because that's all you're going to have pretty much as time goes forward. It's an exciting time because everything is changing, and I love it when students can come back and say, 'Oh my gosh, we covered it.' Smartboards, sure they're going to need interactive boards some, but a lot of that is fading away because of the devices that are being held. The old document cameras, not a lot of schools are purchasing that. I would say when I talk about K-12, being in contact with those K-12 institutions to know that when those Smartboards are going out or whatever they have, they're not replacing it…We've got to be able to figure out – if students can use their phone and get some good use out of students using phones, then I'll probably focus a lot more on phones or things that I know they're going to see. I don't have a checklist of what they should learn. I mean, I do, but that changes. I wish I could say they should know where home row is with their little fingers when they keyboard, but that changed as soon as we started texting. I see a lot of really efficient keyboarders that hunt and peck and can type just as fast. But I think keyboarding skills are still just extremely important and not relying on spell check.

University Professor C remarked about technology and change when she was asked about how she taught her students to teach technology to their future students,

Again, because it's an online class, they have to do a lot of things. I give them things that they need to look at. The only way to learn to teach technology is to use technology because it changes. Well, you know. I could teach them how to set up a Google Doc and Google form and all of that, and within a year, Google is going to do something different. All you can teach them when you're teaching a technology class is to instill in them the need to teach themselves because it just changes too much. That's why I don't use a

> textbook and why I have to, at the beginning of every semester, go back and recheck my links. I still had a broken link mid-semester this year.

This code was used as proof of technology use as a best practice earlier as well. University Professor C added a bit more to her answer she said,

> You know, it's there one minute and it's not the next. I just don't think you can – it's not where you can sit down with a book and learn it. I think you have to learn how to learn, learn how to find things. One week, we do things on educational blogs where they have to go and read all these technology blogs and find what they need or want to keep up with. Those are the ways they're going to keep up with it.

She was asked how she designed her technology lessons and she spoke of the opportunity to order a textbook but felt it would be out of date,

> Again, they offered to buy me a textbook. I mean they're out of date before you've even used them, and to read about technology is not the same as to use technology. And I'm a reading teacher, for Pete's sake, and I'm all about reading, but not in this particular class, not how I view it. Things may change. They may start saying that I have to do this, this and this or whatever. I'll make my case for what I do. The final in this class is where they design a website that acts as a portfolio for things they've done both in the tech class and various things they've created through this as well as an opportunity for lesson plans, but they can use it to show an employer. It's not the same kind of – it's not a final that stops…It just never does, and there is no way you just took a technology course and never think about it again and then go out and teach.

This answer was used previously in the technology use section; it overlapped with the code technology is constantly changing. Also when asked if there was technology for her to use as a

teacher at the university she explained that the technology she has was because she was a reading teacher at an elementary school. She further explained,

> I had an Airliner, and that's what I used in the classroom before we got the Smartboards. I used the Airliner a lot. I haven't picked up – or wouldn't have – since I got the Smartboards. We used to have clickers all the time. We use Kahoot. You don't need that anymore. There's just so much that has changed.

University Professor A spoke briefly on technology changing. She commented on it when she was asked how she determines what she teaches. She mentioned, "My course is kind of a moving target and changes every semester." Also when asked how she designed her lesson plans she indicated,

> I don't use a textbook. They're out of date by the time they come out anyway, and they're expensive and a waste of money because students don't read them anyway. I've reached the point where I've written iBooks. The first iBook I wrote, I did one big book like a traditional textbook. You know, the whole course in one big book. Well, that didn't work. So, I had to refocus myself and evaluate it, so now I've taken that big book and divided it into chapters. Each week, they get a mini iBook, which basically is a handout that has all the materials they need to know before learning an app like Adobe Slate, for example.

Again she briefly touches on technology changing when she was asked what technology concepts should be taught in preservice teaching programs so they can teach their future students, "That's a hard one because regardless of what it is, it's going to be different tomorrow. It's just changing so quickly."

University Professor E spoke of technology changing at different times in her interview. She hinted at it when she was asked about the components she considers when designing her technology lesson plans,

> Okay, so what we do here is our technology courses are aligned with our sequence courses, so we work very closely with the sequence course instructors. We see what their projects are and what their content is that they're covering, and we try to align that with various technologies that can support their projects that they do in their courses. For instance, when they are learning how to develop concept maps to structure their units, we would expose students to various programs that allow for concept mapping. We would – if they are learning about how to incorporate a hook or an anticipatory set, in my class, we focus on using and finding video that's engaging and then using softwares that alter the video to make it more student-interactive. Popcorn is now gone, but we used to use Popcorn as software. Now, we use a software, which is through YouTube. So, we try to align our tech course with whatever is occurring in the actual sequence course to help it be somewhat embedded.

As noted several times previously codes overlap and this quote has been used before to highlight technology use, technology integration, project-based learning, and now technology change. She also referenced technology change when she answered the question how did she feel preservice teachers learn best. She declared,

> I think they learn by doing best. I guess that's probably my paradigm. I was a science teacher before. That's what we do. We pose a problem at the beginning of class. We talk about a concept with technology, and then the students do the rest of the hour practicing. I focus a lot on the idea that they need to experience it, so they need to

> experience the frustrations of figuring technology out. I do not ever take them specifically through something step by step to show them because I talk about the need for them to be adaptive experts because that technology I could show them today changes tomorrow. We provide them with – I always provide them with several different options to complete their project, and then they choose the option that's most fluid for them or what they find to be the easiest. Then the next class period, they talk about which one they chose and why they chose it, what the benefits were for – like for instance, if they chose Yogio over – what's the other one we use – Screen Castomatic – why they would make that choice.

This answer was used as evidence for learning by doing and project-based learning. She referred to constant change as "adaptive expertise" when she was asked what technology concepts should be taught in preservice teaching programs so they can teach their future students,

> I think I've already talked about Adaptive Expertise – they need to know how to roll with it. I think that's something our candidates really struggle with. It seems on my evaluations for my courses, there are always 3-4 complaints about how I didn't walk them step-by-step through every project. Though I explain it and they probably could tell you adaptive expertise is something – that was my mantra for the year – they still have that desire to have me hold their hand and walk them through the process. So, I think that's the biggest thing as teachers. They have to learn to adapt to the culture, to the learning environment, to society. That's just at the core of what we do as educators. That's probably the biggest one of the foundational skills that I think our candidates need to have.

University Professor B alluded to technology change when she referenced what she wanted to teach, she explained, "The content that I would like to teach – the content we decided before making the syllabus is – we add something new every semester. The syllabus is changing every semester."

The next two perceived barrier codes had a frequency of nine. They were 100% control/autonomy over content for course(s) and course is taught before the preservice teachers take education courses (it is a prerequisite class). The autonomy over the class became a barrier in terms of time spent developing the course. University Professor A referred to her autonomy over the course when she responded to how she determines what she teaches,

> I'm the only one who teaches it, so I have total, 100% control, but I make those decisions based on what I see out in schools and what I see teachers doing and what technology I see teachers using. So, if I'm not seeing it or reading about it on teacher blogs and websites or Twitter feeds or social media that I follow in education, I'm probably not going to teach it.

She also hinted at her time spent working on resources for the class as a barrier due to her complete control over the course. She said,

> I don't use a textbook. They're out of date by the time they come out anyway, and they're expensive and a waste of money because students don't read them anyway. I've reached the point where I've written iBooks. The first iBook I wrote, I did one big book like a traditional textbook. You know, the whole course in one big book. Well, that didn't work. So, I had to refocus myself and evaluate it, so now I've taken that big book and divided it into chapters. Each week, they get a mini iBook, which basically is a

> handout that has all the materials they need to know before learning an app like Adobe Slate, for example.

This answer was used previously as evidence of technology change but it is also relevant to time spent creating resources for the course.

University Professor E agreed that autonomy was somewhat of a barrier for her when she answered the comparison question of how she felt about the content she teaches, the content she wants to teach, and the content she should teach. She began, "I think we have a lot of autonomy to look at what the expectations are and then figure out strategies to do it, just the idea that we're supposed to be experts in our field."

University Professor D implied time spent locating information on the current trends and school district needs to create content for her courses when she answered how she determined what to teach. She explained,

> The first thing that I look at is current trends and innovation trends. Then I have been out in districts so my main focus would be preservice teachers. I see what they're going out to, and I talk to those teachers and administrators that are out in districts and what their needs are. We can send our preservice teachers out to do a lot of different things, but we need to make sure we're staying as current – and I have found that a lot of K-12s can sometimes be more current in what's going on because they can, because they have had to, because they're the feet on the ground, the boots on the ground.

This code like several others was previously used as proof for another code, technology changes. The next time she referenced this time spent gathering data from outside sources when she responded to the question on what components she considers when designing her lesson plans. She shared,

> We have elementary and secondary students; I get both in my classroom. Plus, I'll have some gen Ed students in my classroom as well. They can take this class. It's generally elementary and secondary education folks. So, absolutely I have to know what is driving that, but I also try to get what's most current and what I feel is most relevant. That is going out into those districts and seeing what is going on. I still stay in contact with a lot of districts to know what they're expecting the preservice or new teachers coming into the field to know, to find out what they're using. That's a lot of the guides that we use. We always fill curriculum first, always instruction first. Then if the technology works, it works. If not, then it's not worth using.

This quote overlaps several codes, technology use, technology integration, technology change, and autonomy over the course.

University Professor B implied the time issue as well when she explained how she determines what to teach,

> We have three, including me – I'm sorry – one faculty and two adjunct faculty members including me. Every week, we have a meeting together before classes, and then we decide what to teach this week. Then before the semester starts, we kind of have a meeting to create a syllabus together and then decide what we need to do and everything. Then every week, we have a meeting to decide what we will teach in that week. That is how we determine.

She again hinted at the issue of time when explaining the components she considers when designing her lesson plans,

> We gave out surveys for questionnaires before class and then test to see how the students are familiar with technology and what tasks they may have to do or what difficulties they

> may have encountered in the class. Then, maybe change the syllabus a little bit and all the required assignments based on the same level for – the level can be adapted to everyone here, not just the kids that are too high or too low.

The other barrier code with the same frequency as autonomy over content was course was taught before preservice teachers take education course. University Professor D referenced this issue when she answered what components she considers when designing her lesson plans. She shared,

> We have elementary and secondary students; I get both in my classroom. Plus, I'll have some gen Ed students in my classroom as well. They can take this class. It's generally elementary and secondary education folks. So, absolutely I have to know what is driving that, but I also try to get what's most current and what I feel is most relevant. That is going out into those districts and seeing what is going on. I still stay in contact with a lot of districts to know what they're expecting the preservice or new teachers coming into the field to know, to find out what they're using. That's a lot of the guide that we use. We always fill curriculum first, always instruction first. Then if the technology works, it works. If not, then it's not worth using.

This code has been used previously in several of the above sections. The codes embedded within this answer are plentiful and have been used to depict perceived best practices such as technology use and technology integration while also illustrating perceived barriers such as technology change and autonomy over content. She also explained in further detail the issue of having the students too early in their preservice teaching program when she responded to the comparison question on how she about the content that she teaches, the content she would want to teach, and the content that she should teach. She indicated her frustration,

> I feel that – I wish I could spend a longer period of time, and if I could design anything at this level, being only a year into this, I would design – my course is such, I feel, a broad stroke. I'd like to be able to narrow it down and break it out and be able to come back with those students when they are assigned a building, a preservice teacher, and they know what technology is out there, and bring that lesson plan. Let's talk about it rather than just imagining something that might happen in two years because they're not out – when they come to me, they're generally sophomores, so they haven't gone through – they're not in a building. That's what I feel I should be doing so it makes more sense to them, but if I could spend more time on information literacy, more on global connections and stay consistently with productivity because there is – so much of what we do is consume, and we don't produce. It's got to make sense. Again, all that mixed together – those three different levels – I think something would come out. Having those kids make connections that will last them beyond higher ed and graduation and get them to where we want ourselves to be as educators right now and give them a door out there.

She acknowledged this issue again when she answered how she believed preservice teachers should be prepared to teach technology to their students,

> I will tell you that when the students come in to my course, because they're education majors, they have not gone through the lesson planning process. The first time I taught this as adjunct, I covered lesson plans, and I realized really quick – and again, it's 16 weeks to do that – there was no way to do an efficient job of best practice of lesson plans. I know most universities have their own structure of doing lesson plans and different theories. I would always refer back to the ISTE lesson plans because I think it covers everything so well when you're wanting to make sure you integrate technology and

> crossover and even through the differentiation or – so, I guess to answer your question, technology needs to be the last thing that's put into a lesson plan. It's got to be the standards you're wanting to meet, the goals and objectives you want your students to learn and if technology makes sense to that. If I was able – and again, if I had the class, once they got out in the schools and I could see the lesson plan or objective or standard they were going for, you could have those richer, deeper discussions about if technology would make a difference, or would pencil and paper – we do a lot of comparison if we're just replacing – we talk a little on the SAMR model because these are sophomores. They don't – they haven't experienced that. I'm not sure I answered that question sufficiently enough because I don't do lesson planning. We talk about it. We touch on it. We don't dive deep because they haven't – my course is not the introductory course, and we don't go deep at all into lesson planning.

This quote was used as an example of technology integration but it is evident that it also directly relates to the technology course coming to early in the preservice teaching program.

University Professor A spoke of a similar issue when she answered the question how did she feel preservice teachers students learn best,

> I ask them to tell me what their two favorite tools were that we use – two favorite apps. We're using iPads dominantly, so I want to know the two apps they use that they love the most. Usually, there's a choice of apps. Once in a while, I don't give them a choice because some app is so awesome that they need to know it. But that really gives me a direction for the next semester, what they liked and what they didn't like and how they thought about using that in their own classroom. That's the key. Whatever we use, they have to come up with a way to use it in their own classroom. It's hard for them in the

> beginning of their teacher education, but it gets them started down that road of thinking about how they're going to put it into a lesson.

This answer was also used as evidence of technology use in a previous section yet it also addressed the perceived barrier of the technology course appearing to early in the preservice teaching program.

She also spoke of the issue a second time when she responded to how she designs her technology lessons,

> I'm going to show them how to do it. I'm going to show them some demonstration projects. We're going to brainstorm ideas for how they could us it in their classroom because it would be wonderful if students were divided by elementary and secondary. But they're not, they're all mixed. We will talk about how it could be used in a social studies classroom, in an English classroom. We'll go through all the different content areas of quite a few of them and then brainstorm out loud what they could do. Then, I kind of put them on it and tell them to make a project.

This is another quote that has been used before as evidence for best practices such as technology use and project-based learning but it also speaks to the frustration of designing a class to be general because elementary and secondary students are in it together at the very beginning of their preservice teaching programs.

University Professor C briefly mentioned the concern when asked how curriculum, standards, indicators, benchmarks fit into lesson planning, She explained, "Anytime they have a lesson that they have to prepare for me and they have to do three – now some of them are real newbies; they're in their first set of classes at XXXX."

University Professor B hinted at the difficulty for the students to understand the purpose of the class because she taught the class that contained freshmen, sophomore, juniors, and seniors. When asked what she thought she should be teaching she mentioned this issue,

> I think it's more theoretical stuff because I need to combine the theories and the technology together to let them know this is good for teaching because sometimes the students are really confused about why they're learning it. Sometimes they feel like it's silly to learn it, but they realize that it's a good technology they can use in their future teaching. I may have spent more time on the theoretical stuff to make it – to integrate into teaching technology, to make the students realize you're not just doing this course; you're learning some type of technology for you to use in your future teaching.

Like other quotes in this section, they can overlap. This answer was used previously as evidence for the best practices of technology use and technology integration.

University professors believe in technology use as the most essential skills/knowledge/concepts, however just merely using technology does not necessarily equal higher-level thinking. Barriers mentioned by the university professors included technology changes rapidly, 100% control/autonomy over content for the course, and the course is taught too early in the preservice teachers academic career. Table 14 summarizes the perceived barriers of University Professors of Education Technology that teach preservice teachers.

Table 14: University Professors of Education Technology Perceived Barriers

University Professors of Education Technology Perceived Barriers	
Term	Frequency
Technology changes rapidly	13
100% control/autonomy over content for course(s)	9
Course is taught before the preservice teachers take education courses (prerequisite class)	9

Summary

Data were collected from a total of twenty-six participants in a midwestern area. The participants were from six different public school districts and five different public and private universities. Of those participants, there were five fourth grade general education classroom teachers, six middle school computer teachers, five high school computer teachers, five curriculum directors, and five university adjunct and tenure professors. The fourth grade teachers produced the least amount of data with fifty-three codes. The middle school computer teachers and the high school computer teachers produced a similar amount, ninety-nine codes and ninety codes respectively. While the curriculum directors and the university professors both produced over one hundred codes with the curriculum directors generating one hundred nineteen and the university professors yielding one hundred twenty-three codes.

Consensus in the Education Field

Many overlapping themes and some conflicting themes arose from the data of the interviews. Some of these overlapping themes and conflicting themes were expected and some were unexpected. There were very few times those all the interview groups were in complete consensus however there were multiple times when different groups agreed or disagreed. To highlight these differences, the groups were split into elementary level, middle school level, high school level, district curriculum directors, and university professors of education technology. The areas of complete agreement will be discussed first. Areas where four of the five groups agreed will then be emphasized, and then areas where three of the five groups agreed will be highlighted. Finally, there are a couple of areas that have two groups of the five that are in agreement that were somewhat surprising. Table 15 will explain the levels of consensus.

Table 15: Consensus Among Education Field Professionals

Consensus Among Education Field Professionals					
	Elementary School	Middle School	High School	District Curriculum Director	University Professor
Own Time	X	X	X	X	X
Constant Change	X	X	X	X	X
Professional Development Important	X	X	X	X	X
Technology use is priority	X	X	X	X	X
Keyboarding	X	X	X	X	X
Project based learning	X	X	X	X	X
Technology Integration	X	X		X	X
Applications		X	X	X	X
Hands-on	X	X	X		X
Autonomy		X	X	X	X
Time Constraints	X	X	X		X
Emphasis on Bloom's Taxonomy				X	
Emphasis on critical thinking				X	
SAMR	X			X	X
Student Engagement	X			X	X
Broken Down Into Steps		X	X		X
Student Collaboration		X	X		X
Common Core Standards	X				X
STEM			X	X	
Project Lead the Way			X		X
Trained Teacher to Teach Technology	X	X			
ISTE					X

Areas Where All Groups Were in Consensus.

There were six areas where all interviewed groups agreed. The six areas were derived from the main themes from the interview groups. Those areas included using their own time to research lessons or teach themselves the necessary technology, the belief that technology is

constantly changing, professional development is important, technology use is a priority, keyboarding, and project based learning.

All groups agreed that they must spend their own time searching for lessons or teaching themselves how to use the technology. At the high school level it wasn't as a significant however, do to the fact that a majority of the high schools follow a specified curriculum from the state. This typically was interpreted as a barrier for all groups. One concern that is raised for this issue is as teachers are searching on their own, how do they know that the resources they are finding are reputable, reliable, appropriate, and researched based?

Another area of agreement among all the interviews was the idea that technology is constantly changing and it is difficult to keep updated. This was highly significant in the middle school interviews, the district curriculum director interviews, and the university professors of education technology. It was slightly less substantial at the elementary level and high school level. I believe this to be true because typically at the elementary level core subjects are the focus of their school day and little time or effort is allotted to computer science topics therefore they may not be concerned about keeping current with technology and technology concepts. As for the lower significance at the high school level, I believe this is attributed to the curriculum provided by the state of XXXXX, which is connected to funding.

Lack of professional development in teaching technology was a third area of agreement between the interview groups. This best practice code was very significant at the elementary level. This level lacks awareness of technology concepts as a result of how their school day is structured and attempting to get all core subjects covered in one day. The other interview groups agreed that it was an issue and that they lacked quality professional development.

An additional area of agreement on best practice amongst all interview groups was that students are users of technology. This was an expected outcome based on the review of literature performed in this study. This was highly significant at the university level; it was the top code for this group. It was also one of the top three codes for the district curriculum directors interview group. It was less important at the high school and elementary level.

All of the interview groups agreed that keyboarding was a best practice in all teacher groups. In fact at the elementary level and the middle school level, it was the top code in both groups. It was still significantly high, placing in the top five, at the high school level. It was less important at the district curriculum level and the university level.

The final area of agreement between all interview groups is project-based learning and the importance of using this method rather than traditional teaching methods. This was a significant finding at the middle school level, the high school level, and the university level. This area of agreement may stem from the teacher's motivation to solve real-world problems. Project-based learning was mentioned at the elementary level and the district curriculum level but with less significance.

Areas Where Four Groups Were in Consensus.

There were seven areas where four of the five groups agreed. These included focus on technology integration, applications, hands-on, Bloom's Taxonomy, autonomy, time constraints, and critical thinking. There were some unexpected findings in this section. These seven areas were collected from the major themes found in the interviews.

Technology integration was an expected response as a best practice based on the review of literature offered by this study. All groups except the high school level group cited technology integration as a significant best practice. At the district curriculum director level, technology

integration was the top code. At the middle school and university level, it was the second most mentioned code. Technology integration was the third most frequent code mentioned at the elementary level. There was no mention of technology integration at the high school level.

Several different applications were named in the interviews at all levels except the elementary levels. At these higher levels of education, the interviewees named specific apps that students should know as apart of best practice. Twelve apps were mentioned at the middle school level. Fifteen apps were mentioned at the high school level. District curriculum directors mentioned fifteen apps as well. Finally, university professors of education technology suggested only seven apps.

As a best practice hands-on learning was an expected best practice yet not all groups of interviewees agreed which was an unexpected response based on the review of literature presented in this study. At the elementary level, middle school level, and university level hands-on learning was found with high significance. It was mentioned at the high school level but with low significance. Unexpectedly, not one district curriculum director mentioned hands-on learning as a best practice.

A barrier that was very prevalent was the fact that the teacher had the autonomy to decide what to teach. This was viewed as a barrier. Typically, autonomy was connected in their responses to the interviewees having to research online for lessons and resources on their own time. All levels where in agreement except for the elementary level. This may be directly related to the fact that elementary teachers are provided curriculums for all core subject areas along with textbooks to guide instruction.

Another barrier that was highlighted in four of the five interview groups was the idea of time constraints. Time constraints were apparent in all groups except district curriculum

directors. It was a significant code at the elementary level and the middle school level registering at the second most frequent code and the fourth most frequent code respectively. It was mentioned at the high school level and the university level but with less weight.

Finally, two very unexpected findings occurred at this level of agreement; four of the five interview groups did not mention Bloom's Taxonomy or the need for critical thinking. Only the district curriculum directors mentioned both of these items. District curriculum directors oversee all levels of education in the public school system and all subject areas, which is very broad. They are typically well versed in overarching best practices without specific details on specific best practices. There seems to be a disconnection between theory and practice when it comes to Bloom's Taxonomy and critical thinking as was highlighted in the review of literature provided by this study.

Areas Where Three Groups Were in Consensus.

This section is highlighting those codes that three of the five groups were in agreement. SAMR is an acronym that stands for Substitution, Augmentation, Modification, and Redefinition. It is used as a scale used to measure integration of technology into the classroom. Three groups considered it a best practice with some significance. Those three groups included the elementary level, the district curriculum directors' level, and the university level. Two groups did not mention SAMR at all, which were the middle school level and the high school level. The middle school and high school levels have specific computer classes that teach computer concepts while elementary teachers are much more focused on technology integration. District curriculum directors and university professors have more of a broad focus therefore it might explain why SAMR was found more often in their responses.

Another area of some belief alignment with three of the groups in approval was technology as student engagement. The elementary level was definitely the leader in this category; it was the number three best practice alongside technology integration with a frequency of nineteen. The district curriculum directors' also had a high significance of student engagement as best practice with a frequency of fourteen, which listed it as the second best practice for that interview group. University professors mentioned student engagement but it was with low frequency. As previously mentioned the middle school and high school levels have specific classes for computer concepts so those teachers typically see their classes as more than student engagement.

An unexpected area of congruency that appeared with three interview groups was the need for projects, assignments, directions, etc. to be broken down into steps. Middle school teachers, high school teachers, and university professors mentioned this barrier with a frequency of four to five times. This is very interesting to find that after elementary school all levels of education are seeing this issue. At the elementary level, this barrier was not mentioned because almost everything is broken down into steps for the students. This means the problem solving is done for them and they are not learning how to do it on their own. One reason for this is the way elementary school is designed with teachers needing to fit in all core subjects in a short amount of time. It would be easier to break projects, assignments, and directions down into steps for students to follow to save time. However, it is evident that this has become a common issue for middle school teachers, high school teachers, and university professors. The ability to break down problems is a real world application and by breaking down projects, assignments, directions, etc. for students, teachers are actually doing a disservice without realizing the future impact. This ability to problem solve must be addressed at the elementary level for it to improve.

The last area where three of the interview groups were unified was on student collaboration. The middle school group, the high school group, and the university group considered student collaboration a best practice. While the middle school group and the high school group considered it a barrier as well. Student collaboration is another skill that mimics real world application however at the middle school and high school level it was found to be an issue. Many times it was mentioned that students have trouble working in groups and cannot negotiate with each other. This is another source of concern that needs to be addressed at the elementary level as well.

Areas Where Two Groups Were in Consensus.

Only two of the five interview groups agreed Common Core Standards are the national standards endorsed by the United States and have been a focus in education over the last eight years. Interestingly, few interview groups mentioned them as a best practice. Only the elementary level and the university level acknowledged the Common Core Standards as best practice. Very little technology is addressed in the Common Core Standards so it was not surprising that they were mentioned with little frequency. Some teachers mentioned their own district objectives but with very little frequency. The university professors were the only interview group to mention ISTE (International Society for Technology in Education) Standards. It was mentioned with significant amount of frequency, it was in the top five codes for the university professors of education technology courses. However four of the five professors mentioned that the ISTE standards were too broad and generic.

It was expected to see more reference to STEM (Science, Technology, Engineering, and Mathematics). Only two groups mentioned STEM and with very low frequency. The high school mentioned it only two times and the district curriculum directors mentioned it one time.

STEM as been an educational acronym that popped up around the late 1990's (Sanders, 2008). Originally, it was SMET but when an officer of the National Science Foundation disliked the sound of the acronym, it was changed to STEM (Sanders, 2008). One high school teacher in the high school interview group mentioned Project Lead the Way multiple times throughout the interview. It was mentioned so frequently that it became the top code in the high school data with a frequency of twenty-five times. Project Lead the Way is a STEM curriculum that is used by one district out of the five that were interviewed. In addition, the district curriculum director for that district mentioned it but with much less frequency.

According to their website, Project Lead the Way is a STEM Curriculum that began in 1997. Currently it is being used in more than nine thousand schools and is present in all fifty states (Project Lead the Way, 2017). It began as a high school engineering program and has developed into a "comprehensive K-12 pathway" program that includes computer science, engineering, and biomedical pathways (Project Lead the Way, 2017). Their computer science pathway aligns with all Common Core Standards, Next Generation Science Standards, Computers Science Teachers Association standards (Project Lead the Way, 2017). The computer science pathway is only available for the middle school and high school levels.

Project Lead the Way requires an annual participation fee and significant amount of supplies. The required supplies are bought through the website and the average amount for the middle school courses costs about $7,400, this does not include the optional supplies. To purchase the high school courses with materials and fees it costs approximately $10,200, this also does not include the optional supplies. Some supplies can be reused in subsequent years but not all. The costs for both the middle school and high school courses include a registration fee for professional development however ongoing professional development is needed, which

would cost extra. There are three phases to their professional training Readiness Training, Core Training, and Ongoing Training (Project Lead the Way, 2017). The cost of these courses is not feasible for many of the districts in the state because of the current funding issues. Due to the popularity over the last twenty years of STEM, it was expected to see much more reference to this topic then what was measured in this study.

Finally, the topic where only two groups were in agreement is the idea of a trained teacher to teach technology. This was the number one barrier for the elementary teachers with a frequency of twenty. It is evident that they would prefer someone trained to teach technology rather than having the teachers attempt to fit it into their day. The middle school teachers also agreed with somewhat less frequency than the elementary school teachers that there needs to be someone trained to teach technology. High school teachers did not mention this topic but do to the design of high school; teachers are specifically trained in their disciplines. District curriculum directors and university professors did not mention this topic. This was expected from looking at the data since their priority is integration into the classroom. Technology integration in the classroom was the top code for district curriculum directors with a frequency of seventeen and it was the second top code for university professors of education technology courses with a frequency of fourteen. These two interview groups also focused on technology use in the classroom with great significance. Technology use was the top code for university professors with a frequency of thirty-one and it was the third most mentioned topic for district curriculum directors with a frequency of thirteen.

Summary

There are many overlapping themes presented in the data yet very few where all groups were in consensus. This difference in opinion and understanding of technology lends itself to the

ambiguity surrounding what to teach and how to teach it. All teachers that were interviewed were expected to search for lessons on their own time. With all teachers picking and choosing lessons they find or design on their own, there is no consistency or spiral nature to the content. Teachers are not able to build on prior knowledge because they don't know what was taught the prior year with regard to technology or if it was taught at all. One main focus at all public school levels was keyboarding. Keyboarding while somewhat important at the interim is a very low-level rote memory skill yet may be beneficial at the elementary level. Teachers need to move beyond keyboarding as a focus, especially at the middle school and high school levels.

Technology use and technology integration is another overlapping theme that again explains where the focus is on technology. Students need to be participating in hands-on learning. They need to be developing, creating, inventing solutions to problems through the use of technology not just merely using it to type or present a topic. Project based learning was another area of consensus, which mimics real world problem solving.

The lack of emphasis on Bloom's Taxonomy and critical thinking is concerning as well. Both are essential in creating higher level thinking lessons and projects for students. At the same rate the barriers presented by the inability of students to collaborate and the need for assignments and projects to be broken down into steps for students are again concerning. One teacher mentioned that the students are products of the testing generation. This may be true when looking at the independent nature of testing and the need for the students to know the steps to solve the problems on the tests.

Determination on What to Teach

As mentioned previously all groups stated that it was the responsibility of the teachers to learn on their own time. This was closely followed by the fact that technology changes rapidly.

These were perceived as barriers. The majority of the interview groups stated that they had complete autonomy with little guidance from the district.

Elementary Teachers.

Sources that were mentioned in the interviews from the elementary teachers included indicators and objectives from the district, which is the main source of core subjects that elementary teachers teach. With this being said, many of the elementary teachers said they were unaware of any district indicators or objectives for technology. The elementary teachers felt that there was limited professional development in general. When asked about their university experience, many of them stated that they had little to no access to technology during their preservice teaching program. Their top feedback was their need for someone trained in technology to teach it because of the importance placed on the core subjects and the limited amount of time the elementary teachers have to teach everything they are responsible for already.

Middle School Computer Teachers.

Middle school teachers named a few sources such as district objectives or state standards but they mentioned those are too vague or too general. They stated that they lack curriculum, resources, and professional development. They felt that they did not have enough preparation in their university courses to prepare them to teach middle school computer classes. Overall, they research themselves looking for lessons however they did mention that it is overwhelming with too many resources to look through online. In fact, the middle school computer teaches stated that sometimes they learn new topics from the students.

High School Computer Teachers.

Resources for the high school computer teachers included Project Lead the Way, state competencies, textbooks, but a majority stated they were using their own time to search for lessons. This teacher group in particular mentioned the most applications by name. They also felt that there was not enough professional development and they need more training to teach computer science. Many of the teachers stated they had little to no technology training in their university program. Two of the teachers mentioned that they reflect on the lessons and tweak them for the next time they use them. They also learn new topics from the students.

School District Curriculum Directors.

District curriculum directors named textbooks, state and national standards, and district curriculum guides as the resources for the teachers. All curriculum directors mentioned that ongoing professional development is important however; it is the teacher's responsibility. This group also mentioned several applications by name. Many of the district curriculum directors stated that sometimes students teach the teachers. However, their primary focus was technology integration and using technology for student engagement.

University Professors of Education Technology Courses for Preservice Teachers.

University professors produced the most data on how they determine their content. The main resource is the International Society of Technology Education (ISTE) Standards. Other resources include school visits, feedback/reflections from university students, current trends/innovations, blogs read by professors, websites found by professors, and twitter feeds. University professors also named several applications but their focus was technology use and integration.

Conveyance of Technology Skills/Knowledge/Concepts

Overall, the main form of conveyance among a majority of the interview groups was student use of technology. By using the technology, students learn how applications work. This would be true if the goal was students as consumers, not students as creators. Technology integration was another primary way the interview groups felt they transferred skills to the students.

Elementary Teachers.

Elementary Teachers mentioned several perceived best practices when teaching technology skills/knowledge/concepts to students. They believe in a variety of assessments, technology as student engagement, scaffolding, student choice, hands-on learning, and project based learning. Elementary teachers see themselves as a guide. They encourage student exploration and problem solving.

Middle School Computer Teachers.

This interview group believed in teacher modeling and student exploration when teaching technology skills/knowledge/concepts to students. While technology integration and students using technology were a main focus, other means of teaching technology included project-based learning, hands-on, learning by doing, and scaffolding lessons. All these are best practices when compared with the constructivist theory that favors students constructing their learning.

High School Computer Teachers.

The high school teachers provided the most data on their perceived best practices in teaching technology skills/knowledge/concepts. One teacher believed that Project Lead the Way was one of the best ways to teach technology skills/knowledge/concepts. Other approaches

included project-based learning, real world applications, student exploration, scaffolding, learning by doing, and class discussions. They want students to collaborate on projects and they see themselves as a guide.

School District Curriculum Directors.

School district curriculum directors have a direct impact on how teachers teach technology through modeling during professional development sessions or through the objectives that are communicated to the teachers. Primarily district curriculum directors agreed that technology integration and student engagement are their main objectives. However, they also suggested that modeling, individualized instruction, scaffolding, pacing, formative assessments, and learning by doing are all best practices when teaching technology skills/knowledge/concepts. They also advocate for instructional coaches to help convey these recommendations to the teachers.

University Professors of Education Technology Courses for Preservice Teachers.

The university professors endorse learning by doing and project based learning at the university level. They promote student choice, hands-on learning, and modeling by the professor. There were significant differences with the type of courses required some courses were only one hour while other universities required three three-hour courses. Event though there is great discrepancy in the number of hours and courses, the professors were unified on the importance of technology use by the students and technology integration.

CHAPTER 5 DISCUSSION

Overview

The purpose of this study was to discover the current views of education stakeholders about important technology skills and concepts and was there a consensus in the education field on teaching technology. To find the answer twenty-six participants from the education field were interviewed. A broad range of educational professionals were chosen from elementary, middle school, high school, district curriculum directors, and university professors that teacher education technology to preservice teachers. The research questions that guided this study were:

- What is the meaning of teaching technology for college of education professors, school district curriculum administrators, and classroom teachers in a Midwestern area to prepare students for college and career readiness?
    - What essential technology skills/knowledge/concepts do students need to learn?
    - Is there a consensus among the education field on technology skills/knowledge/concepts students should have?
    - How do college of education faculty, school district curriculum administrators, and teachers decide what technology skills/knowledge/concepts to teach?
    - How does college of education faculty, school district curriculum administrators, and teachers convey technology skills/knowledge/concepts?

The interview protocols were comprised of ten questions and were similar for all participants. The questions varied only slightly based on their position: classroom teacher, curriculum director, or university professor. The interviews were audio recorded and ranged

from ten minutes to sixty minutes in length. They were transcribed and coded for ideas, opinions, and information relating to the teaching technology.

Significant Findings and Discussion

As previously noted, there are three main groups of participants: classroom teachers, curriculum directors, and university professors that teach education technology. Within the group of classroom teachers, the group is further subdivided down to three levels: elementary general education teachers, middle school computer teachers, and high school computer teachers.

Elementary Teachers.

Data from the fourth grade teachers produced the fewest amount of codes out of all data collected. These interviews were also some of the shortest interviews as well. With these two factors in mind, it is fair to say of all the participants the fourth grade teachers were the least familiar with teaching technology and the topic as a whole. I believe this maybe a result of their position as a general education teacher. They are responsible for teaching a wide range of core subjects such as: reading, mathematics, science, writing, and social studies. Therefore their knowledge in their respective grade level lends credence to the idea that general education teachers teach "wide but not deep."

In all districts interviewed, elementary computer class was considered an exploratory class. Students visit exploratory classes on a rotation basis. Different districts have different exploratory class offerings. All districts that were interviewed offered music, physical education (P.E.), and computers. Most districts offer library as an exploratory class as well but not all. Other districts offer Spanish and art at the elementary level. Therefore all students have access to a computer course but typically the teacher is an untrained aide so quality lesson planning is compromised.

The elementary teacher's main priority in technology skills/knowledge/concepts was wanting students to learn typing, which on the Revised Bloom's Taxonomy Scale is at the basic level: Remember. Another perceived best practice that was important to fourth grade teachers was a variety of assessments and using technology as an assessment. Finally, the beliefs that technology directly related to student engagement and the teachers main focus on integrating technology were important to the fourth grade teachers.

In comparison very little was mentioned about students creating technology, student collaboration, and student growth. In fact, none of the fourth grade teachers mentioned any state or national standards relating to technology nor were they aware of any district, state, national technology standards. Their main structure for their lessons stemmed from the district prescribed curriculum and that is used as the foundation for their lessons. Therefore, if it is not on the district curriculum they don't teach it. Hence, the reason it was important to interview the district curriculum directors who create the district curriculum.

The fourth grade teachers seemed to be much more focused on best practices such as scaffolding, student choice, hands-on learning, and variety of learners than the other groups. These four best practices were rated higher for fourth grade teachers than any other group. Elementary teaching is much more conducive to these best practices do to the design of the school day. The students spend the whole day with one teacher except for a thirty-minute lunch period, a twenty-minute recess, and an exploratory class of approximately thirty minutes to one hour (depending on the district). Therefore, more class time is devoted to scaffolding, student choice, hands-on learning, and taking into account the variety of learners in the class, which are considered best practice and elements of constructivist theory.

The top two perceived barriers, limited or not access to someone trained in technology to teach it to students and the importance of core content over teaching technology, occurred with the same frequency. These go hand in hand. As stated earlier the fourth grade teachers are responsible for teaching all core subjects so they would prefer there was a trained person to teach technology. Several of the school districts use untrained aides to "teach" the computer classes. In theses cases some districts use a committee of certified teachers and curriculum directors to design a "computer class notebook" that the aide follows each week. Other districts use one certified teacher to design lessons and share them with the untrained aides. A majority of the time keyboarding software is the focus of the lessons rather than computer science concepts or skills.

Along with those two perceived barriers, is the issue with time. The time constraint barrier occurred almost as frequently as the above two barriers. The fourth grade teachers must attempt to get in all core content within a day yet time increments are highly prescribed by the district. Typically, 120 minutes is devoted to reading and English language arts (ELA) and 60-90 minutes is devoted to math concepts. Then add in the thirty-minute lunch period, thirty-minute recess, thirty to sixty minute exploratory classes, counselor lessons, and assemblies so therefore there is limited time for the remainder core subjects of social studies and science. Typically, fourth grade teachers must alternate social studies and science because they don't have time to fit both into the day.

Another barrier that appeared frequently that is connected to the time constraint barrier is the idea that teachers don't have the time to teach the technology they want the students to use and do the project at the same time. The teachers time and time again cited a specific scenario in their interviews in relation to time constraints. They stated that they design lessons or search for

lessons with the idea of time constraints in their mind. They will choose a less technology involved lesson for their students because they don't have enough time to teach the students how to use the software and then try to help the students use it in the project. It takes too long. They would much rather have a computer teacher teach the students how to use for example, Microsoft Excel in computer class first then the teacher can incorporate it into a lesson much easier because the students have been taught previously how to use it and the teacher doesn't have to use part of her/his day to teach students how to use it.

The fourth grade teachers mentioned that they must explore or self-teach themselves on their own time about technology or technology lessons for their students. There is limited professional development on technology and very few guidelines given by the districts. The teachers feel like they are on their own. Surprisingly in the perceived barriers very little was mentioned about the constant change in the technology field. Typically, that goes together with exploring or self-teaching on their own time. However, in these interviews of fourth grade teachers the idea of the technology field in constant change was only mentioned one time.

Interestingly another perceived barrier was teacher use of antiquated technology in college. This points to the importance of looking at preservice teaching programs in universities. The preservice teaching programs need to be using the newest technologies and teaching current computer science concepts and skills. Teachers also stated that they have limited access to technology and typically they must share devices throughout the entire school. This too would have a bearing on lesson planning not only is there not enough time but not enough devices so then what is the motivation to use or teach computer science skills/concepts?

Overall, the fourth grade teachers seemed to place the most emphasis on keyboarding skills with great frequency. They also seem to place a greater emphasis on using a variety of

assessments, technology use for student engagement, integrating technology as a main focus, scaffolding, student choice, and hands-on learning. Their perceived main barriers included limited or no access to a trained technology teacher, importance of core content over teaching technology, time constraints, exploring or self-teaching on their own time, teacher use of antiquated technology in preservice teaching program, and limited access to technology at their school.

Middle School Computer Teachers.

The opinions expressed from the middle school computer teachers allowed for greater quantity and variety of codes to be disaggregated. Middle school and high school teachers are much more narrowly focused on their particular subject through the design of middle school and high school schedules. Therefore, they teach computer classes five out of seven hours of their school day. However, computer classes are elective courses in all the middle schools that were interviews. This translates into only some students gaining exposure to computer science concepts and some not all. Students who are unsure or who have never been exposed to computer science concepts may not choose this elective for fear of losing the ability to attend a different elective such as art, choir, band, orchestra, performing arts, foreign language, family and consumer science, etc. It is possible for students to never have a technology class at all in middle school, which would affect their perception of technology courses or their ability to take one in high school thus affecting their potential future career choices.

The top two codes were typing/keyboarding as a priority skill and integrating technology into core curriculum subjects. Many of the middle school computer teachers taught computer applications. This may explain the emphasis on keyboarding and integrating technology into core curriculum subjects. Other significant codes included students are users of technology,

students should be prepared for the future, teacher modeling of technology, student exploration of technology, project based learning, and hands-on learning.

Very little was mentioned about collaborative student work, digital citizenship, real-life application, and student choice. As mentioned above middle school days are broken down into hours. Students attend a different class each hour with a passing period of 3-5 minutes between each class. This may be the reason little is mentioned about collaborative student work. It may be difficult to use collaborative groups with a limited amount of time.

Surprisingly little attention was given to digital citizenship. Typically, middle school is the time period where students gain a little more independence and exercise their opinions more. They also realize their behavior affects others and learn to influence others either positively or negatively through their words and actions. This is also the time period where they begin using their devices more through texting, taking photos, and using more social applications such Facebook, Instagram, and interactive games. It was surprising that more middle school teachers did not talk about digital citizenship in relationship to cyber bullying and protecting themselves online.

Another surprising observation was the data on real-life application and student choice. As mentioned previously, middle school students start realizing their ability to make more independent choices for themselves and they are beginning to see the world beyond themselves. Therefore, I expected more emphasis to be placed on those two best practices.

Shockingly there was no mention of technology standards of any kind within the best practices theme. This points to the importance of this research study directly. It would be expected that middle school teachers who are narrowly focused on their subject should refer to

the standards as a best practice at least once during a thirty-minute interview about best practices for technology in education.

The middle school computer teachers also had perceived barriers but their barriers were divided between two categories; middle school teachers perceived barriers and middle school teachers student barriers. The top barrier was teacher freedom/choice in what to teach. This barrier related to all of the top four barriers. These included in order of frequency self-taught/teacher explores on own time, technology field constantly changing/trying to stay current, and time constraints. There is a cycle that is evident. Technology is ever changing and without district guidance on best practices, teachers must explore and design lessons on their own time outside of their workday. Time constraints may have two meanings here, the first meaning could be within lesson planning there is not enough time to research and the second meaning could be within their daily schedules they do not have enough time to complete tasks with their students.

Within the barriers category, it was interesting that the technology standards were mentioned very rarely as a barrier and it was stated only one time that they were vague and broad. Also, outdated resources were mentioned only one time as a barrier. However with the lack of district guidance and teachers charged with the responsibility of designing their own lessons and researching themselves on their own time, it explains the reason why outdated resources would be mentioned only one time as a barrier. One barrier that would be expected to surface more frequently with the teachers having to design their own lessons is being overwhelmed with the all the technology resources online.

A second theme emerged out of the barriers theme and that was student barriers. The top student barrier was the lack of students' ability to create/build technology. This stems directly from the computer classes focusing on applications rather than computer science concepts/skills.

The second most common student barrier was computer classes were exploratory classes and that reduces access/exposure to all students.

Overall, middle school computer teachers emphasize keyboarding as a crucial technology skill and the integration of technology. This is a direct result of how the classes are created. The classes are mainly designed around computer application software. The focus of these computer application classes is on using technology rather than creating it. As for barriers, the teachers spend their own personal time researching and designing lessons within a constantly changing field with little to no guidance from the district. What is being taught? How is it equitable among different middle schools within the same district? Are the lessons of high quality? How can the districts answer these questions and have confidence that the teachers are teaching the correct concepts?

Within the barriers theme, student barriers were discovered. A significant student barrier is the fact that students lack the ability to create/build technology. Again, by design of the classes and their focus on application software students are exposed very little to creating/building technology. Another student barrier that was highlighted is the lack of exposure to computer classes because it is considered an exploratory class or an elective class rather than a core class. The middle school computer teachers that were interviewed were very vocal about this student barrier. They believed all students should have access to computer classes as one of the core requirements of the middle school curriculum.

High School Computer Teachers.

Data that were collected from the high school computer teachers produced three main themes. Similar to the middle school data, high school classers by design are narrowly focused on a specific subject each hour. Typically a high school teacher teaches one particular subject or

possibly two different classes within the same subject for example algebra 1 and algebra 2. This narrow focus allows for more depth within the subject.

Shockingly the top code occurred from one interview. A high school computer teacher referred to Project Lead the Way twenty-five times within the interview. This is a program that can be bought by school districts in three different sections: K-5, 6-8, and 9-12. There is an annual participation fee for each section. This program provides the lesson plans, materials, and professional development all at a cost. There are three pathways computer science, engineering, and biomedical science. Within each pathway are several different courses that can be purchased. It is stated on that the computer science pathway aligns with the standards from the Computer Science Teachers Association. Only one high school computer teacher in the midwestern area mentioned this program out of the five that were interviewed. The cost associated with this program maybe the reason others have shied away or maybe other districts are not familiar with this program or unaware that it exists.

Interestingly, the highest best practices codes for the high school computer teachers were project based learning, teacher wanting students to problem solve, real world applications, students working in groups, and keyboarding/typing focused. These codes speak directly to how most of the teachers teach their classes. They want their classes to resemble the real world with projects that need problem solving with several team members working together. However, they still cannot seem to get away from having a significant focus on keyboarding or typing skills with this code landing in the top six.

Many different software applications came up in these interviews, more than in the middle school computer teacher and fourth grade teacher interviews. The acronym STEM (Science, Technology, Engineering, and Math) only occurred two times throughout all five

interviews and the Computer Science Teachers Association (CSTA) only appeared once. Those best practices of constructivist theory appeared sparingly as well. Learning by doing, hands-on learning, scaffolding, and student choice all showed up but with significantly less times than in the middle school computer teacher interviews and the fourth grade teacher interviews. There was a wide range of opinions that contributed to the data gained from the interviews.

Barriers were identified from the high school computer teachers as well. Similarly to the other two groups of teachers, it was evident that most of the high school computer teachers have the freedom and choice to choose their projects and they too must explore on their own time or were self-taught. They also expressed that their teacher training was outdated. With so much time being spent looking for lessons, it was surprising that more teachers don't collaborate with other computer teachers. Only one time was collaborating with other computer teachers mentioned. In addition, the high school computer teachers did not express as much concern over the most common issues of technology such as it constantly changing, having difficulty keeping current, or that technology content is too broad.

The final theme that was established was student barriers. The number one issue high school computer teachers have with students is working in groups. Students have trouble working in groups. The issues range from not liking particular people, to letting one person do all the work, wanting to work with their friends, to lower reading ability students not being able to keep up, etc. Students also want all lessons broke down into steps by the teacher. However, this is exactly what the teachers are trying to teach the students to do, not do it for them.

Unexpectedly two codes appeared that I thought would either not show up or with more frequency. The first one occurred two times in two different interviews it was mentioned that teachers have a hard time getting girls to code or take computer science classes. One teacher

even mentioned that he goes to all the girls' sports teams' practices and does a commercial for his computer science classes trying to pique their interest to get them to enroll. The second code that appeared two times was that students are automatically comfortable with technology because of exposure. This was expected to surface much more often but as it relates to students being consumers of technology rather than creators of technology, the idea might not have had a significant enough connection to the interview questions, as did the topic of integration of technology or students as users of technology.

Generally, the high school computer teachers were primarily focused on project based learning that involved working in collaborative groups solving real world problems. The high school computer teachers, like the other two groups of teachers, must research projects and lessons on their own time or self-teach themselves new technologies. While the freedom of being able to choose projects seems agreeable, the time spent researching counterbalances that freedom to create a barrier. According to the high school computer teachers, the major student barrier is working in collaborative groups. Students have difficulty collaborating, communicating, and contributing effectively to complete projects.

School District Curriculum Directors.

The data from the district curriculum directors' interviews produced the most codes from all the school related data. It is evident from the variety of codes that the district curriculum directors have a wide sweeping view of the district. There were many varied opinions with in the data but the primary focus of the district curriculum directors is technology integration as a best practice with a frequency of seventeen. After technology integration, emphasis was placed on student engagement as a best practice. Finally, two codes rounded out the top four perceived best practices, which was cyber safety/online safety and technology use.

District curriculum directors concentrated on teachers integrating technology and student use of the technology. These two ideas directly correlate with districts that have purchased technology. With financial budgets in education shrinking in the state, the first hurdle is to purchase technology. Typically districts attempt to pass a bond issue to purchase technology, which public citizens within the school district must vote on. Therefore, it is not guaranteed that it will pass. Once a bond issue is past for technology, the district must decide how many devices to purchase and how they will roll them out. They then will take bids from different companies and the school board will vote on which bid to accept.

Once the technology is acquired then it is then usually distributed to the teachers first. The company or the district provides professional development sometimes however; sometimes it is not provided based on the notion that teachers will explore on their own time. The districts that have provided ongoing professional development on the devices have been more successful with teachers integrating the technology. Teachers typically have use of this technology before the students for a certain time period. The time periods varied from district to district anywhere from two weeks to six months before it was issued to the students.

After the students have received their technology, sometimes the district will provide a short introduction to the technology such as a one – hour workshop or different short presentations that the students can choose. From there on there is an expectation that the teachers will integrate it regularly into the classroom. A majority of the districts that were interviewed are in this stage. However, there are various ratios of student to devices within these five districts. Two districts are truly one-to-one. One district is two-to-one, two students to one device. One district is Bring Your Own Device (BYOD). One district is one-to-one at the

middle school and high school levels while their elementary schools are four-to-one, four students to one device.

Another variance noted with these districts is the devices that are purchased. Typically many of the districts have purchased tablets for kindergarten through second grade that remain at school. While third through fifth/sixth graders, depending how their elementary schools are organized, received a tablet that can go home. Middle school and high school students received a laptop that can be taken home as well. The district offers insurance at a reasonable price typically between $10-$20 and they also offer online safety filters for families either for free or a small fee, depending on the district. Families can opt to purchase the device at the end of high school if they choose to.

The fact that a majority of the districts having purchased their technology devices within the last year explains the stage the districts are in with relationship to technology. According to the interviews provided by the district curriculum directors, they all seem to be at what I call the "integration stage" and expecting their teachers to integrate the technology on a regular basis and use it for student engagement. Seymour Papert (1990) coined this device oriented thinking as "technocentrism." It is the idea that the computer has become a central focus but only as a replacement device.

By integrating technology into traditional schooling, teachers typically use it, "to lead the child step by step through the learning process" (Papert, 1990). Papert (1990) stated that this, "shows that the emphasis in their minds is on the computer as an instructional device" and this should be avoided. While this is one part of education, it is the smallest part and technology can do so much more (Papert, 1990). Papert (1990) asserts that it is more than just re-examining the

application of technology, we must, "re-examine our assumptions about education that were made long before the advent of computers."

At the other end of the spectrum of best practices, there were many codes that appeared with little frequency. Theses codes included meeting the needs of the students, real-life application, students needing to be able to operate multiple platforms, career ready, problem solving, student choice, programming/coding, and standards/content needs to be valid. These speak directly to the necessity of this study and cause for concern. These are all best practices when preparing students for college or careers and they are not a major focus for the district curriculum directors with regard to technology. The district curriculum directors are the people that oversee the curriculum for the district in all subject areas and decide the path students will take in their school career, which directly influences their future. Technology is not given the credence as the other core subjects but rather looked upon as a skill to be integrated or for student engagement.

The next theme that will be discussed is District Curriculum Directors' Perceived Barriers. As the director of curriculum, these directors understand they are the face of the district and are great at representing their district in a positive manner. Barriers were not easily extracted from these interviews. Even though this theme produced only six barriers, I felt it was important to highlight the differences in perceptions of barriers between the teachers, district curriculum directors, and university professors of education technology.

The barriers included technology changes rapidly, needing to have a technology culture, financial issues with trying to add more technology; middle school/high school computer classes are elective, and curriculum directors not familiar with best practices in computer science. It was expected that the district curriculum directors would discuss financial issues based on the current

climate in [the state] surrounding funding and the fact that technology is rapidly changing. Yet it is interesting that one director mentioned that the middle school and high school classes were electives without much discussion for the need of them to be a requirement. I received a very honest reply to my question of best practice with regard to technology, which was counted as a barrier. A district curriculum director replied stating that the interviewee was not familiar with best practices in computer science. This response was not easy for the interviewee to say yet I believe it held the most truth out of all of the interviews.

The final theme that was created from the district curriculum directors' codes was their beliefs about computer teachers. This was a theme that I started to develop when the best practice question was asked. The beliefs that small group professional development and that it was the teachers' own responsibility to learn technology and technology concepts on their own time are very interesting. The importance of professional development is considered a best practice in all curriculum areas, which points to the reason why the district curriculum directors mentioned it with significance and will be addressed further in a subsequent section.

There are some factors to consider with the belief that it is the teachers' own responsibility to learn technology and technology concepts. One question to consider is would these curriculum directors allow teachers to learn on their own math, reading, science, or social studies topics? I believe they would not, and it explains all districts provide curriculum to their teachers to follow. The district wants to ensure that certain topics are covered in certain grade levels and that there is progression and a cyclical nature to the curriculum. I do not believe that the district would allow teachers to pick and choose what they want to teach. There is too much uncertainty in that practice yet it is allowed in teaching technology. This points directly to the

importance of this research and the need for a curriculum that mimics the progression and cyclical nature of other core curriculums.

Those codes within this theme of district curriculum directors' beliefs about computer teachers that appeared with the least amount of frequency included codes that are significantly surprising. Codes that appeared only one time included teachers need to build relationships with students, teachers need to know where students need to go (with respect to curriculum), teachers should use the discovery model, teachers need to know what to teach, teachers need to explore just like students, teacher's professional judgment, and no district expectation of technology. These codes are considered best practices in teaching yet with regard to technology they were the codes with the least amount of frequency in reference to computer teachers. Again, the most honest code is the final one that stated there was no district expectation of technology and highlights the significance of this study.

University Professors of Education Technology Courses for Preservice Teachers.

The amount of data generated from the University Professors of Education interviews outweighed the other interview groups. Their opinions widely varied which explains the amount of codes and yet they agreed on several issues. Two themes developed from the interviews of university professors of education technology. They were University Professors of Education Technology Courses for Preservice Teachers Perceived Best Practices and University Professors of Education Technology Courses for Preservice Teachers Perceived Barriers.

As mentioned early there was significant agreement on one main best practice, technology use. This code occurred with a frequency of thirty-one times within five interviews. Understandably based on the technology use being the top code, the next most frequent code was integrating technology as a focus of their university course with a frequency of fourteen.

Another code that occurred with the same frequency of fourteen was preservice teachers learn by doing. The final top best practice code was project-based learning.

One reason for this focus on integration may come from the fact that technology integration has been very highly defined by SAMR (acronym for Substitution, Augmentation, Modification, and Redefinition) and TPACK. TPACK is an acronym for Technological Pedagogical Content Knowledge (Koehler, 2012). According to the TPACK website, "TPACK attempts to identify the nature of knowledge required by teachers for technology integration in their teaching, while addressing the complex multifaceted and situated nature of teacher knowledge" (Koehler, 2012).

All forms of technology integration are not equal. This is evident when some teachers use technology devices/software as replacements for pencil and paper activities, while other teachers may use technology to inspire students to use technology to create an invention that solves a problem. By highly defining technology, professors are comfortable teaching technology integration. They know exactly what to teach. Let's transfer this idea to teaching technology. If it was a little more defined or given a little bit more structure, would teachers/professors/directors of curriculum understand it and be able to teach it more effectively?

Contrary to the most frequent codes are the least frequent codes. The most significant codes with a frequency of one or two were keyboarding, needing problem solving skills, preservice teachers being comfortable with technology, Common Core, needing higher level thinking, student engagement, digital citizenship, internet safety, and needing more coding. There are mixed ideas here with regard to best practice. The university professors are the only ones that mentioned Common Core within the interviews, which will be explained in a following section. Also, the idea that students need to be comfortable with technology is not a significant

factor for the university professors as was found in this study. As stated earlier in the review of literature, students are consumers of technology not producers. Just because they have grown up with technology and know how to use it does not automatically signify that they understand how to create technology.

Two best practices that I expected to see with greater frequency were needing problem solving and needing higher-level thinking. However, I believe the best explanation for this is the differences in these courses from university to university. All courses were designed differently from the delivery style of the content to the amount of hours the course met. At one university, the education technology course is a one-hour completely online course. One university is a one-hour course that meets face-to-face and online. Another university the education technology course is a three-hour course that meets face-to-face. These previously mentioned university courses are taken before or concurrently with being accepted into the teaching program. Therefore that means that these students have never been taught how to create a lesson plan nor have they had the opportunity to take any methods courses. This may be one of the main reasons the university professors are in agreement with the course being focused on technology use and integration.

Two universities require their preservice teachers to attend two or more classes in education technology. The university that requires their preservice teachers to take two three-hour education technology classes has the preservice teachers take before or concurrently with being accepted into the teaching program then one later concurrently with their methods classes. The final university requires their preservice teachers to take three three-hour courses. They are sprinkled throughout the teaching program. One course is introductory course that similar to the other universities is taken before or concurrently with them being accepted into the teaching

program. Then they take a course after they have been accepted into the teaching program. This second course focuses on technology in special education. The final course is taken right before student teaching concurrently with their methods courses. Its focus is integrating technology into the classroom. This freedom in course design, amount of required courses, and when they are taken translates into too much variability and lack of uniformity in experiences and exposure to technology skills and concepts in the preservice teaching programs. There is no emphasis on order, consistency, or best practice in universities' providing education technology courses within the teaching program.

Other codes that were expected to appear more frequently based on frequency of the other interview groups were student engagement, digital citizenship, internet safety, and keyboarding. Professors do not seem to be overly concerned with these topics. In addition, there seems to be a lack of interest or focus on programming/coding. With the recent grassroots movement and the gaining popularity of programming/coding, it was a surprise to find that professors are not considering it a best practice.

Two anticipated barriers of the university professors were that technology changes rapidly which makes it difficult to stay current and that they have complete autonomy over their courses as does most professors. However, the final significant barrier was not an anticipated barrier. This significant barrier is related to when the education technology course(s) are taught. At all five universities the first education technology course was typically a prerequisite course that is taken before students have had any exposure to education courses.

The biggest complaint is that the students come in with no idea what the profession of teaching is like nor do they understand how technology fits into teaching. They have never designed a lesson plan or taught a lesson, some have never worked with children. Even if the

focus of the education technology course is integration as previously established, how can a preservice teacher fully understand how to integrate technology without any prior knowledge relating to classroom experience? This is a significant finding and design flaw that this study has unearthed.

As for significant barriers that occurred infrequently were classroom teachers do not have time to teach technology, we consume we do not produce, school districts not providing professional development is a mistake, lack of equity/access to technology, and because of increased exposure there will be less need for this course. It was expected to see these barriers more frequently rather than only one time throughout all five interviews. Do these professors get out into the field to see the state of technology in the school districts their preservice teachers work in?

The barrier addressing less need for this course because of exposure is not a surprising finding considering the focus of all the courses is technology integration and the course is a prerequisite. If courses continue to focus on integration, the possibility that the course would disappear is true. However, if the course curriculum would change to focus more on higher-level thinking, problem solving, and computer science concepts, it would provide a basis for an education technology course that could be paired with methods courses later in the preservice program.

There were two final observations that the researcher felt worthy of noting. One observation that appeared in the interviews but was not mentioned with great frequency yet it was true of all the universities interviewed was the fact that in all of the technology courses, the elementary majors and the secondary majors are mixed together in the same class. This is an inherit design flaw and the researcher felt it was a significant finding to point out. From the

professors' points of view, this is too wide a range of levels to teach technology skills/concepts to. Since the primary focus of these courses are integration, the professors mentioned that the lessons they develop for elementary majors are not applicable to the secondary education majors and vice-a-versa. The professors would prefer to offer two separate courses.

Furthermore, differences occur between subjects. Technologies for math and science are not necessarily appropriate for English Language Arts. Even within the subject of science some technologies could cross over, however the different sciences lend themselves to different technologies. Yet, all secondary educations teacher candidates take the same technology course. This presents obstacles for the professor and unfortunately the course becomes extremely limited to basic uses of technology that apply to all preservice teachers.

The second observation that did not come to light through the coding strategy was the fact that all of the teachers come from a variety of backgrounds and not all are full professor nor do they all have their doctorates. There are adjunct professors, teachers from area school districts, and several times graduate teaching assistants teach the classes. I believe this has a direct effect on content, delivery method, knowledge base, and experience provided to preservice teachers.

Implications for Teachers in Public Schools

Overall, there are concerns for public schools and computer science. All teachers were left to their own devices when it comes to lesson planning. They must create their own lessons without much guidance, which raises the question what is being taught? This freedom sadly lends itself to ambiguity at all public school levels. All teachers must research the topic on their own time and develop their own lessons. How do they know what was taught the previous year or what to prepare the students for the next year?

Another concern that impacts public schools overall is the seemingly lack of focus on digital citizenship and online safety. It was not a significant focus at any level in public school in this Midwestern area. While many elementary students have access to phones and other devices, typically schools do not allow them in the classrooms and parents are usually much more vigilant about what their child is doing on the phone or device. However at the middle school level students seem to have much more freedom. They typically have their own accounts, purchase apps on their own, and less direct control by their parents. This translates into a need for much more guidance on digital citizenship and online safety. It needs to be much more of a priority in elementary schools, middle schools, and high schools. This presents a problem at the middle school and high school levels because computer classes are elective and not mandatory but is that a topic that needs to be in the computer science curriculum? Designing digital citizenship lessons that a homeroom teacher could facilitate in conjunction with the Library Media Specialist could easily solve the access to all students issue.

A third area that impacts all areas of public schools is the importance of professional development specifically for teaching technology. All teachers felt that the professional development was little or nonexistent with regard to technology. Those that stated they had professional development in technology felt it was outdated. With the state having financial issues with respect to public schools, one of the first things districts cut is professional development. All teachers felt that technology is constantly changing with that in mind it is difficult to stay current accordingly quality professional development is needed.

Elementary Teachers.

Specifically elementary teachers lack the time in their day to teach computer science this is evident from the data collected in this study. If they choose to try to fit it in, they have no

guidance on what to teach. What motivation do they have to incorporate computer science topics? They would have to research the topic on their own time and develop the lesson on their own. This may take away preparation time they need to prepare the other core subjects they are required to teach. Therefore, it is easier not to teach it or think that the computer teacher will teach it. However, many elementary schools in this Midwestern area have decided to replace certified teachers with paraeducators in the computer classrooms. This is an unwise decision looking at the data from this study. The main focuses in the computer classes are keyboarding and technology use. The main focus for elementary teachers is keyboarding, technology integration, and technology as student engagement. Therefore, students never have the opportunity to be exposed to true computer science concepts and computational thinking, which then limits their future opportunities.

Middle School Computer Teachers.

At the middle school level, computer classes are electives and they compete with a variety of other classes such as choir, band, orchestra, art, drama, foreign language, etc. If a student takes a computer class it seems that computer application (word processing, spreadsheets, presentation software, etc) is the main mode of computer science with very little emphasis on computer science concepts. The main focus at the middle school level was found to be keyboarding, technology integration, and students using technology. If a student chooses not to take a technology course, it is possible they will not take one in high school either. Therefore, the last time they had any type of instruction or access to computer science would be at the elementary level. Middle schools may need to reevaluate the need for computer applications in favor of more rigorous computer science concepts that incorporate computational thinking and student collaboration.

Two other issues at the middle school level is the inability for students to collaborate and students needing assignments broken down into steps. These two barriers are concerning do to the fact that these skills mimic real world application. While they are not directly related to computer science concepts, they are essential in high-level problem solving and computational thinking.

High School Computer Teachers.

At the high school level much like the middle school level, computer science is elective and competes with other electives. High school computer teachers are focused mainly on project based learning, problem solving, real world applications, students working in groups, and keyboarding. High school teachers may need to reconsider their focus on keyboarding, it seems a little antiquated. Also again, like the middle school teachers, high school teachers are concerned with students' inability to work in groups and the need for assignments to be broken down into steps. These skills are crucial in being successful problem solvers.

Implications for District Curriculum Directors

District curriculum directors are responsible for maintaining all curriculums, which give them a wide view rather than a detailed view. This is true based on the findings of this study. How do they know what their computer teachers are really teaching day to day? Some districts have district guides but they are just general topics to consider covering rather than specific detailed curriculum. Their main focus is technology integration, student engagement, and SAMR (Substitution, Augmentation, Modification, Redefinition). This may be true because many districts have recently purchased one-to-one devices at the middle school and high school levels. Therefore, they expect their teachers to be integrating the devices with respect to SAMR and using them for student engagement purposes. This group was also a big proponent of digital

citizenship and online safety, again probably in relationship to the newly acquired devices at the middle school and high school levels.

District curriculum directors were also in agreement with the teachers that technology changes rapidly yet they also believed that teachers needed to use their own time to create lessons and stay up-to-date. Coincidently that also stated that professional development was important. However many teachers felt there was not enough professional development or it was outdated. District curriculum directors may need to consider the professional development within their district based on how autonomous the teachers are and the sources of the lessons they design on their own.

Another consideration that may need to be addressed at the district level is the standards they are using for the computer classes. Districts typically rely on the International Society of Technology Education (ISTE) standards to drive the decisions teachers make about computer science concepts yet ISTE standards when analyzed do not give specific curriculum content. They are broad overarching principles to keep in mind when designing lessons. Therefore typically at the elementary and middle school teachers are on their own but sometimes at the high school level they will consider purchasing a unit or even a curriculum like Project Lead the Way.

The costs associated with purchasing a technology curriculum program are very expensive. It would be much more feasible to locate a computer science curriculum that is based on the constructivist theory, which incorporates hands-on learning, higher level critical thinking, problem solving, real world application, and student collaboration. A curriculum that mimics curriculum from core subjects that spirals to ensure students get repetitive practice in computer science concepts and yet students develop/create new solutions to problems.

Implications for University Professors of Education Technology Courses for Preservice Teachers

There seems to be the most variety in the university professors of education technology. Every university is doing something different from the content to the amount of hours required to the experience of the professors. There are very few commonalities. This presents many challenges. Preservice teachers are having vastly different experiences when taking these classes.

Universities typically require very limited amount of time to be allotted to technology courses in relationship to other core subjects. It is evident that it is not a priority. Most universities interviewed have only one course that is required some had more. One class was one credit hour online while several classes were three-hours and were mixed between online and meeting in person. Some preservice teachers were required to have one technology class while others were required to have two or three.

The first class is usually taken before preservice teachers even get into their education classes. They do not know how to create a lesson plan, they don't know the expectations of the classroom, they do not know how to manage technology in the classroom, etc. The focus of these classes is technology use and technology integration. As with most university courses, the professor has autonomy over what they teach however there was no evidence of instruction on how to teach computer science concepts or computational thinking. These two topics were never mentioned in any of the interviews.

Another issue university professors find when developing their class is technology is constantly changing and they are always trying to stay up to date. It makes it difficult when the university places all preservice teachers in their class. The elementary majors and secondary majors are mixed together. The needs of these two groups are immensely different. Attempting

to accommodate these two groups of preservice teachers with one class and with generic lessons just will not be successful nor meet the needs of the preservice teachers when they acquire their first teaching jobs. This may be the reason technology integration and technology use remains the focus of the education technology course(s).

An area of immeasurable difference is the experience of the professor. Only one of the professors taught in the public school system, three were tenured professors, one was an adjunct professor, and one was a graduate teaching assistant. These professors had very little background in teaching technology. Universities may need to consider some guidelines for hiring a professor in this position.

Recommendations for Additional Study

The results of this study suggest that teachers of technology classes are self-taught and develop their own lessons with limited guidance. Ambiguity permeated the interviews. The question of best practice in teaching technology to students was answered with technology use, technology integration, student engagement, project based learning, etc. All of which do not directly speak to the actual question asked. The lack of informed response leads to concern, what are they teaching and do they really know what is best practice in teaching students technology? Teachers are gatekeepers and they want guidance. If the teacher does not know best practice in teaching, it directly affects the students and their future.

Currently the National Technology Plan endorses the ISTE standards, which are too broad and vague. These standards are one cause of the ambiguity issue. One suggestion would be finding a research based K-12 curriculum that would provide this information and guide the teachers, districts, and universities that the nation endorses. One curriculum that does have this potential is the curriculum developed by the Computer Science Teachers Association. More

research is needed to determine if this is the answer to the question what computer science concepts should be taught?

This study was a general study to measure the status of teaching technology in a midwestern area. More research is needed to investigate this topic in more areas of the nation to compare the views in this study to other areas where technology is more prevalent and corporations may be partners or support school districts. Are these results normal when compared to other areas of the nation?

Further research is needed to determine the design of the preservice education technology class. What is best practice with regard to teaching preservice teachers to teach technology to their future students? Should they continue mixing the elementary and secondary preservice teachers? Should the class be online or in person or both? What should be the focus of the class? Are other preservice courses integrating technology therefore the technology course could focus on computer science concepts, higher level problem solving, and student collaboration rather than technology integration or student engagement.

Additional research could be conducted from the students' point of view in all areas from public school to university and then correlated with this study. Once students completed high school computer science courses, were they prepared for college courses or careers? Were preservice teachers prepared to teach technology to students from their education technology course? In the same vein, research is also needed on business owners or professional industry could be interviewed to research the needs of industry. What are the concepts, skills, and knowledge these businesses need students to have and teachers to teach? Then when compared to the research in this study, are teachers, school districts, and universities preparing the students adequately?

Fiscal responsibility is always a major concern in education. A study that would compare the amount of funds spent on technology in the preservice teaching programs compared to the data from this study on how it is being taught (number of credit hours compared to the funding, the content of the courses, etc.) would also prove beneficial to stakeholders. A second area of fiscal responsibility that could be examined is the amount of funds spent on technology in public schools compared to how it is being taught.

School districts strive for equity in curriculum instruction that is the reason behind the core curriculum guides, however apparent ambiguity in teaching technology has been highlighted in this research with regard to content, curriculum, and lesson design. This information could be used as a base to compare student experiences within a district. This study has shown that all teachers teaching technology developed their own lessons, how equitable across the district is student experience and exposure to computer science topics? Are students having the same exposure and experience from one school to another?

Concluding Thoughts

This research study set out to examine the status of education technology in a midwestern area with access to several school districts and many universities that supply teachers to the school districts. This study found that the current status or the meaning of teaching technology in this midwestern area revolved mainly around technology use and technology integration rather than actual computer science concepts and computational thinking. Another outcome of this study found that a majority of the teachers are self-taught without much guidance. They design their own lessons from researching online or from social media and on their own time. This has caused widespread ambiguity. It is unknown what teachers are truly teaching, there is no consistency or cyclical content from one year to the next or from one school to the next.

I surmise that because many districts subscribe to the ISTE standards as the basis for their district' technology plans; teachers and district curriculum directors are unaware that they do not know best practices in teaching technology to students. By trusting the nationally endorsed technology standards, it is easy to think the teachers are following best practice. This is why more guidelines are needed to curb the ambiguity.

University professors seem more in tune with best practices yet are restricted and not given the proper tools to fix the situation. The professors are bound to one class with both elementary and secondary majors mixed together. Also, their class is typically a class taken before they take their education classes. I suspected that if given the chance university professors of education technology would change many things about the structure and content of the class.

This research study confirmed some outcomes that were expected, discovered some unexpected outcomes but it also left some questions unresolved. I feel the research question about what essential skills/knowledge/concepts do students need to learn was answered more in the literature review than by the interviewees. The consensus on the essential skills/knowledge/concepts focused on keyboarding, therefore I feel that this question was unresolved do to the limited experience and background the interview participants had in teaching technology.

Technology is constantly changing and the information provided in this dissertation gives teachers, school districts, and universities insight into what is being taught at all levels with regard to computer science in a midwestern area. My hope is that this research study provides a platform to promote dialog among all stakeholders in education about computer science content, curriculum, and professional development. A specific need has been highlighted for guidance on

content. Teachers are on their own, developing their own lessons, searching online, searching social media for ideas. However there is too much ambiguity. How reliable are those sources, are the lessons research based, how does one teacher know what the previous teacher taught, how is this equitable for students? We need to prepare our students for their future.

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APPENDIX A – TEACHER INTERVIEW PROTOCOL

1) What grade level and content area do you teach? Potential Follow-up question: is your grade level departmentalized?

2) How do you determine what you teach at your grade level and in your content area?

3) How do you know if your students met the outcome for the lesson/activity?

4) What are the components you consider when designing your lesson plans? Potential follow up question: How do curriculum, standards, indicators, benchmarks, learning theory (Behaviorism, Cognitivism, Constructivism), theoretical framework fit into lesson planning? How do students learn best?

5) The next question is a comparison question, How do you feel about what you teach, what you want to teach, and what you should teach? Why?

6) Thinking about technology and your university experience, how were you taught to teach technology to students? Potential follow-up question: Was the emphasis on incorporating technology devices or on the technology concepts/skills?

7) How do you design technology lessons? Potential follow up question: Are there resources available to teach it, for instance standards, indicators, etc? Is there technology available to you as a teacher at your school? What types of technology is available to students at your school?

8) What technology skills/concepts should be taught in schools?

9) Thinking about best practices in lesson planning, how do you believe technology should be taught to students? Why? Follow up question: Who should teach this? Why?

10) What type of school district do you work in (urban, suburban, and rural)?

APPENDIX B - UNIVERSITY PROFESSORS OF EDUCATION TECHNOLOGY INTERVIEW PROTOCOL

1) What level (undergraduate/graduate) and content area do you teach? Potential follow-up question: What college/department are you associated with?

2) How do you determine what you teach in your specific content area?

3) How do you know if your students met the outcome for the lesson/activity?

4) What are the components you consider when designing your lesson plans? Potential follow up question: How do curriculum, standards, indicators, benchmarks, learning theory, theoretical framework fit into lesson planning?

5) How do you feel about what you teach, what you want to teach, and what you should teach? Why?

6) Thinking about technology, how do you teach technology to your students? Potential follow-up question: is the focus on technology devices, integration, or skills/concepts?

7) How do you design technology lessons? ? Potential follow up question: Are there resources available to teach it, for instance standards, indicators, etc.?

8) What technology skills/concepts should be taught in preservice teaching programs so they can teach their students those concepts?

9) Thinking about best practice in lesson planning, how do you believe preservice teachers should be prepared to teach technology to their students? Why? Follow up question: who should be responsible for teaching the preservice teachers how to teach technology? Who should be responsible for teaching students technology concepts/knowledge?

10) What type of institution are you? (private, public, etc)?

APPENDIX C – SCHOOL DISTRICT CURRICULUM DIRECTOR INTERVIEW PROTOCOL

1) What is your position?

2) How do teachers in your school district determine what to teach?

3) How do you know if students in your school district have met the outcomes?

4) What are the components you expect your teachers to consider when designing their lesson plans? Potential follow up question: How do curriculum, standards, indicators, benchmarks, learning theory, theoretical framework fit into lesson planning?

5) How do you think teachers feel about what they teach, what they want to teach, and what they should teach? Why?

6) Thinking about technology, what do you know about teaching technology?

7) What is the school district expectation for teachers when they design technology lessons? Potential follow up question: Are there resources available to teach it, for instance standards, indicators, etc.?

8) What technology skills/concepts should be taught in schools? Potential follow-up question: Should these same skills/concepts be taught to teachers?

9) Thinking about best practices in lesson planning, how should technology be taught by your teachers? Why? Potential follow up question: How are your teachers prepared to teach technology to their students? Who should be responsible for teaching it?

10) What type of school district do you work in (urban, suburban, or rural)?

APPENDIX D – INFORMED CONSENT FORM

Informed Consent Statement

Sources of Ambiguity in Teaching Technology

INTRODUCTION

The Department of Education Leadership and Policy Studies at the University of Kansas supports the practice of protection for human subjects participating in research. The following information is provided for you to decide whether you wish to participate in the present study. You may refuse to sign this form and not participate in this study. You should be aware that even if you agree to participate, you are free to withdraw at any time. If you do withdraw from this study, it will not affect your relationship with this unit, the services it may provide to you, or the University of Kansas.

PURPOSE OF THE STUDY

The purpose of this study is to explore the teaching of technology at the elementary and secondary level, the school district level, and the undergraduate preservice university level.

PROCEDURES

You have been asked to complete a face-to-face interview conducted in a convenient location that will be recorded. The interviews will be conversational in manner and will require no prior preparation on your part. You may have the option of stopping the recording at any time .The interview will require no more than forty-five to sixty minutes of your time. The researcher, Susan Thies, will be transcribing the interview. No one will have access to the interview other than the researcher and the recordings will be stored securely on a digital recording device that does not have access to Internet or access to any other foreseeable device that could become unsecure. The recordings will be erased after the study has been published and the researcher has graduated.

RISKS

Your participation in this study is completely voluntary and considered low-risk through Internal Review Board standards. While I foresee no risk or discomfort for yourself or others, there is no penalty for refusal to participate. You also have the option to discontinue participation at any point during the interview without penalty.

BENEFITS

Your participation in this study will yield direct benefits to the study and will also indirectly benefit the research subject. The benefits for the participants include increased awareness of technology concepts at all levels of education (elementary, secondary, and higher education).

Participation in this study may also inspire change in teacher preparation programs, teacher learning, and teaching instructional methods. These aforementioned benefits may have a secondary or indirect benefit to your students. The students may benefit academically as a result of their teachers' participation in this study.

Potential benefits for the research subject include outlining the necessary knowledge and skills students need in computer science and thus laying a foundation in computer science education for the K-12 sector. From this foundation, educational professionals and policymakers can move forward with a solid research base from which further curriculum decisions or purchasing decisions could be made. This study could enhance teacher preparation programs across the nation and help revise the curriculum to prepare teachers to teach technology concepts to their students.

A summary of the findings in this study will be available to the participants.

PAYMENT TO PARTICIPANTS

There will be no payment for the participants in this study.

PARTICIPANT CONFIDENTIALITY

Your name will not be associated in any publication or presentation with the information collected about you or with the research findings from this study. Instead, the researcher(s) will use a study number or a pseudonym rather than your name. Your identifiable information will not be shared unless (a) it is required by law or university policy, or (b) you give written permission.

Permission granted on this date to use and disclose your interview information remains in effect indefinitely. By signing this form, you give permission for the use and disclosure of your interview information for purposes of this study at any time in the future.

REFUSAL TO SIGN CONSENT AND AUTHORIZATION

You are not required to sign this Consent and Authorization form and you may refuse to do so without affecting your right to any services you are receiving or may receive from the University of Kansas or to participate in any programs or events of the University of Kansas. However, if you refuse to sign, you cannot participate in this study.

CANCELLING THIS CONSENT AND AUTHORIZATION

You may withdraw your consent to participate in this study at any time. You also have the right to cancel your permission to use and disclose further information collected about you, in writing, at any time, by sending your written request to: Susan Thies, Principal Researcher, J.R. Pearson Hall, Rm. 421, 1122 West Campus Rd., Lawrence, Kansas, 66045-3101

If you cancel permission to use your information, the researchers will stop collecting additional information about you. However, the research team may use and disclose information that was gathered before they received your cancellation, as described above.

QUESTIONS ABOUT PARTICIPATION

Questions about procedures should be directed to the researcher(s) listed at the end of this consent form.

PARTICIPANT CERTIFICATION:

I have read this Consent and Authorization form. I have had the opportunity to ask, and I have received answers to, any questions I had regarding the study. I understand that if I have any additional questions about my rights as a research participant, I may call (785) 864-7429 or (785) 864-7385, write the Human Subjects Committee Lawrence Campus (HSCL), University of Kansas, 2385 Irving Hill Road, Lawrence, Kansas 66045-7568, or email irb@ku.edu.

I agree to take part in this study as a research participant. By my signature, I affirm that I am at least 18 years old and that I have received a copy of this Consent and Authorization form.

_____ _____

Type/Print Participant's Name Date

_____

Participant's Signature

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