The Role Technology Education plays in our Schools.

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Abstract

THE ROLE OF TECHNOLOGY EDUCATION IN OUR SCHOOLS.

Michelle Cieslewicz

Under the Supervision of Dr. Jodean Grunow, Ph.D.

This paper will focus on Technology Education and the role it plays in our schools. The purpose is to take a look at how teachers can prepare students for their future by teaching them technological literacy. Technology is always changing; therefore, so does our teaching. The best way to teach technology is really up to teachers. Technology needs to be integrated into every content area so students can see how problem-solving and critical thinking are for every area of life, not just one area. Students need to leave school knowing how to figure out what technologies they should use when solving any problem that comes their way. Getting students to be technologically literate is a process; however, it will pay off for students when they are able to use technology to benefit, not only themselves, but also to help solve real-world problems.

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Chapter I Introduction

"Developing from industrial roots only at the turn of the last century, the philosophy of technology education is a small and comparatively new field of inquiry" (Morrison-Love, 2017). In comparison to the established fields of math and science, the study of technology is very new. It is also developing and changing at a very quick pace. "Technology Education is an undervalued and underutilized component in many schools. It needs to be argued that the fluidity that sets it apart from traditional subjects also allows Technology Education to stay current with real world applications in ways that core disciplines cannot" (Ast, 2018, 2). Research shows that students enjoy using technology and are often more motivated when having the opportunity to use it. If teachers can get students to see how technology can be used to assist in all areas of life, it will not only make their learning more meaningful, but can possibly help in areas that are yet to be seen. Ast also states that, "Technology Education will bridge the gap between academia and the needs of the global community" (2018, 16).

Technological Literacy is the end goal when teaching technology. The real struggle is that there is a huge debate regarding what technology literacy really is. According to Brown, there are many views of what technological literacy is, how it is continually changing and evolving, and consequently, state that "it is the ability to use, manage, and understand technology" (2010). One needs to continuously keep learning about technology and knowing how it can help make our jobs and lives easier. "Becoming technologically literate, therefore, does not have a starting point or a finishing point, it is a never-ending process" (De Vries, 2018, 41).

According to Brown, the International Technology Education Association believes "students should be engaged in cognitive and psychomotor activities that foster critical thinking,

decision making, and problem solving" (Brown, 2010). A teacher needs to provide opportunities for students to develop these skills, but how can this be done? Brown states that "students should be given opportunities to solve practical, 'real-world' problems, and they should be engaged in the design process" (2010, 51). Teachers need to know how to allow this to happen so avenues can be created for students to take the time and learn how to get to the problem solving and design process. These skills do not come naturally; they need to be taught. As students learn how to be problem solvers, they can learn how to deal with 'real-world' problems that impact how we live and who we are.

"Technology education is a practical school subject where hands-on teaching strategies are employed" (Ritz & Martin, 2013). As technology continues to change and develop, the teaching will also need to continue to change. Researchers are constantly trying to figure out what should be taught in technology education and how students should be assessed. Ritz and Martin keep researching "what to teach and how to teach it to better prepare youth for their futures in a technological society" (2013). As research progresses and more teachers use technology in a variety of ways in their classrooms, we are learning more about preparing students for their future in jobs, some of which may not yet exist.

Statement of the Problem

The International Technology Education Association states that the goal of technology education is to "produce students with a more conceptual understanding of technology and its place in society, who can thus grasp and evaluate new bits of technology that they might never have seen before" (Brown, 2018). So what is the purpose of Technology Education within our schools? What skills should be taught? How does one teach the skills needed to prepare students for the future, who will know how and when to use the appropriate technology?

Purpose of the Study

The International Technology Education Association has 20 standards for Technology Education that are organized into 5 categories: nature of technology, technology and society, design, abilities for a technological world, and the designed world (ITEA, 2000). There are many standards and ideas of skills that should be taught, but very little direction regarding how to get students to the point of meeting these standards. The International Society for Technology in Education also has standards for computational thinking competencies as well as for computer science. The state of Wisconsin has standards for Information and Technology, as well as Technology and Engineering standards and Computer Science standards. Teachers need to sift through all these standards and figure out what skills are most important to teach, while also teaching what his or her school has identified as skills important to teach. Technology Education is a very complicated content area. Through this research I will suggest many ideas and ways to meet standards so that when students leave a class, they will be prepared to move onto their next step in life and will have a wonderful foundation of technological literacy skills.

Significance of the Study

Students struggle with problem solving and thinking for themselves. Students already know so much about technology, but we need to help them to figure out problems and ways to find the answers independently. Students often "google" a question or topic and, if they cannot find the answer easily, they give up. We want students to see how technology can be used in all subject areas and how math and science and art all work together.

Through this study I hope to show ways to integrate technology into each area of content, perhaps stimulating creative ideas regarding what to teach. Technology Education works best if

technological literacy is taught and integrated into all content areas. Technology is always changing and will continue to change as students move into career paths; however, developing their understanding of using technology and how it can help in a variety of situations is what our students must have to be successful.

Delimitation of the Study

This is not an exhaustive study of how to teach technological literacy. The study is to help get creative ideas into the classroom so more ideas can be developed and, in turn, motivate students. The student population today is diverse; investigations that work for some may not work for others. A good creative teacher will dig deeper and hope to reach students where they are so they can be engaged and technologically literate. If a school does not have iPads, Chromebooks, MacBooks, tablets, desktops for students to use, technological literacy is difficult to pursue. This study hopes to give examples of ways to integrate core subjects and technology.

Methodology

Using the Karrmann Library System, I found primary and secondary sources to complete my literature review, as well as, professional journals and articles about Technology Education and how it is being used in classrooms. I was also able to find articles on the ITEA standards and how programming is being integrated in businesses, as well as, in the classroom to prepare students for their futures.

Chapter II Review of Literature

Technology in the Classroom

Technology Education as a discipline will contain industrial arts, vocational education, and college preparatory classes. "The nature of technology education has changed: it has gradually evolved from focusing on skills to focusing on technological literacy. This literacy implies that pupils and students have developed a realistic image of engineering and technology" (Rossouw, Hacker, & Vries. 2001, 409). Whereas academic (core) class content is the same regardless of the tier the student is on, technology is much more individualized. Each tier is customized for the needs of the student (Ast, 2018, 14). In one class you may have an athlete who could care less about programming, a girl who thinks this is for nerds, and another student who loves programming and already knows more languages of programming than those of which the teacher has heard. Teachers need to meet the students where they are and try to make each student better and more prepared for wherever life takes them. The athlete may one day work for a company and look back at his or her middle school or high school class as the only place he or she ever heard programming language used, and yet, it will be the foundation for his or her ability to do that job.

The main purpose of technology education is developing technological literacy, but in some cases a vocational element remains. In vocational education the focus has been on preparing for a career in commerce or in technical areas (Rossouw, Hacker, Vries, 2011, 410). Technology is used in so many careers and used in many different ways. Students need to see a variety of ways to use technology so they can figure out the best way for them to pursue. Technology Education, in its many forms, is an important element of STEM education. The "T" in STEM designates not only the technological literacy of the Technology

Education Standards, but also the Technical Education provided in vocational training (Reed, 2018). STEM covers so many fields and shows how all areas are integrated together. The focus needs to be on teaching how skills can be intertwined and can build off other skills. "Technology Education teaches application; it is the ability to use knowledge, existing or new, to complete work" (Ast, 2018, 16). All teachers want students to now learn the skills they will need to be successful in the future; technology education is exactly that, teaching students the building blocks they need for any area of future interest as a career. "According to Klein, anything you can do to get your kids to collaborate and problem-solve -- those are the biggest components employers are looking for in the real world" (Provenzano, Klein, & Davis, 2016). We want to use the technology that is available to help students use it and problem solve with it. "Throughout its existence, Technology Education has adapted to meet the trends in education and the needs of society" (Ast, 2018, 1).

"With the maturing of technology education as a school subject, research was needed to continue to determine what to teach and how to teach it to better prepare youth for their futures in a technological society" (Ritz & Martin, 2013). Teaching technology right now is a privilege. To be a part of this changing field allows for better teaching. The challenge is learning new technology constantly and knowing it well enough to teach it. The teacher does not need to know more than the student; the teacher needs to guide the student in the correct direction to work through the problem. Teaching persistence is going to help the student more than knowing how to do a single function on a Chromebook; the function may or may not be ever used again.

"Technology encompasses the way humans develop, realize, use, and evaluate all sorts of artifacts, systems, and processes to improve quality of life. Technology literacy helps people live in, and control, the technological environment that surrounds us. This literacy comprises

practical knowledge, reasoning skills, and attitudes" (Rossouw, Hacker, & Vries, 2011, 410). These skills are essential for learning any topic and, if technology is what is going to motivate students to learn these skills, it needs to be done well. As students learn and develop these skills, they are becoming stronger students and can press through challenges in all classes. Much of learning today is done online, including turning in assignments, as well as delivery of an entire class. Students need to be able to know how to work through technical and non-technical problems without constant oversight from an instructor.

The American Academy of Pediatrics currently emphasizes the importance of selecting digital media that are developmentally appropriate, with high-quality content, along with offerings that allow adults to play and view along with their children (International Literacy Association, 2019). In the past, young children were encouraged to rarely have screen time. The new digital media has brought a variety of ways for children to use technology to increase their learning; and therefore, can be very valuable to their learning. One example is "the integration of digital technologies in ways that complement and enhance learning with other essential materials and activities" (International Literacy Association, 2019). Classrooms are full of powerful and helpful learning tools; digital technologies cannot replace those, but used together, student learning can be enhanced. "The use of technology that supports the development of creativity, exploration, collaboration, problem solving, and knowledge development" is another example (International Literacy Association, 2019). Blocks, puzzles, drawing, and free writing can foster these attributes, but, digital technologies can help deepen the learning associated with them.

In art, a teacher can lecture on proportions, but if a student could "jump into the painting and fix the proportions and sizes of objects within the painting" (Bush, Karp, Nadler, Gibbons, 2016, 222), that could create a real connection. This can be done, through the free app, Keys to

the Collection. Students are able to design an avatar while they "explore concepts of probability, sample space, and the counting principle during the creation of their avatar" (Bush, Karp, Nadler, Gibbons, 2016, 222). Students then are able to digitally jump from painting to painting restoring order. "Students found this technology connection to be engaging and novel while deepening their understanding of proportional thinking and how ratios link art to mathematics" (Bush, Karp, Nadler, Gibbons, 2016, 222). This integration helps students see how worlds are connected, how math is important in art, and how technology can make both a little easier. Using technology can be very valuable and can help students understand a topic they may have never really understood.

"Creativity is the development of new ideas" (Hokanson, 2016, 3). So, in technology education, allowing creativity is essential. Students need time to investigate and work with the technology given to be creative and learn new and interesting skills that can be shared with others. This could be transformational (Hokanson, 2016, 4) if students could use their creativity and go beyond content to teach each other. As teachers, we want students to be able to teach skills to others. Peer teaching can often elicit understanding.

Integration of Technology into Core Academic Classes

"Though there is no separate technology section to the Common Core State Standards, technology literacy and the use of technology devices are included throughout the standards, suggesting that effective teaching and learning now requires not only technical competency, but also an understanding of how technology interacts with content knowledge and teaching practices" (Kimmons, Miller, Amador, Desjarkins, & Hall, 2015, 810). Often overlooked, technology needs to be incorporated in teaching content. Students are expected to "not only use technologies competently but to use them in ways that effectively connect with practice and

employ critical thinking to support effective learning experiences in real-world contexts" (Kimmons, Miller, Amador, Desjarkins, & Hall, 2015, 811).

Students often struggle in mathematics, failing to employ logical thinking skills or perseverance in working through problems. iSolveit is an app that can be used to strengthen math knowledge and comprehension. Most puzzles can be completed in 15 minutes and easily can be incorporated into a math class, on occasion, or assigned as out of class work. The puzzles are designed to strengthen reasoning and logical thinking skills; essential skills for learning math (Karaman, & Sakow, 2015). Rafranz uses her interactive whiteboard to produce videos to help strengthen student understanding of math concepts and key terminology (Provenzano, N., Klein, E., & Davis, R., 2016).

According to Schaen, Hayden, and Zydney, third grade students worked with first grade students using TinyTap to create an app using iPads to help learn math concepts (2016, 506). Students then had time to use the app to work on math concepts. Students were able to use graphics and record their voices to narrate. Their ownership makes the app much more engaging and, therefore, they are more likely to use the app to increase knowledge. There are times students are led to see a bigger picture. According to Bush, Cox, and Cook, students discovered that the program TinkerCAD had little creative value without the understanding of proportions (2016, 113). Many times, students put information into a program or a computer and take what comes out as truth. Part of teaching is helping students see the red flags, answering, "Does this make sense? What's wrong?" Part of Technology Education is allowing students to see how programs or websites work and then be lead to experiment with them. Many times, students will not see a mistake at first; they think it is a computer, how can it be wrong? Leading students to see, that the computer works with the information given it helps deepen learning.

Google maps and 360 photography can help students learn about geography and the world around us. This can very easily be connected to any Social Studies unit. 360 photography is new and engaging for students. Allowing students to work with this new technology and see all that can be done with it, will increase students' creativity and allow them to solve problems as they are encountered in the real world. Provenzano has incorporated maker space environments in his school and found according to Hamka, "maker space serves as an 'open-air environment' where students can access the latest technologies, like 3-D printing" (Provenzano, Klein, & Davis, 2016). 3-D printing is increasing in popularity and the possibilities are endless. Allowing students to see a problem and design, compute and print an actual tool that could be used to solve a real-life problem is a great learning experience. One cited class did exactly that. A fourth-grade class saw a kindergartener who was born without a limb. Students brainstormed, designed, measured, and, through trial and error, were able to 3-D print a prosthetic to help this kindergarten student (Bush, Cox, Cook, 2016).

The technological learning environment does not have to look like a traditional classroom. Students can move around the room, working with a variety of equipment, creating meaningful projects or coming up with new, innovative ideas. One item in Provenzano's maker space is "Raspbery Pi, a programmable computing device." Students use the program to address the identified problem and learn to code and create apps as they work. According to Klein, her students do projects on iPads, create videos, slideshows, and work with apps like Aurasma (Provenzano, Klein, & Davis, 2016). Aurasma is an augmented reality platform, a free app that allow students to interact with the physical world.

Teaching to Code?

"Coding is not only the act of creating complex programming language, but is also the creation of a sequence of instructions with tools basic enough for young children" (Estapa, Hutchinson, Nadolny, 2015, 494). "Coding is the new foreign language, that is what kids will have to know to do anything in any job -- create things, build a website, make things work" (Provenzano, Klein, & Davis, 2016). Coding is a word commonly used for programming. There are many languages of code and all take time to learn. Smith and Neumann explain it like this, "Physically enacting and building computer programs established a concrete mode of representing transformations, making both the mathematics content and programming more tangible and understandable" (2014, 187). Coding can create meaningful connections to content areas that normally would be more difficult to understand. It is not just using the computer that makes it meaningful; it is the process that goes behind coding to help students learn to problem solve and think critically when something does not work right away.

Coding can be taught in a variety of ways. Many curriculums are free and start with unplugged activities to learn the basic fundamentals needed to actually code an entire program. Scratch, code.org, and code academy are free and are great curricula to use to get students to begin coding. "Scratch is a colorful, easy-to learn programming language used by children as young as 5" (Pierce, 2013, 40). "Scratch's flexibility allows students to use different programming blocks to create reflections, explore dilations, and increase the complexity of translations" (Smith & Neumann, 2014, 187). "Scratch's interface is based on a drag-and-drop, building-block approach that lets users experiment with variables and conditions in an intuitive way" (Pierce, 2013, 40). It also "provides an interface in which users must think creatively, reason systematically, and often work collaboratively to program their own interactive stories,

games, and animations" (Estapa, Hutchison, & Nadolny, 2015). Scratch is interactive and begins slowly teaching the core concepts of coding, allows students to build their creativity and learn much more than they would if it were just programming. Teachers who use this program not only have students program and be creative, they also stop and have the students act out what they have programmed. Teachers found that "acting out each program command helped students reason about and predict the actions, leading to a more nuanced understanding of the attributes of transformation" (Smith & Neumann, 2014, 187).

LOGO is an educational programming language, developed by MIT professor, Seymour Papert and colleagues (Smith & Neumann, 2014, 185). Papert wanted to "use programming as an expressive medium to study other topics rather than as a skill to be learned for the sake of learning" (Estapa, Hutchison, & Nadolny, 2015). Students program a turtle. "The ability to program, the ability to code, is an important part of being 'fluent' today" (Pierce, 2013, 38). Alice was created to teach programming theory to young students. Alice lets users experiment with 3D animations, games, and videos through drag-and-drop programming of interactions between virtual people and objects in a 3D world. This makes it especially useful for storytelling exercises (Pierce, 2013, 40). According to Resnick, "the best learning experiences happen when students are interacting and sharing and collaborating with one another. Our goal is not to help students learn to code but code to learn. The coding or programming is not the end goal; it's more a means of learning many other things" (Pierce, 2013, 41). "Programming gives the students a logical method to present themselves in a creative way and own their learning. They get to be logical and creative at the same time" (Pierce, 2013, 42).

Students in Joanna Boyd's computer programming class are using programming to create their own programs around what they are already learning in other classes. This provides a level

of excitement and engagement that students might not otherwise get from the curriculum. Boyd says, “I really believe it is exciting that part of the brain that education doesn’t give them” (Pierce, 2013, 42). Boyd provides resources for researching and learning new programming concepts and uses programming to further overall education. Boyd also has noticed that girls are outperforming boys in mastery of the language and quality of work. Often times, girls are not interested in fields that involve coding so to get girls excited and performing well is very exciting. Another area that is often not seen is a shared interest in learning between students and parents. However, the shared experience of working with technology leads students to connect with their parents in a way she has not seen with other subjects (Pierce, 2013, 42).

Phillip Reyland, CEO of Byte Department, set out to learn Ruby, a programming language used to make most of the company’s web apps. He says, “the hardest part is to find the time to sit down and learn it” (Woyke, 2012, 110). Right now, students have the time, they have the ability to set everything aside and just learn a programming language. Now is the time to get students interested and engaged in programming. Reyland is an ambassador between his team and clients in creating a need to learn to program. Tom Hughes, co-founder of KeyWifi, also says that learning programming allowed him to know basic website structure and the value of time-saving design tools like Bootstrap. The knowledge allowed him to specify, and even tweak, KeyWifi’s site design. There are many programs that have been made accessible to easily learn the basics of programming. CODECADEMY is a free, online, self-paced lessons in Javascript, HTML, and CSS and is adding lessons in Python and Ruby. Coding tools that cost money include: Code School, Treehouse, and Girl Develop It (Woyke, 2012, 110-111).

“Coding literacy is an important type of digital and disciplinary literacy that is relevant to classroom instruction” (Estapa, Hutchinson, Nadolny, 2015, 494). “Coding is a new type of

literacy. Just as writing helps you organize your thinking and express your ideas, the same is true for coding. In the past, coding was seen as too difficult for most people. But we think coding should be for everyone, just like writing" (Estapa, Hutchinson, Nadolny, 2015). If students do not have a class to specifically use technology to benefit learning, teachers need to dig into the many ways that technology can benefit student learning and create meaningful learning moments. However, teachers need to consider how the technology will benefit students' learning before jumping into using it. "We encourage teachers to consider in advance the many ways that integrating these apps and these new approaches to teaching literacy may benefit students" (Estapa, Hutchison, Nadolny, 2015).

"Children learn to solve problems and design projects, and they develop sequencing skills that are foundational for later academic success" (Estapa, Hutchison, & Nadolny, 2015). "Computer programming is an activity similar to solving problems in other domains: It requires skills, such as decomposing, abstracting, iterating, generalizing" (Scherer, Siddiq & Sanchez, 2019, 764). According to Smith and Neumann, integrating geometry and computer science supports learning about transformation while students not only code, but act out the code for deeper understanding (2014, 185). "Technology can be a great equalizer. To prepare students for careers, schools must do a better job of teaching critical thinking and problem solving. In this sense, coding is an urgent need" (Provenzano, Klein, & Davis, 2016).

Problems.

A few problems have arisen as coding has been put in more and more classrooms. "No consensus about where it fits within the educational curriculum and the lack of qualified computer science teachers comfortable in teaching programming are barriers. Resistance to a class that looks more fun than substance is another" (Pierce, 2013, 39). With a lack of qualified

teachers and with students not gaining the interest while in high school, finding teachers to teach coding is very difficult. According to Herschbach "a common challenge is that Technology Education classes are used as a dumping ground for students that do not have plans beyond high school, perform poorly, and have behavior problems" (Ast, 2018, 1).

"This problematizes any technology education paradigm that wishes to incorporate the concept of becoming technologically literate. It is simply not possible to set assessment criteria that are standardized in order that predefined aims and objectives are shown to have been achieved. This is simply because we all have differing perspectives about the way we value and perceive technologies, values, and perspectives that may well change over time." (De Vries, 2018, 40).

Students' Future

"Digital citizenship is an essential element of technology and engineering literacy. As rapid technological advances have increased people's capacity to access and share information anytime and anywhere around the globe, there is increasing concern about the misuse and abuse of information" (National Assessment Governing Board, 2018, 81). Digital Citizenship common sense is a great resource to use to teach digital citizenship. There are lessons and/or entire units to teach a variety of skills and computer safety. It also provides a great assessment for students to demonstrate their knowledge. Teaching students how to behave while using computers, is an important skill and one that is often overlooked. Students are taught how to treat each other, how to talk to one another, but often times, they are not taught how to behave when using a computer. Students often feel more courage and power to say something online that they would not say to someone's face. This habit needs to be broken to protect our students from themselves and from others.

"Students should be able to use their knowledge about technology to develop explanations and make predictions, comparisons, and evaluations" (National Assessment Governing Board, 2018, XVIII). Students are comfortable with using Google to find just about any answer. Students also need to be able to think for themselves. "Being a practical school subject, focused on "doing," so learners could comprehend how society operated and the knowledge and abilities one would need to develop as contributing members of society" is a goal of digital citizenship (Ritz & Martin, 2013). Rafranz states, "technology could spark students' intellectual curiosity and 'give them a window' to resources and skills beyond the classroom" (Provenzano, N., Klein, E., & Davis, R., 2016). According to Hanford, "technology and globalization greatly increased the skills required for most occupations. To be successful, employees would need to be multi-skilled and be able to retrain throughout their careers to remain current with the continuously improving technology" (Ast, 2018, 9). "Many of the critical challenges that we face as a society, and that our young people will eventually need to address, have large technological components such as the quest to link experts throughout the world, the search for sustainable energy, dealing with global pandemics, and the development of environmentally friendly agriculture to feed a growing world population" (National Assessment Governing Board, 2018, XIII).

Chapter III Conclusions and Recommendations

Technology Education is continuously changing. Knowing what to teach and when to teach it is a very difficult task, yet very important. Technology can be integrated into every class and when taught along with a quality lesson can enhance learning. This will also allow students to take ownership of their learning. There are many apps and programs that can be used to enhance this learning; however, the teacher needs to be comfortable leading students within the programs or apps and needs to be able to select appropriate technologies which will effectively enhance learning.

I would recommend that teachers become more aware of the ways technology can be integrated into every area of learning to benefit student learning. This would allow for more meaningful learning and show students the value that technology can provide. Teaching students how to use a variety of technologies and feel comfortable using them, is a very important skill for their future. Most careers involve the use of technology in some form and having basic skills is very important in learning more in-depth programs.

ITEA states that "people benefit both at work and at home by being able to choose the best products for their purposes, to operate the products properly, and to troubleshoot them when something goes wrong" (2000, 2). So, let us help students with these solutions. Then teachers need to use technological literacy to work with students to become problem solvers, and to move them toward becoming the successful individuals at home and at work, that we want them to be.

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