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Toward a Unified Computer Learning Theory: Critical Techno Constructivism

by

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Here is to the unknown unknown—may it continue to breed imagination.

Bryan Philip Sanders, 2019

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ABSTRACT

Toward a Unified Computer Learning Theory: Critical Techno Constructivism

by

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Why did we ever purchase computers and place them along the wall or in the corner of a classroom? Why did we ever ask students to work individually at a computer? Why did we ever dictate that students should play computer games or answer questions built from a narrow data set? And why are we still doing this with computers in classrooms today?

This approach has contributed to a systemic problem of low student engagement in course materials and little inclusion of student voice, particularly for traditionally underrepresented students. New transformational tools and pedagogies are needed to nurture students in developing their own ways of thinking, posing problems, collaborating, and solving problems. Of interest, then, is the predominance in today's classrooms of programmed learning and teaching machines that we dub 21st century learning. We have not yet fully harnessed the transformational power and potential of the technology that schools already possess and that many students are bringing on their own.

This dissertation aims to address what is missing in best practices of technology in the classroom. Herein these pages will be performed a document analysis of cornerstone books

written by John Dewey, Paulo Freire, and Seymour Papert. This analysis will be in the form of annotations comprised of the author's experience as an experienced educator and researcher, and founded in the extant relevant theories of critical theory, technology, and constructivism. The three philosophers were selected for their contributions to constructivism and their urgings to liberate the student from an oppressive system. With a different approach to educational technology, students could be working towards something greater than themselves or the coursework, something with a passionate purpose derived from student inquiry. Instead of working at the computer and having a "one and done" experience, students could be actively transforming their studies and their world. And instead of reifying existing social and racial inequities outside of the classroom through the large computer purchases and the dominant culture attitudes and beliefs found in many software products and databases, we could be examining our practices and programs with a critical lens that allows us to question and seek more inclusive community strategies.

The final chapter is about asking for, pushing for, and dreaming for new kinds of schools, classrooms, software, hardware, and new ways to think about and create new opportunities for students. Mixed reality, sometimes called augmented reality, is likely the anticipated future of computers in the classroom.

We need to, very deeply and purposefully, mix up electronics with people. We are in a new era with new understandings of old issues showing up in old problems. A unified learning theory for computers, computing, and digital learning environments could help to redefine classroom spaces and class time, as well as graduation outcomes. The revolution will indeed be

live on the Internet, but it will also be remixed and recreated by students organically and authentically pursuing their own truth.

Keywords: *educational technology, constructivism, techno-constructivism, 21st century classroom, computers in the classroom, mixed reality, programmed learning, critical theory*.

CHAPTER 1

BACKGROUND OF THE STUDY

The Problem of Behaviorism and Cognitivism

Chapter 1 will discuss how the behaviorist approach to computer usage in schools and classrooms has contributed to a systemic problem of low student engagement in course materials and little inclusion of student voice, particularly for traditionally underrepresented students. Additionally, the stimulus-response technique commonly found in curricular and pedagogical models in schools ignores expanding computer processing power and what the hardware and software is now capable of helping people to create. Further, this mismatch encourages students, who are often far more advanced than the faculty and staff in the use of new technologies, to develop a reliance on low-level skills for academic purposes. In sum, we have not yet agreed to a theoretical approach for classroom computer usage that best serves students.

The main problem this dissertation will discuss is that predetermined outcomes in educational technology usage limit critical thinking, creativity, intellectual growth, and problem-solving skills. This dissertation will also provide an historical look at how distance education and the development of computers for educational purposes have relied heavily on behaviorism and cognitivism. These two histories have influenced major computer equipment purchases, human resource funding, and, importantly, pedagogical and curricular choices regarding computers.

Personal Background

For over 20 years, I have worked with students to find the intersections of language, literacy, research, data analysis, art, performance, and technology. Together we have built computer labs, radio stations, video games, interactive displays, portfolio websites, theater performances, art happenings, and more. In my role as a high school English teacher, I strive to

serve also as a bridge to various subcultures at the school and assist in a re-imagining of the public space. Through my willingness to continually tear down my own assumptions and question my own policies and politics and practices, I further open myself up to students' worlds and words. I am interested in their self-expression, their intellectual and creative developments, and I help them engage with critical consciousness. I principally operate from an inclusive perspective that my students are interesting and useful humans—from this point, our work takes shape guided by constructivist principles and follows student inquiry to help inform the next curricular steps. Planning the entire year in advance does not allow a classroom community to see itself or discover itself. This "un-classroom" approach is the classroom that I believe needs to become mainstream; it is the approach that I use to stay engaged as a lifelong learner. It keeps me curious and always in-progress towards dynamically shifting goals and outcomes.

Currently, I wish to explore the potential for new theories, pedagogies, and practices that reside within digital learning environments (DLEs). In its current state, many unexamined assumptions guide what passes for 21st century work with computers and computing in classrooms. There are many types of DLEs, ranging from a text-only bulletin board to a comprehensive online course to a learning management system (LMS) to a three-dimensional virtual learning environment (3DVLE). All the DLEs have in common, at their core, an attempt to harvest multiple interpretations from the active users and to laterally place these multiplicities, these multi-narratives, on purpose in a shared environment. One could argue that a DLE might be the best example and tool of human ingenuity capable allowing us to explore latent creative and intellectual potential in previously unknown ways. However, unintended problems ensue when we use the digital space to merely replace lined paper, number two pencils, scissors,

colored pencils and markers, construction paper, encyclopedias, magazines, books, and calculators.

Background of the Problem

Schools are not known as places that move quickly in response to changing philosophies, burgeoning innovations, or marketplace attitudes outside of themselves (Educational Technology in the 21st Century, 1995; Micheuz, 2009). While innovations in the fields of art, medicine, and science evolve, the re-imagined classroom of the future that many have dreamt of and written about for nearly forty years has yet to take hold (Harel & Papert, 1990). Most people would leave a doctor's office upon seeing that his most current tools are from fifty years ago. Most people would have their doubts about the effectiveness of the doctor's approach if he used an old strategy about which you had read many criticisms. In schools, however, students, teachers and families alike have grown to tolerate the anachronism (Feenberg, 2002).

Technology use in education can certainly speed up our use of paper and how we process and access information. In fact, that is the most understandable goal of using a computer and the one that brings most novice users to convert their workflow to digital. However, replacing paper simply maintains things as they are. For decades, the machine has had the potential for more uses than yet discovered. Why invent a new gadget to teach the same material in the same way (Papert, 1972)? To disrupt the norm, this dissertation will urge the conversation about how to get students to learn together *with* computers and technology, not isolated individually in a corner *at* a computer terminal. Shifting the emphasis of computers in the classroom to a blended or mixed reality will empower the students and undermine the critics (Educational Technology in the 21st Century, 1995).

Human Success Cannot Be Predetermined.

The institution of school is known to move slowly in response to changes in society at large, but the students themselves change rapidly and frequently in response to those same changes. Students daily bring to campus an abundance of microprocessors and have grown reliant on the widespread availability of high fidelity wireless Internet connectivity (Yoo, 2015) —school communities witnessed a "new normal" with student familiarity of computing devices, computing literacy, and multi-user engagement in online virtual environments. This near-silent shift has occurred over the last ten years, during which time, some observed a widening gap between the kinds of jobs available and the relevance of subject matters studied in schools (Kellner & Kim, 2010). Additionally, schools and classrooms faced a greater number of restraints placed on curricula and student outcomes due to accountability and funding policies that largely dictate how administrators allow their teachers to use class time for what is sold as "in the interest of students." Students at earlier and earlier ages were far more flexible with more complicated tools than what their schools provide (Kafai & Burke, 2015). This indicated a gap between student readiness and school preparedness that often went unrecognized and undiscussed. As schools set their "June outcomes" during the previous June, educators and administrators may then end up with predetermined outcomes that limit student growth and creativity, as well as their critical thinking and problem-solving skills.

Having Computers Does Not Mean the Future Has Arrived.

Global interconnectedness via Internet and pocket-sized devices to create, distribute, and access information has grown exponentially. The explosion of available information as well as an ongoing reliance on computing to access, collect, and share information, has resulted in an amplification of the already well-documented "digital divide" (Attewell, 2001) that politicians,

philosophers, and philanthropists have worked on for at least two decades. A recent study (Araque et al, 2013) indicated an important reminder: increased availability of Internet access and computer hardware alone still did not improve the chances for low-income families to emerge from poverty. Training and support along with leveling the playing field had a greater chance for helping families to improve their station. This same equation for helping people to help themselves applied not only to families in their homes, and communities at large, but also students in a classroom. Teachers were often given a single computer for their classroom, or perhaps a school has a single computer lab for many classrooms, but even when a 1:1 computer program is implemented, training and support are lacking. As a result, the computer hardware and software were not utilized to transcend or transform lives, minds, curricula, or schooling. In other words, the yet unrealized vision of computers in schools as a radical liberation tool still awaits us: "High quality hardware and educational software alone cannot make this change and will not result in better educated students: educators need to change for this transformation to begin" (Troutner, 1991, p. 14). Fundamental shifts in daily classroom life can happen with guidance from research and theory.

In a 1995 Congressional hearing on Education and Technology, Seymour Papert said, "I think there's an education establishment that has its head wedged in a culture that grew up over a century during which there was the most lethargic progress in education of all fields of human activity and they continue to suffer from being part of that culture" (Educational Technology in the 21st Century, 1995). This dissertation provided a look into the established writings that encompass the field, even reaching into some texts that were written before the advent of the computer; those authors discuss relevant fundamental principles and attitudes that directly relate to a reimagining of classroom computer use. Further, many articles have been written by

educators, social critics, pundits, philosophers, parents, and industry moguls. New ideas are prevalent, perhaps in an overwhelming abundance, but how many of these ideas make their way to teacher and administrator credential programs? How many of them assist in guiding the work of training the very people charged with creating experiences for student growth and learning? And how many ideas penetrate the very heart of the system itself and position themselves in opposition to the status quo?

Statement of the Problem

Computers today have incredible processing power far beyond most of the utilitarian purposes they serve in schools today. This is not entirely surprising given the history of teaching machines and learning machines, which were created as rote learning devices reliant on behaviorism as the main teaching strategy. Presenting students with stimuli to which they must respond represents the majority of both the historical and the current usage of computers in classrooms. Missing are the expectations that when students work with computers that they can create original content and explore problems or develop critical thinking through the process of following their own inquiries.

In this age of test scores tied to budgets, typically only that which would increase test scores would survive a budget cut—dreaming up a new curriculum or pedagogy with computers does not have guaranteed funding nor very many promises of funding. An experimental program where students "learn by doing" in a shared experience with a three-dimensional creative space sounds intriguing, but it will typically lose the funding face-off with a program trusted to keep the core subject standardized test scores reliably strong and growing. Furthermore, many people might expect students to figure out how to use computers on their own outside of school, given the preponderance of devices and websites and apps readily available.

And while some schools and educators work with the guidance of International Society for Technology in Education (ISTE) and Partnership for 21st Century Learning (P21) in their lessons and outcomes, it is certainly not the order of the day nor the requirement at most school sites. To push at this some more, all of this occurs in a simultaneous space where educators, scientists, and parents often acknowledge the unmet needs of students to find their voice and style, and to find individualized pathways of learning. In other words, we have more tools and venues available than ever before for students to discover an individualized interest and focus, but are slow to let them have greater value, weight, time, and space in our classrooms.

Digital Learning Environments (DLEs) that are safe and sanctioned by schools can offer opportunities for students to develop essential 21st Century skills, such as cognitive flexibility, electronic civic engagement, computer science literacy, judgment of source material, collaboration, and complex problem solving. Further, DLEs can help provide spaces for students to remix concepts and objects in search of new innovations to help better serve humanity. As cultures and societies change, new needs for systems emerge, towards which students could be working with real data to produce ideas and prototypes. Too often the benefits of creative collaboration receive short shrift when pitted against one's individual academic progress.

Digital learning environments (DLEs) can also be powerful creative places for students to create, share, and explore a variety of cultural expressions in a diversified and meaningful manner. Underrepresented students are most often the marginalized voices in our classrooms. Educators seek pedagogies that emphasize inclusivity of all student ideas and experiences into the central narrative of the classroom. Using DLEs with a methodology steeped in critical theory and techno constructivism allows schools to create more places and pathways for students to express themselves, develop critical inquiries into their own assumptions and interests, challenge

the assumptions of others, and deepen their connection to a lifetime of learning. It is incumbent on schools to not only create and nurture these spaces for students, but to also train their faculty how to use them and rethink their methods from previous years. The culture shift has already rapidly occurred outside of schools; now we must find a way to follow suit inside of schools.

Purpose of the Study

This dissertation study provides a document analysis (Bowen, 2009) in the form of annotations of three seminal works, namely *Democracy and Education* by John Dewey (1916), *Pedagogy of the Oppressed* by Paulo Freire (1970), and *Mindstorms: Children, Computers, and Powerful Ideas* by Seymour Papert (1980). Selecting these three authors was on purpose because all three call for a liberation of schooling from governments and corporations. Additionally, Dewey, Freire, and Papert all provide practical uses for their theories that have direct application to educational technology. The document analysis will follow an "interpretive paradigm, as in hermeneutic inquiry," (Bowen, 2009) in the triangulation of data to then put forward new and unifying ideas in Chapter 5.

This study will lend its voice toward a unified learning theory for computers, computing, and digital learning environments for others to implement in their own practices and studies. The study looks at the two-headedness of behaviorism and constructivism in education, with particular focus on classroom computer usage and classroom computing. There is a high incidence rate of behaviorism alongside a high interest rate in constructivism. The relative absence of critical theory in techno constructivist thinking will also be explored for the purpose of finding unification of these ideas, hence the title of this dissertation—Toward a Unified Computer Learning Theory: Critical Techno Constructivism.

Significance of the Study

The larger significance of this study is to look for and ask for new approaches to school and the perpetually changing needs of the students. In a digital learning environment, teachers and students have enormous potential for multimodal and multivalent approaches, as well as multiple entry points. Many classrooms today have access to incredibly powerful machines that can create an immersive and effective John Dewey-inspired learning environment that honors the students and the teachers, and even more, honors the process of creativity in pursuit of knowledge and production.

It is impressive to find that so many elements of the great constructivist thinkers instead of conflicting with one another can commingle and co-exist in our modern computing era. Once superimposed on each other, these elements begin to point toward a new approach, a new theory, a new classroom experience, and even a new graduation standard.

The main use and pedagogical design of the Pressey "teaching machines" was to encourage automaticity of skill and content in narrowly defined sets of data (Pressey, 1926). As the processing power of computers became powerful enough to allow for new designs in software and approaches with pedagogy, constructivism and constructionism were looked to for new possibilities and potential for how to use computers in schools. With all these changes in the potential and power of the "teaching machines," however, the approach many schools take has remained more closely aligned with behaviorism and cognitivism. This dissertation uses a document analysis (Bowen, 2009) of seminal works from John Dewey, Paulo Freire, and Seymour Papert for the purpose of adding to the existing theories of computer use in classrooms and further developing a unified learning theory for computers, computing, and digital learning environments.

In sum, the words "technology and education" all too often means "inventing new gadgets to teach the same old stuff in a thinly disguised version of the same old way" (Papert, 1980, p. 353). Most software used in classrooms for the past three decades has relied on closed loop situational data simulations and narrowly focuses students on predetermined sets of information—this is "edu-tainment", not education (see Appendix B). Put another way, this is a transactional approach and not a transformational approach. Further, staunch opposition to computers typically comes from people who think the computer by itself is useful, even though it is more reliable that computers do not produce student learning but rather students can enhance their learning with computers (Papert, 1980). Meanwhile, we are witnessing a widening gap between the kinds of jobs available and the relevance of subject matters studied in schools. Simultaneously, schools and classrooms face a great number of restraints placed on curricula and student outcomes due to accountability and funding policies (Feenberg, 2002). In the middle, are today's modern learners who are ready for us to figure out a new and comprehensive approach to effectively teach with the Internet in digital learning environments (DLEs)—and keep in mind that the power, the reach, the accessibility, and the information contained there within expands each month with no foreseeable limit.

When I refer to a DLE, I am including DLEs through the ages and not only the most modern and sophisticated. This distinction is important because elements of various DLEs could be useful even if from older models, and furthermore, the nature of computer hardware and software is that all of the predecessors rest within the most modern—the past informs the future.

Digital learning environments (DLEs) need more research and pedagogical support in order to fully blossom into radical teaching tools. Using critical theory, constructivism, constructionism, and an intentional countering of industrial-age schooling frameworks, I now

lend my voice toward that end. It is possible to develop a transformational way to use DLEs. In this dissertation, I offer an analysis and a synthesis of many concepts in order to develop a unifying theoretical and pedagogical approach currently not found in the literature.

This dissertation imagined renegotiated learning spaces and new forms of classrooms that are inclusive and equitable. This dissertation pushed ahead to ask that transformational teaching and learning serve as a primary mark of success favored over standardized testing and teacher as banker (Freire, 1970). Empowering teachers, students, administrators, and parents to aim at something other than test scores and grade point averages is a not-so-hidden goal of this dissertation. Digital learning environments provide classroom teachers an educational sandbox to offer students an immersive and immediate experience with which they can develop their cognitive tools and construct knowledge (Dalgarno & Lee, 2010). Further, the three-dimensional virtual learning environments **(**3DVLEs**)** also urge forward the conversation about new forms of classrooms and new uses of educational technology in order to help foster critical thinking and problem-solving skills through open-ended classroom experiences (Harel & Papert, 1990). Children in heterogeneous environments require constructivist classrooms not traditional ones for their voices to be heard and grow (Ackermann, 2001). Social justice education is the opportunity to address concerns with the educational system itself, and not only what or how to teach the children. A more socially just education system benefits all students (Eglash, Gilbert, Taylor, & Geier, 2013).

And the future of learning is not so far away from what we already know and do in a traditional classroom. We are well versed in how a classroom provides the platform or space in which the attendees co-construct an understanding of the course content with the guidance (not direction) of the teacher. Real reality, face-to-face human interaction, has all the components of a

DLE without the electronics. The familiarity of classroom discussions can be seen as a model for the computer-enhanced classroom because teachers and students begin by interacting with objects and ideas alone (work at home) and then encounter others in a multi-user space (attend class) as they go on to negotiate and co-construct ideas and objects together (create meaning together). Perhaps teachers who rely more on lectures might find the electronic classroom experience helpful towards scaffolding a constructivist approach towards making meaning. Likewise, teachers already more inclined towards constructivism may find that their practices are a natural stepping stone to that of DLEs. Thus, as with any new approach or paradigm, the electronic campus too will give some the nudge to revisit their assumptions in non-electronic spaces and others the ability to forge new never-before-possible lessons, projects, and ideas within the electronic space.

Research Questions

The study addressed these two research questions:

1. How has the history of behaviorism and cognitivism impacted the development of using computers in the classroom as a transformational tool?
2. How can a techno-constructivist theory be expanded to meet the needs of modern learners and contemporary issues?

Research Design

The research design and methodology are addressed in detail in Chapter 3 of this dissertation. The “methodological and data triangulation” (Bowen, 2009) of this study relied on the selected documents for analysis.

The statement of the problem and the research questions led to the selection and discussion of materials for the histories of distance learning and the computer, as well as the

literature review. Next, the descriptor codes were derived from the histories and the extant theories from the literature review; the codes carried the prominent themes of those documents. Then, the excerpts to be annotated from the seminal works were selected according to the codes. Finally, the content analysis of the three seminal works were interpretive and stem from this author's informed notes grounded in his positionality and experience. Further, the Dedoose software tool version 8.0.35 (2018) was used to analyze the coded excerpts for concordance and intersections of ideas unseen without the aid of a computer in the final thematic analysis (Bowen, 2009). All together, these analyses were combined to put forward fundamental principles and thoughts toward a unified computer learning theory for classrooms.

Theoretical Framework

The theoretical framework for this dissertation is that of constructivism, for it alone allows for the most flexibility and co-construction of truth inside this narrative. The work of a constructivist remains elastic even when articulately and accurately aiming for a goal; the ability to shift in relationship to what is discovered through research and study provides an acknowledgment of that discovery. The very nature of what is proposed in this dissertation dictates that the dissertation too be afforded that same flexibility found in constructivism. Further, the principles of radical constructivism (see for example, von Glasersfeld, 1990) even more clearly and cleanly articulate how I operate and approach the work here, for as a subset of constructivism, it allows and encourages truth to depend more heavily on the experiencer, the one experiencing the truth.

Often in academic work do the traditions of objectivity and empiricism and epistemology "cancel out" the voices of radicals, subalterns, and other marginalized groups and individuals. Because at the heart and core of this dissertation I call for a toppling of the standardized test

money machine and a reorganization of graduation outcomes to better suit the students in their ever-changing contemporary society, I put forth here a vision founded in a radical framework tradition that has been bested time and time again.

Methodology

This document analysis study was aligned with qualitative research that makes space for the individual agent conducting the study to have his positionality not only guide the ideation but also the methods of collection and connection. While this study used existing theories and pedagogies and histories to triangulate the problem, the related literature, and the approach, it was also inclusive of the thematic and critical analysis derived from my interpretations of the collected materials. However, with over 20 years of classroom teaching experience, I had the benefit of formally and informally studying students, teachers, schools, practices, and dilemmas using educational technology. This experience, when added to my critical study of the selected documents, helped shape the annotations of the identified seminal works. Document analysis in a hermeneutics approach was the primary methodology.

Assumptions, Limitations, and Delimitations

I operated on the assumption that a decoupling of education and test scores will allow for free thought. With that liberation, schools can forge into new territories previously unknown by traditional classroom experiences. I also operated on the assumption that computers and technology can be used in schools in ways that have yet to be discovered. With the classroom as an open sandbox, we can remain receptive to new ideas.

I assumed that augmented or mixed reality was the preferred approach in collaborative groups precisely because it allowed for no barriers between “offline” and “online”; students would not have to disappear into a one-viewer-only experience (as in virtual reality). We still

enjoy and benefit from seeing each other's facial expressions. With augmented reality and DLE spaces, I maintain that school can remain markedly human, use future-ready tools, and preserve the intangible qualities of working collaboratively in the same physical space.

Further, I operated on the assumption that essential questions about the nature of schooling and education were in constant short supply. I preferred to ask these kinds of questions again and again: What happens when we make room for student control of the artifacts they produce and the topics they study? Classrooms can change. Schools can change.

One limitation of this study was my selection of a single work from each of the three major authors: John Dewey, Paulo Freire, and Seymour Papert. If I were to read their entire body of work and perform the same document analysis, I may have come up with different results; or, perhaps I would have been unable to perform this study altogether. Therefore, it must be acknowledged that the three selected texts were aligned with the problem and the research questions.

The intersections of theory and pedagogy in schools and classroom also guided this dissertation. Theory is the thinking behind the method, and pedagogy is the method. These concepts move simultaneously and concurrently, since a pedagogical approach is often built from a theory, even if that theory arises naturally as a reflection on how students respond to another pedagogy. From experience, I anticipated a multitude of pathways by which educators arrived at conclusions that help define their theoretical position; it is then this very position which can later define the pedagogies to be used or developed next. It was also assumed in this dissertation, though, that educators need to experiment with different theories and pedagogies for a period of years in order to define their theoretical position. Therefore, the theory proposed in this study will add to the body of work for educators to experiment with and assimilate into their

own meaningful work. The Critical Techno Constructivist theory proposed in this dissertation was not intended to be a final resting place for the ideas contained herein.

Definition of Terms

1:1 computing: programs that provide all students in a school, district, or state with their own laptop, netbook, tablet computer, or other mobile-computing device. *One-to-one* refers to one computer for every student (One-to-One, 2013).

21st century skills: refers to a broad set of knowledge, skills, work habits, and character traits that are believed—by educators, school reformers, college professors, employers, and others—to be critically important to success in today's world, particularly in collegiate programs and contemporary careers and workplaces (21st Century Skills, 2016).

3DVLE: a three-dimensional virtual learning environment that capitalizes upon natural aspects of human perception by extending visual information in three spatial dimensions, may supplement this information with other stimuli and temporal changes and enables the user to interact with the displayed data (Wann & Mon-Williams, 1996).

Analog: as humans, we perceive the world in analog. Everything we see and hear is a continuous transmission of information to our senses. This continuous stream is what defines analog data (Analog, 2006).

Augmented reality (sometimes called *mixed reality*): augmented reality, commonly abbreviated "AR," is computer-generated content overlaid on a real-world environment (Augmented Reality, 2016).

Blended learning: the practice of using both online and in-person learning experiences when teaching students. In a blended learning course, for example, students might attend a class

taught by a teacher in a traditional classroom setting, while also independently completing online components of the course outside of the classroom (Blended Learning, 2013).

Computer: technically, a computer is a programmable machine. This means it can execute a programmed list of instructions and respond to new instructions that it is given. Today, however, the term is most often used to refer to the desktop and laptop computers that most people use (Computer, 2006).

Constructionism: an educational theory that is student-centered and emphasizes discovery learning, where students are encouraged to work with tangible objects in the real world and use what they already know to gain more knowledge (Constructionism, 2005).

Constructivism: the belief and practice that students and teachers together engage in an ever-shifting dynamic process of learning and building meaning together through co-construction in problem-solving situations (Vygotsky, 1978).

Critical Theory: a movement in social and political philosophy that maintains that the primary goal of philosophy is to understand and to help overcome the social structures through which people are dominated and oppressed (Critical Theory, 2009).

Digital: digital information is stored using a series of ones and zeros. Computers are digital machines because they can only read information as on or off—1 or 0. This method of computation, also known as the binary system, may seem rather simplistic, but can be used to represent incredible amounts of data (Digital, 2006).

Extended Reality: extended Reality (XR) is an umbrella term encapsulating Augmented Reality (AR), Virtual Reality (VR), Mixed Reality (MR), and everything in between (Extended Reality, 2019).

Hardware: computer hardware refers to the physical parts of a computer and related devices. The internal hardware parts of a computer are often referred to as components, while external hardware devices are usually called peripherals. Together, they all fall under the category of computer hardware (Hardware, 2006).

Information Communication Technologies (ICT): ICT refers to technologies that provide access to information through telecommunications. It is similar to Information Technology (IT), but focuses primarily on communication technologies. This includes the Internet, wireless networks, cell phones, and other communication media (ICT, 2006).

LMS: a learning management system (LMS) is a software application or Web-based technology used to plan, implement, and assess a specific learning process. Typically, a learning management system provides an instructor with a way to create and deliver content, monitor student participation, and assess student performance (LMS, 2018).

Mixed Reality: a type of hybrid system that involves both physical and virtual elements; an online course that has open access and interactive participation by means of the Web (Mixed Reality, 2019).

MOOC: an online course that has open access and interactive participation by means of the Web. MOOCs provide participants with course materials that are normally used in a conventional education setting - such as examples, lectures, videos, study materials and problem sets (MOOC*,* 2019).

Pedagogy: the art or science of teaching; education; instructional methods (Pedagogy, 2018).

Programming Language: a programming language is a set of commands, instructions, and other syntax use to create a software program (Programming Language, 2011).

Sandbox: a sandbox is a style of game in which minimal character limitations are placed on the gamer, allowing the gamer to roam and change a virtual world at will. In contrast to a progression-style game, a sandbox game emphasizes roaming and allows a gamer to select tasks. Instead of featuring segmented areas or numbered levels, a sandbox game usually occurs in a "world" to which the gamer has full access from start to finish (Sandbox, 2018).

Theory: a supposition or a system of ideas intended to explain something, especially one based on general principles independent of the thing to be explained (Theory, 2018).

Virtual Reality: virtual reality is best described as an illusion of reality created by a computer system (Virtual Reality, 2006).

WWW: stands for "World Wide Web." It is important to know that this is not a synonym for the Internet. The World Wide Web, or just "the Web," as ordinary people call it, is a subset of the Internet. The Web consists of pages that can be accessed using a Web browser. The Internet is the actual network of networks where all the information resides (WWW, 2006).

Summary

This document analysis addressed the dilemmas faced when using computers in classrooms. These dilemmas came in the form of limiting outcomes through predetermined pathways and stunted the growth of critical thinking, creativity, and problem-solving skills. This study sought to provide a new and unifying theoretical approach to how computers are used in classrooms in the teaching and learning cycle.

My research pointed to a new way to intersect critical theory, constructivism, constructionism, social justice inclusion and engagement, educational technology, connectivism, and cultural responsiveness. Instead of focusing on external goals and expectations determined by dominant culture norms, the heart of this dissertation was to urge classrooms to transform into

inclusive, creative, and academic spaces that explore alternative learning pathways with computers.

My research has shown that most software programs, as well as classroom methods, for using computers rely on a stimulus-response framework. Student voices at the margins of the classroom are rarely included this way, and student engagement is lower. The digital classroom provides not only the hope and promise of an invented (and hopefully better) future, but it also places the tools of liberation in the hands of those who will sculpt that new world.

Chapter 2 provides a historical understanding of how this dilemma came into being and isolates two competing forces. The rise of the machine as a teaching or learning tool comes from a history of behaviorism and a stimuli-response method of acquiring information. Simultaneously, the rise of alternative classrooms in distance learning models demonstrates a potential for creativity with computers in detaching the teaching and learning from tradition. Additionally, Chapter 2 also shows the existing theories and pedagogies currently in use to address responsive teaching and teaching with computers. These well-known progenitors of the field comprise the foundational thinking necessary to identify, understand, and interpret computer usage in the classroom. The following ideas will be discussed: behaviorism, cognitivism, constructivism, constructionism, critical theory, connectivism, and virtual reality.

Chapter 3 shows the methodology used in this study to develop and determine a unifying learning theory for computers, computing, and digital learning environments. Using a document analysis and a theory-building method, as well as computer-aided intelligence, this study also added annotations to three seminal works. These works were identified as crucial to the field and study of education but also for their possible interwoven themes and concepts when viewed from the lens of educational technology. John Dewey's *Democracy and Education* (1916), Paulo

Freire's *Pedagogy of the Oppressed* (1970), and Seymour Papert's *Mindstorms: Computers, Children, and Powerful Ideas* (1980) were the three works that were studied in order to create a new and unifying theory.

Chapter 4 contains the study itself which is comprised of annotations of passages that the author of this dissertation determined to intersect with the extant theories and pedagogies identified in Chapter 2 and an application of educational technology in today's classrooms. The author of this study is a career high school English teacher who uses educational technology and can critically identify passages from the seminal works as possibly linked to educational technology even if the original authors did not intend for their words to be read that way. The annotations moved chronologically through each of the seminal works named. Additionally, the excerpted passages were identified in Dedoose (version 8.0.35), a research software that allowed for computer-aided intelligence to provide analyses of concordance and intersection of words, phrases, and concepts beyond what a human mind can do alone. The author of this study tagged each excerpted passage with a theme or motif that emerges so that the software could accurately provide an analysis of potential worth.

Chapter 5 summarizes the findings of the study and proposes a new learning theory for digital learning environments. Additionally, recommendations for further and potential uses of this theory will be proposed.

CHAPTER 2

HISTORY AND LITERATURE REVIEW

Distance Learning and Development of Computer

This chapter discusses both the history of distance learning and that of the development of the computer. Importantly, the history of behaviorism as part of the physical and philosophical construction of the computer provided essential insight into how current use was connected to previous use of computers in classrooms. This history pointed to how the hardware and software have greater potential than schools might be ready for, and that given the chain of events which led to computers in classrooms, there is a great need for reimagining computers in the classroom. These two histories provided necessary background information to show not only how alternative learning environments have been a part of education for many years, but also how the computer itself can serve as an alternative learning environment.

Additionally, this chapter discussed the extant theories and concepts relevant to forming the theoretical framework and background to perform the study. This literature review showed that through a combination of ideas that demonstrate the history and support constructivism, it is possible to reimagine the classroom with the addition of critical theory and new technological advances.

A History of Distance Learning

Distance education was the earliest form of a digital learning environment (DLE) or a virtual learning environment (VLE). It is the "acquisition of knowledge and skills through mediated information and instruction, encompassing all technologies and other forms of learning at a distance" (Bower & Hardy, 2004, p. 5). The earliest record of a virtual learning environment was in 1728 Boston when a teacher offered lessons in shorthand via postal service. The first

educational institution to offer a distance education course was a Swedish university in 1833 offering the study of composition by post. As students and teachers were successful, this methodology grew in popularity. More and more universities and businesses utilized the postal service to offer a variety of coursework to students of all ages. Notably, the International Correspondence School in Scranton, Pennsylvania had enrolled one in 27 Americans by the year 1900. They offered a course on mining safety that was well regarded (Bower & Hardy, 2004).

With the advent of radio technology, distance education broadcasts began to become popular during the 1920s and then television continued the trend from the 1950s and beyond. In 1969, the founding of the British Open University gave new life into the distance education movement with the advent of full degree programs and a variety of courses similar in depth and breadth to what we have come to expect from a face-to-face university experience. Within two decades, fiber optic and satellite technology made possible an interactive two-way communication within these correspondence courses and changed forever the expectations that students and teachers alike have for what is possible in distance education (Bower & Hardy, 2004). A classroom without a room, or a classroom with many rooms, became the new normal.

The rise of the Internet brought more widespread use of distance education and allowed for a new influx of asynchronous courses. This proved advantageous in that students could complete certificate and degree programs at all hours of the day. For the many students who both work and study, distance education via Internet was a complete game changer that opened the university doors to students who could not previously attend. Particularly in the large population of students who attend community colleges, asynchronous courses served via Internet proved a huge asset in improving their career trajectories. As a social justice issue, colleges and universities must consider their budget spending on a traditional physical plant versus

revitalizing their Internet bandwidth and course offerings online (Bower & Hardy, 2004). Each educational institution has a duty to serve the good and the will of the people attending. A state-of-the-art building may not be money well spent when reviewing the lives, the needs, and the habits of their students.

Students today benefit from a wide array of offerings from more colleges and universities than ever before. Some have observed that the speed of delivery and the diverse offerings are just an important new beginning and that what remains ahead is to "address the challenges of constructivism and move our still conventional institutions to seriously embrace online teaching and learning" (Anderson & Simpson, p. 6, 2012). Pedagogies, outcomes, and curricular standards have yet to keep pace with the technology available to deliver courses. Of note, however, is that with all the changes in distance education, the most current state of it contains all its previous states. Each of these pedagogical approaches (behaviorism, cognitivism, constructivism, and connectivism) has played a role in this development, and Web 3.0 is still an unknown entity (Anderson & Dron, 2012). Currently the Internet is in the phase of Web 2.0, where the main distinction between it and Web 1.0 is that now we have more entry points to both read and write the Internet. Formerly, in Web 1.0, there were far fewer opportunities for ordinary Internet users to write and share their own information for others to discover. Web 2.0 has provided great opportunities for both individual financial gain and viral notoriety. This is an essential development in working towards a democracy of wealth and power, and it is also the first successful attempt towards a rapid rebalance of Caucasian male dominance in media. These approaches are discussed later in this chapter because of their relevance to shaping the field of educational technology. Merging these ideas with the ideas found in Chapter 4 of the study are how the theory proposed by this dissertation was formed.

The last two decades have seen staggering growth in schools, colleges, and universities worldwide that have become familiar with course content delivery via Internet-connected devices as well as online engagement either wholly or partially replacing face-to-face time. The strangely named MOOC (Massive Open Online Course) that was once a rarity or outside alternative option for students and teachers has become widespread; one can enroll in courses at Harvard for free via their MOOC. Most schools have an online supplement to their physical meetings, while a few schools operate solely online. Postal carriers on horseback and then video cassettes have been abandoned for high speed Internet. Distance education is here to stay and will only continue to grow in size, options, availability, course offerings, and popularity.

A History of Computers and Classrooms

The teaching machine. In the 1920s began the search for a way to automate some elements of teaching. This began in the field of psychology when Dr. S. L. Pressey presented a machine at American Psychological Association meetings: "Rather than stultifying education, such mechanical aids should free the teacher from unnecessary burdens and leave her free for those inspirational and thought-stimulating activities which are, presumably, the real function of the teacher" (Glaser & Lumsdaine, 1960, p. 24). Substituting the human with the machine, from the onset, was a thoughtful method for creating more time and space for more of the intangible qualities of study and learning to occur. When people can luxuriate in their studies, probe inquiries, seek answers, combine the minds of the people in the room towards a shared collaborative purpose, a different sort of teaching and learning takes place separate from rote learning. The machine “allowed the student to respond to a set of multiple-choice questions which was asked after he or she had read the printed passage of material to be learned” (Collis & Muir, 1984, p. 1). The "teaching machine" gave instant feedback as to whether a correct response

was provided by the student, and a record of the responses were registered for teacher review. This time-saving device was designed to help push teaching and learning into new intellectual pursuits that did not require a teacher to check for comprehension or memorization of facts and formulas. The early history of the machine in the classroom was to outsource the least creative and intellectually stimulating aspects of teaching students. Certainly, this concept was met with opposition, though the purpose and the vision of the machine in the classroom had radical and progressive roots. Encouraging teachers and students to focus more on deep thinking and innovation carried with it the sense and spirit of a "deschooled society" that departed from rote memorization and test scores driving the focus.

The sense of urgency to meet the needs of a growing population of students entering classrooms via mandatory schooling impacted the decision-making of policy makers and administrators. With a demand for graduation outcomes to become standardized, at a minimum across a city or county, and extrapolated further to nationwide expectations that would come later, it was easy to see the tensions between teacher autonomy and innovation with a perception that every student should have a similar foundation or base of knowledge when they leave school. The teaching machine and other audio-visual aids and materials then became part of the larger machine of society, the factory model of education that Freire (1970)decried as "banking education" which was later also criticized by other scholars, even though it does still exist at the time of this writing. After World War Two, in the United States, the education system needed to expand:

> There are more people in the world than ever before, and a far greater part of them want an education. The demand cannot be met simply by building more schools and training more teachers. Education must become more efficient. To this end, curricula must be

> revised and simplified, and textbooks and classroom techniques improved. In any other field a demand for increased production would have led at once to the invention of laborsaving capital equipment. Education has reached this stage very late, possibly through a misconception of its task. . . . It is best seen in the productive interchange between teacher and student in the small classroom or tutorial situation. Much of that interchange has already been sacrificed in American education in order to teach large numbers of students. There is a real danger that it will be wholly obscured if use of equipment designed simply to present material becomes widespread. The student is becoming more and more a mere passive receiver of instruction. (Glaser & Lumsdaine, 1960, p. 137)

The problem that this dissertation addresses was baked in to the history of how computers and students and outcomes were viewed as fixed objects that are generally predictable and capable of being placed in boxes. There has been great popularity of the didactic approach to education due to it being normalized, somewhat through necessity, and somewhat through preference. Skinner's observations are important in naming the confluence of content delivery changes with a student population increase. These were accidental variables that merged, however, the impact has been far and wide reaching, in that instruction over construction easily emerged as the dominant pedagogical approach under such conditions of class size. That teachers could and would utilize audio-visual aids to "automate instruction" makes perfect sense, and it is precisely this history that continues to be of interest in this dissertation. The reliance and patterning of technology to replace the instructor formed what I view as a destructive and damning view of technology in the classroom—the computer did not have a chance to become anything but a lonely terminal for one student or a bank of computers for students to individually work on the

same task, albeit side by side, under these conditions. Passively receiving instruction is the history of computers that this dissertation wishes to name, critique, disrupt, and circumvent.

The 20th century in American education showed some great promise for interdisciplinary work that bridged home and school worlds. In particular, the John Dewey progressive schools, however, were not sustainable as a mainstream approach once the school-age population increased and there were competing notions of grades, assessment, and course units. Furthermore, the Educational Testing System (ETS) became a corporate entity that worked from the outside to standardize curricula and outcomes inside therefore causing schools to aim the work done in classrooms towards goals external. B.F. Skinner's observations of conditioning students to become passive recipients of information and knowledge, without accident, lined up historically with the rise of ETS. The teaching machine became just another vehicle for 'filling the heads' of students to satisfy requirements that focused on grades, matriculation, standardizing knowledge, and standardizing units of study and transcripts for graduation and college admissions.

Computers grew later in the last quarter of the 20th century to have great potential and to serve many of society's needs, from communication to transportation to urban design. We may not be able to fully quantify the influence that these early days of behaviorism and cognitivism in computer usage had on the trajectory and fate of the educational value sitting latent, though it is possible to link and superimpose various connected histories and ideas to see the shape of events and their value. That the first computer was a terminal for single use in a single data set for a single student to "get it right or wrong" is rather symbolic at this later stage in computing history, as so much has changed in not only the construction of the machine itself but also in the theories of knowing and creating meaning. Again, this dissertation finds inspiration and a philosophical

toe-hold in that layered and intriguing history, because the early ideas of Dewey could not have been successful with the technology of his day. However, today there are no restrictions from the machine but plenty from individual educators, the parent community, the educational institution, the college admissions matrix, and the mechanisms for students to demonstrate competence in individual subject matters. This conflict should be surprising given that at this later stage in educational and computing history we also have plenty of great ideas stemming from progressive education, critical theory, constructivism, constructionism, and connectivism, in addition to a well-informed public growing in awareness and demanding more options for their children's schooling that break free from tradition.

Programmed instruction. B. F. Skinner expanded the use of Pressey's machine with his own theories regarding operant conditioning that postulated that a student's learning occurs in response to a behavioral change. His teaching machines were constructed so that the "initial learning materials were also presented by the machine" (Collis & Muir, 1984, p. 1). This approach became known as programmed instruction (PI) and had the impact of reducing the number of instructional minutes needed on a lesson. The behaviorist approach to using these early teaching machines primarily focuses on a stimulus-response method whereby students are presented with new pieces of information (one at a time) that are then expected to be correctly typed on a keyboard. The machine then gives an automatic reply after checking the answer and presents the incorrectly answered question again. If the student keyed in the correct answer, he is supplied with a new question in the sequence (Troutner, 1991). Over time, however, educators and researchers observed that students of average achievement and above were not engaged by the Skinner teaching machine, and despite the interest, research, and funding throughout the 1950s and 1960s, this early computer-aided instruction (CAI) fell out of use (Collis & Muir,

1984). Nonetheless, this approach automated the acquisition of information and became an important standard for moving students through a set of data with the aid of the machine. Most of the computing history that followed this achievement to assist students to develop their knowledge base did not stray from the basic premise of stimulus-response. Curricular packages written specifically for the teaching machine continued to rise in popularity and variety to this day. One does not have to look very far on the Internet to find free and low-cost downloadable programmed instruction. That the computer serves as an endpoint "instruction kiosk" does not surprise us due to its long history of similar use in many learning environments.

This dissertation is directly analyzing and criticizing that very dilemma which has dogged our progress and reinforced and reified the negative forces of computers in the classroom. Education is personal and political (Freire, 1970); each of the decisions made on behalf of subjugated students, particularly the marginalized and underrepresented, comes with great consequence in their lives, and impacts the future patterns and attitudes of school leaders in their planning of curricula and pedagogy. Programmed instruction is counter to engaging with student voice, choice, and inquiry. In 2019, in the age of extended reality (XR), when computer hardware, software, and Internet bandwidth are all at peak highs in their development, and the future job market for current students in elementary school is far less predictable than ever before, the old standards of educational tradition are having a harder time proving their relevance and success rate. Folded into this shifting future and how we respond is a persistent need for students to be critical thinkers, conscious readers, articulate writers, empathic listeners, engaging speakers, logical argument-makers, flexible collaborators, and creative innovators—these skills have long been the focus of school and will likely always be, but how those goals are achieved form the heart of the ongoing debate in education.

Computer assisted instruction. A few major developments occurred in universities and labs during the 1960s. First was the PLATO system (Programmed Logic for Automatic Teaching Operations), which contained many courses that the computer was programmed to teach the user at his own pace. The system relied heavily on a graphic interface which eventually even allowed for the user to use touch to interact with the material, which while not uncommon in 2019 was monumental at that time. Using a keyboard, a basic tool for subsequent decades, to interact with the computer first happened with the PLATO system. The coursework on PLATO "had been prepared by subject matter specialists" (Collis & Muir, 1984, p. 2) using a new computer programming language designed by professors at the University of Illinois. Similar to how one constructs objectives, a syllabus, and lesson plans for a correspondence course using the postal service, the software product had the power of interactivity along with being a standalone set of course materials, assignments, tests, and quizzes. This was the start of trying to create a classroom experience in a packaged commodity. PLATO had a few hardware incarnations up through the 1980s before the coursework software alone became the focus and continues to be sold today. This milestone served as an important beginning of software packages containing predetermined curricular databases of material prepared for, often self-paced, student work at a computer terminal. Of interest here is also the common perception by non-educators that the measure of a successful course is more about the amount of information that a student can readily access from his mind after completion. Educators, on the other hand, spend far more time discussing and theorizing how to engage with students in a process of learning that is oftentimes difficult to measure in a quantitative fashion.

At the IBM laboratory in San Jose in the 1960s, another development occurred with the creation of the IBM 1500 system that "included such features as light pens, color image

projectors, and computer-controlled audio units" (Collis & Muir, 1984, p.2). This system became highly regarded for being able to process large amounts of data and providing sophisticated learning experiences. The flexibility of the system hinged primarily on the floppy disk drives, which allowed for a variety of software writers to provide diverse offerings of programs. This shift opened the door for many changes that allowed a new creative period to flourish.

The development of software was a key expansion from the 1960s forward. The Computer Curriculum Corporation (CCC), which later became part of Pearson Educational Technologies, led the field out of Stanford University. This movement dovetailed in the 1970s and 1980s with major advances in computer hardware that then allowed for even further new developments with software. New computer programming languages were being constructed which allowed for some standardization, and thus portability, of the software programs. In particular, the languages BASIC and LOGO made their way into schools and homes because they were written for novice users. This richness led to the creation of some major software companies that dominated the field for decades: Broderbund, The Learning Company, and the Minnesota Educational Computing Consortium (MECC). These companies produced most of the programs that were in classrooms during the 1980s and 1990s. Many students of those years fondly recall the quirky and sometimes bizarre experiences they had running through programmed instruction in other worlds they could not have imagined. A student's experience in an imaginary world interfacing with a set of data had value, but how much? What are the implications of the student's experience at the computer terminal towards furthering her education in any given subject? What are the learned behaviors and attitudes about ideas and information that students gather from their experiences at the computer? This dissertation wishes to ask the questions about the history of classroom computer usage in an effort to reconnect and

reconstruct some of the original efforts and visions of its creators combined with later-formed theories of constructivism, connectivism, and critical theory.

Microchip expansion. Computer Assisted Instruction (CAI) as we tend to think about it, began in earnest from 1975 forward due to the expanding computing power of the microchip. This led to uses beyond the drill-and-practice software programs, even though they still dominated the marketplace. Uses for the newly added audio systems and graphic interfaces were rapidly being developed, and before the now-ubiquitous mouse, there was a light pen with which students could interact with the computer screen. Some of the most popular computer programs from this era still provide inspiration for future developments and mark important cultural reference points with their recognizable early 8-bit graphics. Programs such as *Apple LOGO*, *Where in the World is Carmen SanDiego*?, *Lemonade Stand*, and *Oregon Trail* led the way for developers and educators to view teaching machines with renewed interest (Troutner, 1991). A spike in classroom computer usage drew many to view not only a lucrative marketplace but also a potential to deliver material in a novel manner. One element that did not change, though, was the approach to learning through a "right answer" approach. Whether the software program presented a realistic or fantastic setting for the material to be learned, there were programmed questions and answers that had to be correctly completed in order to move the user from one stage to the next.

The use of audio, video, and CD-ROM materials grew in popularity during the 1980s and 1990s, until Internet connections became more cost-effective for schools to access materials and programs remotely. Curricular materials that move and engage the student's senses allowed for a greater exchange of ideas, as well as for students to immerse themselves in new concepts outside of the classroom face-to-face time. The computer screen became more appealing due to the

combination of interactivity with sound and video, though it is important to note that these changes were in line with the very early history of Pressey's machine—a student was greeted with a stimulus and must respond. Change came mostly to the speed of the hardware, the diversity and richness of the software, and the immersive qualities of the experience.

With each passing year, more schools developed their infrastructure to not only provide high quality wireless connections to the Internet, but some also provided laptop and touchscreen computing devices to students. These software programs and hardware implementations fit well within the boundaries and parameters of traditional schooling, as they were teacher-directed or school-mandated. However, since 2004, an explosion of variety and availability of utility programs, user-uploaded content, and social networks has grown at a previously unseen pace alongside a rapid increase in younger and younger students using microcomputers in their daily lives outside and around school. Web 2.0, or the read-write Web, has shifted both the expectations of its users and the demand in its use. How educators and districts and governing agencies respond to this shift is an ongoing discussion.

The prescient observations of Gordon Moore and Bob Metcalfe that the processing power of a microchip will double every two years, and that a network's value will quadruple as it grows in size, are debatably the two "rules" that governed life with computers and the Internet (Yoo, 2015). Nearly any discussion about computer processing power referenced Moore; and nearly any discussion about the depth and breadth of our networked devices and identities referenced Metcalfe. By 2019, the enormous leaps of both the microchip's power and the network's power are quite possibly far beyond what we use them for on a daily basis. However, with that kind of potential, we have upon us a new day, and a new ability to extend our thinking about knowledge and our relationship to learning with computers, computing, and digital learning environments.

What is next remains in perpetual renegotiation outside the school's walls while some inside the school's walls make new paper copies of last year's articles and tests.

Looking Ahead. The reality of computers woven into so many elements of a day's activities is more than a trend but is now a fact. As expected, there were healthy debates regarding when and if and how schools and educators respond to the shift in how information is created, acquired, and synthesized. For some, it was clear over 25 years ago that in order to restructure education with computers and computing: "Teachers will need to change drastically as they adopt a role as learning facilitator of knowledge and drop the role of knowledge dispenser" (Troutner, 1991, p. 14). Although the potential to be a constructivist tool sits latent within the computer's place in school, computers in classrooms today are still more often than not used as stimulus-response terminals, encyclopedias, and word-processing utility devices. The forces that dictated this use are many ranging from state legislators to site principals. School funding tied to student standardized test scores alone will hinder creativity in the classroom. Once we allow for critical theory precepts to enter the dialogue regarding school policy and philosophy, we should anticipate an enormous number of questions and dilemmas that face the profession, the culture of schools, the coursework of teacher and administrator training programs, and the experiences of the students themselves. Educators are highly skilled at thinking about what works best for students, however, this can be a self-congratulatory echo chamber of concepts that dysconsciously excludes student voice about their experience.

Where we decide to take students in their pursuits of knowledge and wisdom during their time on earth is a decision often shrouded in metaphor and vague hope. The rhetoric of the elders on the pulpit of the world stage often make grandiose claims that sidestep one salient fact: the whole of humanity cannot decide for an individual human what works best without considering

the choice and voice of that one student. Seeking to create schools that are inclusive and meaningful for all students has always been the core goal of education, but it has become a political mishmash laden with catch phrases and ladled with catch-of-the-day programming for sale to the highest bidder. And the teacher's practice of force-feeding students Monday through Thursday to have them regurgitate on Friday's exam only further emphasizes the deep void and the soulless and purposeless purpose:

> In the light of our present knowledge a school system must be called a failure if it cannot induce students to learn except by threatening them for not learning. That this has always been the standard pattern simply emphasizes the importance of modern techniques. John Dewey was speaking for his culture and his time when he attacked aversive educational practices and appealed to teachers to turn to positive and humane methods. What he threw out should have been thrown out. Unfortunately, he had too little to put in its place. Progressive education has been a temporizing measure which can now be effectively supplemented. Aversive practices can not only be replaced, they can be replaced with far more powerful techniques. The possibilities should be thoroughly explored if we are to build an educational system which will meet the present demand without sacrificing democratic principles. (Glaser & Lumsdaine, 1960, p. 159)

We have been at a crossroads for many years with how best to use the computer in the classroom and many organizations have sprung up to meet this need and demand. Most computer-using educators would agree and argue that replacing paper was not enough of a reason to use the computer, and that we already have many strategies to engage students in meaningful work without a computer. Skinner's observations were essential on this topic because of his close work in operant conditioning and with Pressey's teaching machines. For if he knew that we were

unfounded in our approach and not yet fulfilling the promise of developing an educational system to transform lives, then the alarm bell has been sounding—for a long, long time.

The percentage of young people who are already on the Internet in a wide variety of ways is staggering and important. In contrast to classrooms where computers were frequently used for closed loop database exercises and activities, in 2015, about 71 percent of children ages three to 18 use the Internet (National Center for Education Statistics [NCES], 2017). This represented a major shift in how students receive and create content, for the Internet is created largely by the people who use it. Teachers can connect with classrooms across the globe in real time and hold collaborative classes over the Internet. Students can write and publish original compositions to the web. Information scientists can extrapolate and interpret multiple data streams from a variety of sources. The decades prior showed a relatively stable approach to information and data, as the materials were controlled by the publishers of the computer programs or video sources. As more and more people created the content that we search for on the Internet, course syllabi included more intersections of information. The precepts found in connectivism attempt to explain these swirling spirals of information gathering, sharing, consuming, and creating.

Most of the trends in the history of information technology showed a demonstrated bi-directionality of exchanging ideas. Software author created a program, software publisher sold the product, schools bought it, and students ran through the programmed instruction. Rarely did student user feedback make it back to the software author, if at all. While the information acquired by the student occurs in a novel manner that entertains and excites and engages the young mind, this pattern still followed the banking method (Freire, 1970) approach that devalued the experience of the learner. As the information age shifted and grew since the 2000s and now into the 2010s, and almost 2020s, there are hints at new methods and new software and hardware

that provide tools to push at the edges of what is possible. However, so far, the majority and dominant forces shaping the use of educational technology maintained a focus on the program, the sequence, and the mastery of content as prescribed from national, state, and local authorities. This approach has persisted since the advent of teaching machines and has similarities with the history of distance learning—content is prescribed, programmed, and practiced. Correspondence courses and teaching machines have a long and healthy history that carried at their core an intent to educate and develop well-informed and productive minds—there is no malice here—however, when processed through the lenses of constructivism and critical theory, one can begin to observe how these historical methods ended up falling short of not only the potential latent within the machines themselves, but also, and more essentially, falling short of meeting the true needs of the young minds that cannot yet know that they were being shortchanged in the process.

Literature Review, Major Concepts of Extant Theories

This section of Chapter 2 discusses relevant concepts found in the literature that relate directly to the construction of a new theory for digital learning environments (DLEs). Virtual reality, augmented reality, and mixed reality environments were all included as possible digital learning environments, although the focus for this dissertation was more towards mixed reality. The reason for using mixed reality over virtual reality was simply to acknowledge John Dewey's assertion that students can create more authentic connections among their schoolwork studies and their home lives when we purposefully mix them. A mixed reality DLE situated their studies within their zone of proximal development, and furthermore allowed for more authentic face-to-face time to occur in classroom spaces. Virtual reality headsets would entrap individual users in their own immersive worlds. While capable of being shared, the virtual reality immersive spaces did not yet acknowledge and make use of some essential human attributes that make up the

intangible qualities of every classroom. So, until there is a new development, and there is always a new development, a mixed reality hardware and software solution is, at the time of this writing, the best solution available.

The following table highlights the existing theoretical precepts relevant to this dissertation. These ideas, together with the history of distance learning and the rise of the computer, along with the annotations found in Chapter 4 will together be used in a synthesis that points toward a unified learning theory for digital learning environments (DLEs).

Table 1
Existing Theoretical Precepts from which This Unifying Theoretical Dissertation Draws

Extant Theory Precept	Author	Theory
The learner responds properly to the presented stimulus.	Pressey (1926), Skinner (1958)	Behaviorism
The learner processes and applies patterns of presented information.	Piaget (1928, 1959)	Cognitivism
The learner creates meaning and interpretation through experience with a body of information.	Dewey (1916) Bruner (1956, 1961) Papert (1972, 1980)	Constructivism Constructionism
The learner discovers solutions in an active exploration of a problem to solve.	Dewey (1916) Vygotsky (1978) Papert (1980)	Discovery Learning Constructivism Constructionism
The learner discovers solutions and creates meaning in a shared environment.	Dewey (1916), Papert (1980) Siemens (2005, 2006)	Constructivism Connectivism
The learner uses reflection as a tool to process presented information as well as personal interpretations.	Dewey (1916) Freire (1970)	Constructivism Critical Theory
The learner applies social and cultural critique to all learned and individually developed interpretations.	Freire (1970)	Critical Theory

Note. The precepts identified here are adapted from seminal works of the above named authors. This list is not exhaustive but instead serves as an orientation for the ideas to come in this study.

It would be a mistake to think of any of these stages or ideas as inherently bad, so it is crucial to reiterate the positionality of this dissertation's author as one that is ever curious and devoutly intellectual while also clearly holding an opinion wishing to be articulated and explored in the pages herein. To discuss behaviorism as a negative force will undoubtedly come across in this document, but it is not because its precepts are malicious. It was the reliance on stimulus-response that has led to the development of the computer as a "behaviorism box" inside of a test-obsessed national context. And that right there is the main dilemma that this dissertation wishes to address in a not-so-mild manner. To be clear: computers in classrooms have potential that can be unlocked in service of marginalized students, and this alone is cause enough to give new life and new purpose for the social justice educator looking at how we can do better and do more for the young minds of today.

The goal of painting the landscape of the relevant ideas found in the literature was to explore a new combination of ideas found when mashing up critical theory, computers and computing, and constructivism. "When a school is constructivist and the test is the typical state standardized test, the school will be at a disadvantage" (Wenglinsky, 2005, p. 51). That we are faced with those big decisions to make a school either traditional or constructivist demonstrates a gap in the literature that this dissertation aims to address, as well as a social justice issue: "The data indicate that the real digital divide is between the constructivist uses to which white, affluent, and suburban students are exposed and the didactic uses to which minority, poor, and urban students are exposed" (Wenglinsky, 2005, p. 83). To make good on the promise of public education we must openly and immediately address this problem. At the heart of the unified learning theory for computers, computing, and digital learning environments proposed here, Critical Techno Constructivism seeks student liberation as the future of learning and schools.

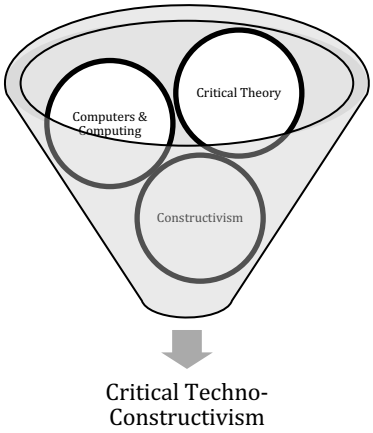

Figure 1. Main topics for this dissertation's unified learning theory.

Behaviorism

This approach to teaching and learning focused its attention on a subject's response to a stimulus. A teacher provided a query to which a student must then reply. The teacher chose to show the correct answer or to develop another method to intervene, however, the student soon saw the correct answer after answering the query. The option of revealing the correct answer to the student provided an opportunity for mastery learning, though it became a rote learning exercise. This back and forth between a student's state of "not-knowing and knowing" served a clear purpose to assist in knowledge acquisition so that a learner may develop a facility with identification of facts and equations (Glaser & Lumsdaine, 1960).

An approach that heavily relied on a behaviorism may have encouraged some students to think of knowledge as small attainable bits of information that were useful mostly for recall and identification. However, the ability to manipulate information and transform it to other purposes and uses may have relied on a student's awareness of the very information with which he is interacting. Therefore, the popularity of behaviorism in the first half of the 20th century made it simple to mistake for "knowing things" what was likely more accurately described as a reflection of recall and identification. A response to a stimulus asked the least from the student in the

learning process. The early design of the teaching machine, which later became known as the computer, was aligned with the history of behaviorism in schools as the primary learning theory (Casas, 2002).

Using this didactic approach "views student learning as going through a linear progression from facts to analyses of these facts and from basic skills such as numbers and operations to more advanced skills such as solving complex problems through analysis of real data" (Wenglinsky, 2005, p. 5). Students typically moved at the same rate in this setup and their grades and matriculation were comprised of a composite score of the number of questions answered correctly divided by the number of questions given. A practice problem done in class was typically found with a similar setup but differing variables on both the homework and the test. This was a highly recognizable form of schooling worldwide for many decades.

A behaviorist model did not preclude a student's self-driven inquiry, though it did not explicitly encourage it. Looking, however, at the concurrent timelines of Pressey's teaching machine and programmed instruction as behaviorism was also employed in a nontechnological manner, one can tease out the trends of the day. Combined with the mandate that all students must attend school, and a growing student population, a rote teaching and learning experience did have a logic to it to accommodate these competing forces. As psychology and brain science developed, so did a new learning theory—cognitivism. The early roots of computers and programmed instruction were slow to shift away from behaviorism to cognitivism and early constructivism, and that is why this study exists.

Cognitivism

A cognitive approach to learning placed value on the relationships to associations and experiences that individuals have when they interface with information. The cognitive scientists

relied on “all that happens” when a student processed information that she newly encountered, for therein lay the neural pathways of understanding and connection leading to deep learning. Some argument between behavioral and cognitive positions revealed the shifting value and importance of the information itself that was destined to be learned by the student. This represented an essential element in the exchange of information and the learner’s movement between “not-knowing and knowing”—what was measurable and why was it measured? A cognitivist approach concerned itself with the meaning placed on the information by the learner and looked for patterns of understanding the method that the student used to learn and if there were an emotional connection or other motivational impetus that could explain a student’s willingness to engage (Piaget, 1959).

This break from behaviorism represented an important development in viewing the individual student in the classroom as a being who can have shifting reasons for wishing to learn and finding difficulty or facility in doing so. The information laid before a student to be studied may not be of the student’s own choosing, but there was yet an interest in looking, with cognitivism, at the individual’s mind and emotional state as part of the process.

Studies conducted by Jerome Bruner (1961) showed that one can observe patterns in the manner that a student approaches novel material and attempts to make sense of it, and that these patterns are clues as to how that student perceives information and stores it for future use. This broke from behaviorism in that it acknowledged the primacy of the student in the learning process:

> It seldom happens, however, that we can consider the categorization of single instances without references to the way a person has categorized other instances which are identical or similar. We need to look at a series of instances in order to know what the properties

> are upon which the person is basing a categorization and what overall procedures he is following. (Bruner, Goodnow, & Austin, 1956, p. 183)

Some of the work done by Bruner and his cohort represented early trending towards the development of personalized attention to the learning process and marked an essential reference point in the ideas leading to constructivism and beyond. Cognitive studies required more in-depth participation from the learner to better understand process. And of note in this historical overview was the potential that opened with cognitive science to wonder about possibly observing patterns in generalized ways based on culture, race, socioeconomics, ethnicity, sex, and gender. While a path fraught with overgeneralizing and stereotyping was dangerous, the concept was pure and at its heart helpful towards individualized education plans and culturally responsive pedagogy.

Additionally, studying human behavior in this manner opened the researcher to a similar scrutiny. A scientist interested in how people process information was also interested in his or her own processing of that which was observed:

> Repeatedly we have sought parallels in the behavior of the scientist going about his business. Seeking to discover what areas of the cortex mediate speech or what substances evoke allergic reactions, the scientist is engaged in much the same kind of behavior as were our subjects. The scientist too is faced with the task of assimilating information, conserving cognitive strain, and regulating the risk of failure and folly. (Bruner et al., 1956, p. 246)

This dynamic angle of interaction between the subject and the scientist was linked to later developments in constructivism, where teachers and students co-constructed truth, and connectivism, where each participant's pathway to discovering, gathering, organizing, and

applying information was unique. Additionally, cognitivism had links to situated inquiry which placed importance on the context in which the teaching and learning took place. All in all, the work of the cognitivists created some of the most important developments for modern educational philosophy. Combined with the brilliance of the behaviorists and their use of the teaching machine to normalize computers in the classroom as an educational tool, the stage was set for new ideas to tumble out and redefine the learning environment.

Constructivism

Developed from the dust-ups between schools of thought regarding how to best understand the process of learning was this dominating force—constructivism. In some fashion or regard, this has been the major focus of teacher and administrator training programs and has taken root in some schools worldwide. However, constructivism, while agreed to by many as perhaps the most effective way of engaging students in becoming active agents in their own education, still does not represent the "go-to strategy" when teachers plan their courses and lessons. In fact, some viewed the experiential or immersive elements of a constructivist approach as highly improbable in leading to a worthwhile learning experience for students. Particularly in high school and beyond, many adults expected students to be held responsible for what essentially boils down to rote memorization and stimulus-response behavioral examination questions each with one single right answer.

For decades, and perhaps even over a century ago, the fundamental principles of Constructivism were discussed and written about in educator and philosopher circles, even without always being officially claimed and named by constructivists. There was no shortage of evidence to point to the kinds of questions and attitudes towards learning and growth that students ought to adopt on their way to becoming thoughtful, productive, and critical-minded

citizens. The constructivist way of co-constructing meaning with students in a shared environment tended to decenter the classroom and focus on dynamics and relationships in the process of experience and doing and learning. Jean Piaget (1959) wrote many texts and conducted many studies about this pedagogical approach and philosophy. His body of work is unmatched and does much to show how intertwined and group-reliant people are in the formation of their ideas:

> For it is chiefly in relation to other people that we are obliged to unify our beliefs, and to place on different planes those that are not compatible with each other, so that we gradually build up within ourselves a plane of reality, a plane of possibility, a plane of fiction, and so on. The hierarchy of these planes is therefore determined by their degree of objectivity, and the capacity for objectivity depends in its turn upon the socialization of thought, since we have no other criterion of objectivity than the agreement of different minds. If our thinking remains shut up within the ego, if it cannot place itself at the point of view of others, disparity between objective and subjective will be through this alone seriously endangered. (Piaget, 1959, pp. 245-246)

A decision in one's mind to agree that an idea makes sense is weighed against the other held beliefs in the room at the time, however if this occurs in isolation, one risks viewing subjective truth as objective, which is a threat to society. There is a natural and internal series of checks and balances when one learns and thinks in a group setting. People will naturally allow and disallow this or that interpretation to take root when discussed in a shared manner. This is beneficial to students for it provides them with a diversity of opinions from which to choose and use as they best see fit.

Constructivism was antithetical to the lecture model of traditional schooling and was directly posited against behavioral philosophies. Cognitive methodologies do share some similarities with constructivism in that they both are interested in the processes involved in how students "come to know" newly acquired information. Where they differ is that the constructivist approach goes further to then consciously create a learning space where meaning and truth can be determined and articulated depending on the students and the experiences they bring to the coursework. There are more examples of experiential learning within constructivist frameworks than behavioral or cognitive (Vygotsky, 1978).

Critics of the constructivist approach also focused on a misunderstanding of co-constructing truth. Nobody was redefining the laws of gravity or disputing the historical records as written. However, the facts that were taught as facts had different impact and meaning when an attempt was made to help students connect these bits of information to their own experiences. The natural cultural exchange that ensued in a constructivist method was a rich one full of possibility.

An experienced teacher within this context needed to do more than plan the material necessary to teach students a concept; the lesson changed and developed as students applied the newly acquired information to their individual understanding of the world in which they lived. The teacher's role was not the repository of knowledge but instead the facilitator and mediator of sharing reality and sharing truth. A pure constructivist school would likely look nothing like how most people alive today have experienced school, for it placed greater value on what happens in the dynamic created in the classroom than any traditional external measure of success. Results from a norm-referenced national standardized test would not matter nearly as much as the personal insights of a student delivering an argumentative speech, about her months of work,

collected in a digital online-viewable portfolio, that she will submit as part of her college admissions packet (Educational Technology in the 21st Century, 1995).

Critical Theory

Made famous by the Frankfurt School in the early part of the 20th century, the precepts of critical theory have more recently also dominated teacher and administrator training programs. By emphasizing the need to stay inquisitive, perhaps even vigilant, about governmental and institutional decision-making that impacted social programs and norms, critical theory became an essential tool to equip educators to help point their work toward establishing civil liberties for all people. The rights and equities that we wish to enjoy did not come as default for all people, and the battles continue even today in 2019. Life, liberty, and the pursuit of happiness are still but dreams for some and it is incumbent upon all to make sure that the rights of the many are not only given to some.

Critical theory was the methodology that empowered students to question the authority of their teachers. Critical theory was the methodology that empowered parents and teachers to question the authority of their school and district leaders, as well as their congressional representatives. Critical theory was the methodology that empowered everyone to question the authority of college admissions counselors and national testing agencies.

The Frankfurt School and specifically the work of Paulo Freire reverberated throughout education with the clear call for all of us to put forth serious effort and concern regarding diversity, equity, and inclusion. Famously, Freire's (1970) "banking education" and "narration sickness" were large parts of the thinking in this dissertation. These are problems to avoid, these are known pitfalls that have flagged educational technology since the dominance of the behavioral philosophy. Further criticism of computers in the classroom will certainly look to the

norm of whiteness, the dominant culture, and wish to name and think out loud about the number of software products over the years that contain contexts and references that treat whiteness as the default. As the rise of software programs for education grew through the 1970s and 1980s, the research on multicultural education had only just begun and had not yet been used as research that would influence the writing of the contextual and cultural cues to appear in the prevalent software programming.

A critical theory approach to analyzing computers and computer software would additionally consider a multivalence in learning pedagogies. Certainly, in the last decade, many advances have been made to include students with disabilities as a core component of the audience for computers in the classrooms. Adaptive technologies are not only hugely profitable but in high demand. Again, the Frankfurt School mindset would have us question the social justice of the large uptick in pricing for these measures of inclusivity, but this is the corporate approach that is "baked in" to how work is done. Using the computer also as a tool to learn English shares as much of the spotlight as adaptive technology, and this should be viewed positively. However, attentiveness also to students of color, students living in poverty, students who are first generation college-bound, and all subaltern or marginalized voices remains as work in progress and mostly undone. Naming the problem and addressing it openly in public and private spaces will allow society to progress towards more diversity, equity, and inclusion. While billions and trillions of dollars are scheduled to be spent on computers and computing in schools in the upcoming years, we must insist that culturally relevant and responsive software is available in just the same way that we demand adaptive hardware.

A critical theory approach to present-day computers and computing for students in the classroom would tend towards an open-source sandbox model rather than a programmed

instruction model. A small team of people creating a closed loop data set for students to move through would give pause to the critical theorists; from what cultural norms is this team creating the data set? Instead, the Frankfurt School approach would push for freedom for students to choose and select material and formulate their own connections via their cultural backgrounds and ways of interpreting the world. With modern hardware, software, and Internet bandwidth, this freedom is not a challenge to physically obtain, though teachers' approach to the classroom itself would need to change. Interestingly, the classroom may need to simultaneously step forwards and backwards in time. Forwards towards new technologies and backwards towards old philosophies.

John Dewey

John Dewey's contributions to education cannot be spoken about enough. His vision for the school itself to serve as the fertile ground where students explored, experienced, and transformed that which they would encounter outside of the campus perimeter was a meeting ground for all constructivists and at the theoretical center of this dissertation (Dewey, 1916). Because they are complex human beings, students arrive to classrooms with worlds of contexts within them. Even without any electronic devices to create meta-worlds or avatars or alternate personae, humans are naturally drawn towards creating narratives and fictions of their lives and relationships.

Dewey's work was interested in finding ways to have the school honor the inner lives of students that from outside of school, and to help draw students closer to the not-so-secret conversation about how school and life were very much closely aligned. The subjects that schools try to teach do indeed happen in the lives outside of the school's perimeter, and so it made sense that students might, with an instructor's guidance, see how what they think, see, and

feel matters inside of the classroom. Further, the interrelationships of students with other students created another series of in-roads and nexus points that a sensitive instructor might find appropriate to use as part of the classroom study.

Inside, between, and among the dynamics of their interactions, multiple curricula worthy of teaching naturally emerged. Add to these natural interplays the intersections of the students with the coursework and its expected outcomes, and there was the rich opportunity for an interwoven complex of narratives and metanarratives within a classroom. How students reacted to the very material taught made for important feedback that instructors used to alter lessons and approaches. Schools today often struggle within many constraints that obscure the following: "The inclination to learn from life itself and to make the conditions of life such that all will learn in the process of living is the finest product of schooling" (Dewey, 1916, p. 56). The pure vision of Dewey's school butts up against standardized curricula and testing tied to funding. Well-intentioned educators who care deeply about their students may find that the Dewey school can exist only in the small passing moments of classroom and school life, but that the full realized vision would not be possible for it cannot guarantee that students will be able to demonstrate content area knowledge at state and national determined age benchmarks.

Digital Learning Environments (DLEs) offered us a modern opportunity to intentionally return to Dewey's core thesis and reconnect the artificially disparate subject areas of "capital S school" so teachers can capitalize on the rich opportunity naturally presenting themselves within the classroom. Dewey's lesson to educators was that we already have the landscape for experimental experiential education inside the minds and interests of the students and how they interact with each other and their environment in real time, without Internet. And now, with Internet, we have the tools to expand and extend the classroom in ways that were previously

unattainable. Mixed reality, augmented reality, virtual reality, extended reality, these are all not only new technology approaches to John Dewey's classroom, but they are also wonderful metaphors for how the four walls of the classroom alone are limiting barriers to the work of school. The construction of ideas and artifacts by students when in school is oddly radical. The primary focus of school is still on instruction instead of construction, though there is simultaneous discussion by all stakeholders of the need to learn by doing and experiencing.

Constructionism

Seymour Papert's work traced the ideas of Dewey, Montessori, and Piaget to his own ideas about a method to teach students how to think and build with computers. He called this constructionism and positioned it as the next incarnation of constructivism. Experimental programs where students used computers in new exploratory ways have grown to become popular and recognizable curricular models. In the past three decades, Seymour Papert (1972, 1980; Harel & Papert, 1990) helped push at the edges of what tradition expects. The students in his pilot programs often surpassed the test performance of those students who completed the traditional course without technology.

Technology usage in education all too often meant "inventing new gadgets to teach the same old stuff in a thinly disguised version of the same old way" (Papert, 1972, p. 245). As a constructivist, Seymour Papert brought to the conversation the importance of teachers and schools creating spaces for students to learn together with computers and technology, not isolated individually in a corner at a terminal. They ought to literally construct and make things in a shared and open working environment. Papert traced the ideas of his predecessors to his own ideas about a method for teaching students how to think and build with computers (Papert, 1980). His suggestions went far beyond a simple computer lab or a computer in every classroom.

Papert urged us to integrate computer science into the curriculum to allow more student control of the artifacts they produce and the topics they study (Papert, 1993). Pilot programs at schools scattered throughout the world became curriculum models for how students can use computers to complete an alternative course of study and still surpass the traditional test results when sitting for exams (Feurzeig & Papert, 2011; Harel & Papert, 1990). From these early experiments and findings, there have been moves to place teaching and learning within DLEs as standard practice in the classroom. Online courses, blended learning, and ventures into extended reality (XR) all represent efforts to figure out how to use the digital space to extend the classroom. Robotics and engineering workshops, clubs, and courses all represent efforts to put students at the center of construction and "making things" in the classroom. One might argue that many of these efforts are fixed outcomes and that the exploratory spirit has been stripped. This dilemma remains central to this dissertation study—where is student choice, voice, inquiry, and freedom to "get lost" in their studies assisted by all of these high-powered future-ready tools?

Microsoft's big push to use Minecraft in the classroom is still currently the most widely accepted DLE in schools, with over 7,000 classrooms using MinecraftEdu (King, 2016). An important feature of using Minecraft as an educational tool is that students can work together without the virtual reality glasses that some people, and perhaps rightly so, fear will further isolate students from each other. Papert's goals aligned more with students exploring and experimenting with ideas in a multi-user space in a mixed or augmented reality that allowed for offline and online interactions to happen in tandem. With augmented reality, three-dimensional virtual learning environment (3DVLE) classroom spaces can remain markedly human and preserve the intangible qualities of working together. The constructivists, the constructionists, and the critical theorists alike would likely bemoan students disappearing into single-viewer

goggles. In other words, computers and computing and machines should remain tools that people work with instead of disappearing into; further, the nature and focus of work produced in shared working environments depends highly on students' ability to interact in ways that are natural. The single user virtual reality googles do not allow for that to happen.

Disrupt the Traditional Reality of Schools by Augmenting It

We can really get this "cognitive dance going" (Ackermann, 2001, p. 9) if we invite the blending of what seems like the contrasting aspects of Piaget's (1928, 1959) theories along with Papert's (1972, 1980, 1993). Children develop progressively to have the ability to detach themselves from the world of objects and start moving those objects, as symbols, around in their minds, much like one's invented identity in a 3DVLE can manipulate objects in hypothetical worlds. Additionally, knowledge formation, and transformation, also occurs through hands-on experience and alignment with different media and contexts. Both have a place in multicultural education, and both can be found in a 3DVLE due its flexibility and organic differentiation as the user explores the software and the software learns about its user through artificial intelligence (Ackermann, 2001). Without standardized and norm-referenced benchmarks, students using a 3DVLE can experience a freedom typically not found when studying and learning.

Pulling through the threads of "libertarian education" in this literature review, the confluence of ideas that emerges out of the historical shift from behaviorism to cognitivism to constructivism to critical theory to the age of microprocessors shows a coexistence waiting to be named. Critical Techno Constructivism may be the correct name. The theories identified here are all aimed at opening potentials and possibilities in the classroom and the mind:

> Both Piaget and Papert define intelligence as *adaptation*, or the ability to maintain a balance between stability and change, closure and openness, continuity and diversity, or,

> in Piaget's words, between assimilation and accommodation. And both see psychological theories as attempts to model how people handle such difficult balances. The main difference is that Piaget's interest was mainly in the construction of internal stability (*la conservation et la reorganisation des acquis*), whereas Papert is more interested in the dynamics of change (*la decouverte de nouveaute*). (Ackermann, 1991, p. 4)

A behaviorism-heavy approach limited the development of critical thinking and problem-solving skills; however, we should keep in mind that the early potential of the teaching machine, though built on stimulus-response, was identified as a method to free the teacher to be a creative guiding force in the classroom. A cognitivism-heavy approach also limited the development of critical thinking and problem-solving skills; however, we should keep in mind that the value of understanding mental processing links to the development of culturally responsive pedagogy and ways to include student voice and ideation in the learning process. A constructivism-heavy approach may limit access to traditional or standardized pathways or gateways depending on the student; however, we should keep in mind that the dynamics of the classroom are unique and the results of what comes from a group's experience together are highly dependent on what happens together. The rethinking and reimagining of schools that has come into fashion in the last two decades owes much to the vanguard constructivists. They hinted at this new classroom and approach throughout the decades of the 20th century before being able to name and articulate the viewpoint present in the prevalent texts and experiments since the 1970s.

Lev Vygotsky's (1978) contributions to the Constructivist approach included his Social Development Theory which articulated how "learning gets made" through the simultaneous threads of interactions and dynamics within and among students sharing an experience. Often when non-teachers describe what they might perceive as the chaos of a classroom, they are

commenting on what teachers would perceive as meaning-making and consensus-building. Constructing knowledge together allowed for students to take ownership of the process as well as find new interpretations that help add value to scholarship. Learning that is oriented to yesterday instead of tomorrow lies outside of the child's zone of proximal development and falls short of being engaging (Vygotsky, 1993). The social constructivist model had interesting ties directly to how students today aggregate and organize information in a highly connected world. The role of the teacher as lecturer has shifted, particularly in the K-12 system, as more and more students show up at school in order to create meaning and make things.

Tying Ideas Together and Leading to Connectivism

Building with Vygotsky's ideas, Rom Harré created the *Vygotsky Space Model* which has many applications and emphasizes the non-linear movement of information and interpretation among four identified quarters of living in a community: public, private, individual, and social (Harré, 1984). The visualization by James Gavelek and Taffy Raphael in Figure 2 showed the overlapping and organic interplay which makes up much of our experiences.

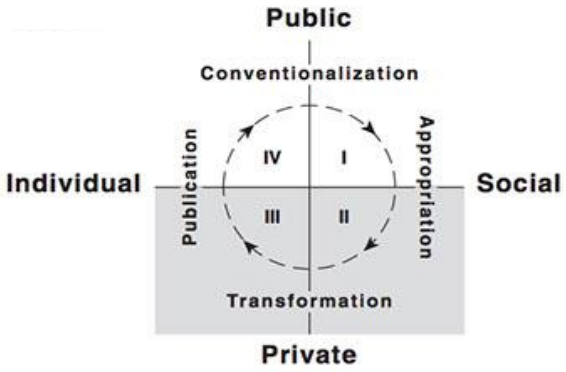

Figure 2. The cycles of information moving from appropriation to individualization. From "Changing Talk about Text," by J. Gavelek and T. Raphael, 1996, *Language Arts, Volume 73,* p. 186, Copyright 1996 by National Council of Teachers of English. Reprinted with permission.

Each of the four quarters was individually altered or impacted by one another while simultaneously altering or impacting each other (the self included), but in no prescribed order.

One was constantly in learning mode and gathers information from a variety of sources throughout each day. As the information became useful or of interest, people then moved through cycles of testing and assimilating the information to then formulate their own belief systems and artifacts.

Figure 2 illustrated that information gathered from the public space can be seen as conventional or acceptable for mass appeal. This also pointed to information gathered in the public and conventionalized quadrant. If an individual wanted to use that information as his own, a private reflection process occurred before a transformation took place. Then, the new use of the information was made public yet again through this one individual and his interpretation. And there were more entry points and processes for transferring information from acquisition to processing to creating to sharing once again. The beautiful simplicity of figure 2 showed the complexities involved in moving from "not-knowing to knowing" and how that process was impacted by both public and private cycles. Additionally, there were entry points for an individual to also share newly created information and artifacts. This process was also impacted by the public and private spheres. Work created in public differs from work shared in public. Taking any entry point as the beginning and tracing it through its natural course showed a multitude, a multiplicity, a multivalent, a multi-structured narrative.

Considering these multiple entry points also ought to include the value and function of time, particularly in our highly networked information age where linear narratives are more difficult to support as the primary method to interpret history and ideas.

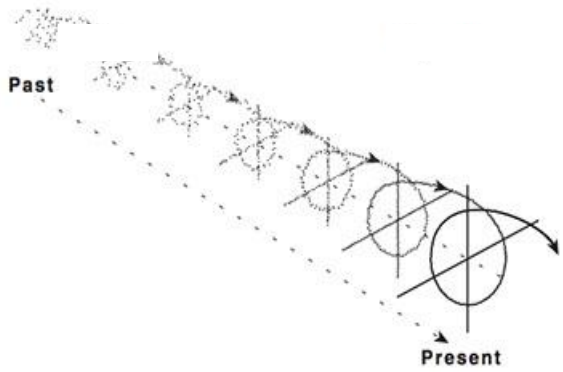

Figure 3. The cycles of information found in Figure 2 charted to show the impact of spiraling time. From "Changing Talk about Text," by J. Gavelek and T. Raphael, 1996, *Language Arts, Volume 73,* p. 186, Copyright 1996 by National Council of Teachers of English. Reprinted with permission.

The naturally emerging narratives and metanarratives found in the classroom have the complexity of this public, private, social, individual information interchange plus the feature of time and multiple entry points. Figure 3 attempted to demonstrate the spirals of time and the non-linearity of how knowledge acquisition and expression all run together. Just as it is impossible to track a handful of water down a waterfall, it is impossible to track the trajectory of a piece of knowledge constructing in a person's mind. However, in both the meaning-making and waterfall, things happen together—it is a social construction. The classroom teacher attempting to capture the complexity of this spiral of meta-narratives becomes limited in the analog world. John Dewey's world view offered us a playing field, but Lev Vygotsky's inspired us to evolve. In the shared multi-user space of a digital learning environment (DLE), and for certain in the future spaces to be developed that are three-dimensional virtual learning environments (3DVLEs), we begin to offer students chances to explore knowledge in new ways that are closer to what they see in the world of their imaginations. 3DVLEs offer an immersive and immediate experience that these figures attempt to illustrate.

This spiral harkened back to the work of Jerome S. Bruner (1961) and what he dubbed the "spiral curriculum" which acknowledged the central role that time and space play in the development of ideas and information in the mind of a learner. As we grow older and gain experience we spiral back to information and ideas that we previously learned and have new interactions with that same information. This forms the foundational approach of Bruner's constructivism in that it makes the case that both a behavioral and cognitive approach to the teaching and learning cycle ignore the strong possibility that we will encounter same or similar information. Furthermore, the spiral curriculum suggested an irrelevance to the insistence that schools and teachers make when they required students to learn ideas in a programmed sequence and are assessed at how well they can memorize or apply those ideas at a particular time and date independent of the learner's readiness to learn those ideas.

A constructivist approach would not be complete without contributions from Paulo Freire's work to decenter the classroom space from a traditional teacher focus. Educators who strive to rethink how their practices in the classroom might unintentionally reify the centers of power they wish to topple are daily doing Freire's (1970) work. Freire saw value in the educational use of computers; however, the resounding Freirean-type questions remain regarding how educational technology might be used to counter the banking approach to education (Feenberg, 2002). Freire would likely be concerned about the effectiveness of online culture in disrupting dominant culture values and policies that systematically oppress. "Technology is more than a tool for transmitting education; it is an environment which must be critically analyzed for its underlying values and assumptions" (Boyd, 2016, pp. 172-3). There remains work to be done in looking for how critical pedagogy intersects with the work of social justice, constructivism, and educational technologies. It is fair to suggest that the Freirean position would be highly

critical of how often what passes for educational software (see Appendix A) operates with closed loop thinking and focuses students on a predetermined set of information or strategies towards a predetermined "success"; they are less education and more edu-tainment; they are less constructive and more instructive; they are less creative and more containing; they are less community and more commodity.

What is a Three-Dimensional Virtual Learning Environment (3DVLE)?

A Three-Dimensional Virtual Learning Environment (3DVLE) is a digitally created software "second space" that capitalizes on the nature of human perception engaging deeply with sights and sounds. A 3DVLE extends visual and aural information so that the user can interact with the data in real time, almost to the point of "feeling" the digital stimuli by fooling the human senses. This "pretend" is achieved by the software's ability to deliver an immediate and immersive experience which allows for the learner to be in charge. This control extends the user's subjective experience, which further creates interest and buy-in (Vygotsky, 1978); additionally, users can create new online identities for themselves, and are able to freely move about and manipulate objects in the three-dimensional environment (Dalgarno & Lee, 2010).

These environments have grown in popularity and function by an exponential factor in a short amount of time. The gaming industry, as usual, dominates the marketplace with 3-D options, though there are some burgeoning experiments to replace the physical classroom with a three-dimensional virtual classroom. Part of the challenge in doing so resides in the continuing debate regarding what exactly to do when in these computer-generated environments that differs from traditional teaching and learning. As of this writing, no consensus exists regarding what to do for schools in a 3DVLE. One popular option that teachers employ involves supplemental single lesson plans or units in which students wear virtual reality goggles to explore a space that

they usually study only by reading texts or passively viewing video resources. Of note is that much of the study and research of 3DVLEs has focused on the quality of the software. (Dalgarno & Lee, 2010) And while the measurement of the fidelity of these virtual experiences makes a huge difference in a student's immersive experience, the pedagogical focus remains aligned with traditional outcomes. This continues to be the struggle embedded within, or "baked in", when using educational technology. Jerome Bruner's reiteration of the purpose of Pressey's teaching machine is still the desired goal: the liberation of the teacher to think creatively with students about material beyond what is tested in traditional formats. Interestingly, though, the hesitation to include immersive technology in educational settings is founded on a belief system that prioritizes a tradition that can easily be reinterpreted and used as a springboard to help bridge the gap and allow for more students, teachers, classrooms, schools, and districts to engage with experimental and experiential educational technologies that also actively subvert tradition.

In a dialogue-based classroom, the students and teacher all show up to discuss a text or topic that they have done some work towards independently, and everyone in the room brings his or her own interpretation and experience to bear on the matter itself. In the course of conversation, interwoven ideas emerge as multiple people attempt to make sense of the matter at hand. With teacher guidance and student participation, agreements and disagreements are mediated and used to continue building a narrative of truth and decision. Sometimes there are non-negotiable facets of the topic, and other times everything is negotiable; this is classroom life, and it is also the first template for what constructivists try to create in digital learning environments. This open classroom discussion without computers functions as a non-electronic version of a three-dimensional virtual learning environment (3DVLE). Interestingly, traditional classrooms often use much of what seems like it belongs only to the world of computers, but this

is not so. The one-hour class where work is shared and developed together serves as a backbone that we can rely upon to make the leap to hyperspace.

Serving the needs of students in any capacity is of course the charge of the educator. What we are witnessing is a shift in interest in how to best prepare students for unknown career situations and information communication networks that inevitably will involve and be intertwined with technological advances. The classroom moves slowly to these external changes and we continue to need to study the benefits and challenges of working within digital learning environments to see how we can best adapt, for the benefit of the student, in school. A study in 2005 conducted by researchers Shih-Wei Chou and Chien-Hung Liu focused on understanding the differences in learner control and learning effectiveness in traditional settings versus technology-mediated settings. Their hypothesis was founded in a constructivist tradition of decentering the classroom via modern technology and wished to measure the student response to a novel approach to learning. Further, they attempted to distinguish the benefits of conventional learning from innovative learning by using traditional test scores as a measure of effectiveness. Like what Papert and Harel (1990) discovered, Chou and Liu (2005) also found support to suggest that educators may have greater success in their students producing artifacts and outcomes that exceed the progress of students in traditional settings. Furthermore, Chou and Liu documented success in accessing students at the margins through digital or virtual learning environments, they use the term TVLE, or Technology-mediated Virtual Learning Environment. Additionally, these students displayed a measurable increase in their emotional openness and readiness to engage with course material:

> Our study supports the hypothesis that learner's emotional learning climate in the TVLE is higher than their counterparts in the traditional environment. One implication could be

> that the students in the TVLE are more willing to join the class due to the novel means of interacting with other students and instructors. TVLEs are open systems that allow for participant interaction through synchronous and asynchronous electronic communication. Due to the available learning and electronic communication tools in the TVLE, students can ask and answer questions, to post comments, and to participate in a knowledge sharing and exchange with peers and the instructor. As a result, students may have more chance to verbalize and articulate their current understanding. (Chou & Liu, 2005)

This hypothesis continues to be important in the fifteen years since the study was conducted because of the exponential growth via Web 2.0 technologies and an increased interest in blended learning models and virtual or mixed reality environments. There is an integrity to placing these ideas side by side by side, for the synthesis of modern expressions and inventions of ideas that have brewed and bubbled for decades shows a lineage, whether it was intended or not. In fact, the gathering of professors and professionals at the 1959 Woods Hole Conference even further demonstrated this link. The sum of their work at that gathering pointed to a shared interest in students gaining more control over their studies, testing companies and technologies finding more inclusive ways to measure knowledge and learning growth, teachers being freed to creatively and innovatively teach material without the constraints of external rote testing measures, and a desire for teaching machines, or computers, to serve at the needs of any individual student as determined by the learner. Jerome Bruner's notes on the conference lined up nicely with what has been discussed thus far in demonstrating this unintentional lineage.

Constructivism at The Woods Hole Conference, 1959

Jerome Bruner's (1961) work found in *The Process of Education* pointed to some of the major concepts of how constructivism makes the case for new schools, new learning approaches,

and new teaching styles. Putting together the insights of the combined minds of the brilliant professors and scientists in attendance at the 1959 Woods Hole Conference, Bruner composed a thoughtful summary into how they could better serve students and teachers in the cycle of teaching and learning. A noteworthy appearance of Pressey's teaching machines at this conference provided an essential nexus with this dissertation, for in the conference's attempt to ask the big question about how to teach and what to teach and when to teach, they were additionally looking for how to use the educational technology of the day.

How are students asked to learn new material and what methods are used to assess their progress? A conference already 60 years old that tackled the same questions of today's conferences hardly gives educators hope for change, but nevertheless that is what happened. Bruner wrote,

> The schoolboy learning physics *is* a physicist, and it is easier for him to learn physics behaving like a physicist than doing something else. The "something else" usually involves the task of mastering what came to be called at Woods Hole as a "middle language"—classroom discussions and textbooks that talk about the conclusions in a field of intellectual inquiry rather than centering upon the inquiry itself. (Bruner, 1961, p. 14)

To focus on the student caught in the trap of school was precisely where many thinkers will agree but not know how to offer a new framework or pathway. Educators are well versed in the dilemma of school precluding and diverting creativity in students. Bruner's observations clearly articulated how students suffer from the presentation of material as a foregone conclusion rather than a subject to inquire about and investigate. If the answers were already at the back of the book, what incentive was there for the learner to engage with the material?

The combination of these decades-old problems with modern computers and computing is precisely the subject of this dissertation. Constructivists have seen for a long time how sourcing the students for knowledge and also engaging them in the practice of inquiry in pursuit of knowledge was preferable to behaviorism and cognitivism. Pressey's teaching machine at this conference was simultaneously confounding and optimistic or even prescient. Bruner went on to describe some more important observations from the conference that center around interdisciplinarity and combining work from isolated disciplines that overlap:

> Consider now some specific problems that received considerable discussion at Woods Hole. One of them has to do with the troubled topic of "general science." There are certain recurrent ideas that appear in virtually all branches of science. If in one subject one has learned them well and generally, that achievement should make the task of learning them again in different form elsewhere in science much easier. Various teachers and scientists have raised the question whether these basic ideas should not be "isolated," so to speak, and taught more explicitly in a manner that frees them from specific areas of science. (Bruner, 1961, p .26)

Naturally, the professors were able to easily observe how formulas, equations, concepts, and ideas in one isolated discipline are often found elsewhere in other content areas. This "piecing back together" of that which was artificially separated in the process of creating a factory model for schooling serves as an often frustrating dilemma foisted upon educators. The impact of mandatory schooling and the struggles it faces in engaging students with streamlined knowledge show through the attempts to put back together that which was taken apart. Moving students from one class to the next each hour of the day in traditionally separated content areas divides the very knowledge that the students are asked to study, know, learn, and put to use in some

novel manner. Attendees at The Woods Hole Conference wondered about these problems and put forth guiding analyses for our modern situation.

Students adept at calculation or completing sets of questions would often receive complimentary remarks and high grades in traditional school. However, their ability to transmute and transfer their knowledge to a new situation they have not encountered was often not practiced or assessed. Bruner focused on this common problem as well, and this too provided yet another guiding principle in this dissertation:

> One hears often the distinction between "doing" and "understanding." It is a distinction applied to the case, for example, of a student who presumably understands a mathematical idea but does not know how to use it in computation. While the distinction is probably a false one—since how can one know what a student understands save by seeing what he does—it points to an interesting difference in emphasis in teaching and in learning. . . . Indeed, it is the underlying premise of laboratory exercises that doing something helps one understand it. There is a certain wisdom in the quip made by a psychologist at Woods Hole: "How do I know what I think until I feel what I do?" (Bruner, 1961, pp. 29-30)

Opportunities for students to practice and play with information must precede any summative assessment, and some argue that constant formative feedback as students practice and play and innovate was a superior model. Asking students to work with content area knowledge and create something that is wholly their own will provide insight into how they are struggling and succeeding with the material in ways unknown to the summative approach. The science laboratory exercise is easy to envision and helpful in the conversation of students "doing

something" with newly encountered information. Otherwise, we cannot be certain that the students are not memorizing for regurgitation rather than acquiring to put information to use:

> Perhaps the technically most interesting features of such automatic devices are that they can take some of the load of teaching off the teacher's shoulders, and, perhaps more important, that the machine can provide immediate correction or feedback to the student while he is in the act of learning. It is still far too early to evaluate the eventual use of such devices, and it is highly unfortunate that there have been such exaggerated claims made by both proponents and opponents. Clearly, the machine is not going to replace the teacher—indeed, it may create a demand for more and better teachers if the more onerous part of teaching can be relegated to automatic devices. Nor does it seem likely that machines will have the effect of dehumanizing learning any more than books dehumanize learning. A program for a teaching machine is as personal as a book: it can be laced with humor or be grimly dull, can either be a playful activity or be tediously like a close-order drill. (Bruner, 1961, p. 84)

Of note is that to a modern reader of Bruner's observations and summaries of the 1959 conference, they would not really stand out as surprising. History tends to push relevance far to the front or the back, and as time marches forward, we have an opportunity to look backwards. The progression of education's history showed that the Dewey school experiment had been swallowed up by the behavioral approach and mandatory schooling. There was not any other organizational model other than the factory or the prison for how to deal with hundreds of thousands of students going to classrooms every day. Meanwhile, new good ideas about how to run a school emerge, but they do not make their way into mainstream traditional education: "There's a concerted effort now underway among national testing organizations like the

Educational Testing Service to construct examinations that will emphasize an understanding of fundamental principles" (Bruner, 1961, p. 31). Bruner stated in his notes on the 1959 conference that the tests themselves are inadequate as a teaching and learning tool precisely because it was easy to emphasize trivial aspects of subject matter through an examination. This served as a central nexus point, an intellectual intersection of the professors in attendance: they were interested in finding the overlaps of individual subject matter content in order to help students see commonalities and patterns in the study of knowledge rather than subjects.

When students disconnected the facts from the subject and the experience of learning the subject, an artificial relationship with information was born. The Woods Hole Conference attendees convened in order to address these issues and offer suggestions that were proto-constructivist. They asked questions about whether students know how to function on all the other meta-levels that go along with the task, or only just the task itself. The attendees were also concerned with a general lack of emphasis on doing, particularly in science and math, where they wanted students to engage in hands-on explorations and experiences of the content. This lines up with contemporary concerns that also place a high value on students having "real world experiences" and speaks to the difficulties that teachers face with implementation. Sixty years have passed since the conference, and markedly little has changed in this respect. Also noteworthy was Bruner's praise of the Educational Testing Service for their attempt to improve what they measure and how. Bruner avoided casting aspersions.

The conference will be remembered for how it was framed by Jerome Bruner (1961) in his volume of reflections on what transpired, which was markedly constructivist before constructivism. Teaching students what content discipline areas have in common rather than the specifics of the subject was a primary concern. This holistic approach showed their flexibility of

mind and desire to create learning experiences for students that emphasized conceptual thinking and creativity. The importance of Pressey's teaching machine present at the conference demonstrated a significant historical confluence of educational technology and Constructivism. The professors in attendance realized at the conference that the machine has the benefit of freeing up the teacher to take on the kinds of qualities they discover as being most beneficial to students: "If the teacher is also learning, teaching takes on a new quality" (Bruner, 1961, p. 90). Having a computer at the conference thus became about freeing the teacher in order to take on roles she or he previously could not assume constructivist learners and models:

> The teacher is not only a communicator but a model. Somebody who does not see something beautiful or powerful about mathematics is not likely to ignite others with a sense of the intrinsic excitement of the subject. A teacher who will not or cannot give play to his own intuitiveness is not likely to be effective in encouraging intuition in his students. To be so insecure that he dares not be caught in a mistake does not make a teacher a likely model of daring. If the teacher will not risk a shaky hypothesis, why should the student. (Bruner, 1961, p. 90)

As all teachers know, the amount of passion that one has for the subject matter will inevitably make its way to the students, even those students who feel that the topic does not match their interests. However, this alone will not be enough to bring along a reluctant learner and it is precisely the habits and behaviors of teachers as thinkers in the classroom that will be seen the most by the students. The co-construction of not only knowledge but also attitudes towards knowledge must be both recognized by educators in order to positively influence students to find their own individual theories and positions, as well as relationships to knowledge. Thus,

constructivism's early days were recorded in this slim volume by Jerome Bruner who convened and recorded an important conference.

In contemporary times, the constructivist approach applies not only to how teachers "run their classroom" but also how information is created, gathered, interpreted, and shared. To address the confluence of Web 2.0 with this open classroom concept, the development of connectivism was an important next step.

Connectivism

Knowledge always exists inside of networks of people and books and experiences. The creation of Information Communication Technologies (ICT) added more networks and shifted how we access and share information. The read-write web is the most monumental achievement in expanding how people choose to learn, aggregate knowledge, remix that knowledge, rearrange it into a new share-able artifact, and then feed forward the artifact for others to consume and add to their network:

> To learn in a connectivist environment, a learner should engage in four stages: aggregate, remix, repurpose, and feed forward. To aggregate, learners should build reliable connections with useful resources. In the remixing stage, learners should see the whole picture and rearrange its parts in order to serve their own perspective. In the repurpose stage, learners are expected to build something from the information that they have collected and rearranged. Finally, in the feed forward stage, learners are encouraged to share and discuss their work with other people. (AlDahdouh, 2018, pp. 3-4)

The K-20 school system still operates on a largely traditional model of lectures, examinations, homework, essays, group work, and projects; constructivism has sometimes been incorporated or infused, but a connectivist theory or pedagogy likely appears as far too chaotic to garner

widespread mainstream favor. And yet, this “chaos” of connectivism was an operating principle underlying the approach and understanding of how learning occurs (Siemens, 2005). Who could account for all the stimuli that fed in to one’s personal experience in the development of neural nodes that comprised the networks and pattern-building that created knowledge and learning?

The theory of connectivism tried to account for how people approached learning and choose to learn, what information they gather, what they do with that information, and how living life in real-time in a sharing environment allowed for "the tectonic shifts in society where learning is no longer an internal, individualistic activity” (Siemens, 2005). But if this was how knowledge happened in an Internet-connected society, there may have been more at stake that suggested and reached for new ways of approaching the work of the classroom teacher. The radical nature of connectivism rested only in the interpreter’s mind, for it was used simply to discuss and analyze ICT in the digital age. And this was the brilliance of the work by Siemens and Downes (2005) for it can be used in a meta-analysis of itself using its own core principles.

The controversy surrounding connectivism focuses mostly on how it may not have been a learning theory nor a pedagogy but rather a description of how knowledge was acquired and created and shared. Certainly, a student-driven inquiry research project would be recognizable in a traditional classroom and yet also contain the very principles of connectivism in how the student went through the process of creating an information network. No matter how one chooses to view connectivism, though, it is still possible to be viewed as a more nuanced theoretical approach to the creation of knowledge that the constructivists tried to describe. In fact, Radical Constructivism has a lot in common with connectivism.

Radical Constructivism. Proposed by Ernst von Glasersfeld, this theoretical approach to knowledge construction allowed for more validity of the ideas formulated by the individual.

Radical Constructivism did not demand that individuals source the origins of their ideas in order to come up with an "experiencer-independent" (von Glasersfeld, 1990, p.1) or objective truth that can be proven without the influence of the person who lays claim to the idea. This approach was not to refute or rebuke the tradition of referencing the scholars that came before but rather to acknowledge that a good idea was a good idea, whether one traced some elements of its origin to those who lived and thought in another decade or not.

That the scholarly tradition gave way to a tradition that chooses to coexist in a parallel alternative should both give hope and befuddle—to where does one go, specifically, after considering the notions of radical constructivism, and for what purpose? The construction of truth may already have some wary of what is at stake when discussing the concept:

> One cannot adopt these principles casually. If taken seriously, they are incompatible with the traditional notions of knowledge, truth, and objectivity, and they require a radical reconstruction of one's concept of reality. Instead of an inaccessible realm beyond perception and cognition, it now becomes the experiential world we actually live in. This world is not an unchanging independent structure, but the result of distinctions that generate a physical and a social environment to which, in turn, we adapt as best we can. Consequently, one cannot adopt the constructivist principles as an absolute truth, but only as a working hypothesis that may or may not turn out to be viable. This is the main reason why the constructivist orientation is unequivocally post-epistemological. (von Glasersfeld, 1990, p. 5)

The connectivists agree: the network of information that an individual constructed when embarking upon a project dictated that person's understanding and interpretation of the material. That a similar argument was borne out of constructivism only makes sense given the orientation

that both theoretical frameworks presented to the world: thoughts and ideas were guided by empirical evidence but not controlled by it. Von Glasersfeld's argument went even further as a radical concept by building an argument comprised of anti-argument. He demonstrated a lineage in scholarly work through the ages that has shrugged off doubt stemming from a dearth of evidentiary support. That von Glasersfeld (1995) used evidentiary support to demonstrate that evidentiary support might be unnecessary demonstrated his brazen attitude towards the hallowed halls of academia and his willingness to call into question the institutions that barred non-compliant and creative thinkers from acceptance. This aligned with the interpretation of Freire's work in support of subaltern voices needing to claim their stake in academia and not be silenced by a tradition that called for empiricism and a classic epistemological approach.

Issues in Educational Technology

Supporting documents in current journal articles about educational technology demonstrated a perennial struggle for how to make, to what some perceive as, the radical shift to the digital learning environment. Many educators and authors writing about the subject returned to recurrent and important themes that were identified long ago. This literature review serves not only as an interpretative and historical record linking these shared conclusions, but also as a marking of the intellectual reference points needed to step forward into a new theoretical space and work towards solutions—solutions that have been a long time coming, so long now that it is time to insist with a more powerful and clear voice.

As early as 1960 in the literature cited here is the need to rethink what we do with the machine in an educational setting. Bruner's reflections on the Woods Hole Conference were echoed 56 years later: "Access to technology is an important first step in the digital conversion of school systems; however, for the conversion to be successful, it is critical to move the focus

beyond the technology itself, to how technology enables teaching and learning" (McKnight, O'Malley, Ruzic, Horsley, Franey, & Bassett, 2016, p. 194). Schools are not successfully addressing students' needs and teachers' potential when they get overly excited and focused on which device or program should be purchased. A solution exists for almost any need, which must first be observed, named, and then pursued. In fact, it might also be the case that an electronic or digital solution may not best serve the needs of the population. One must also be prepared for that reality.

Some studies have shown that a digital classroom allows students to outperform their peers working in a traditional classroom. However, since schools are in the business of dealing in a human capital commodity of intellectual and creative behavior, and not building factory-line widgets, we must acknowledge that a digital classroom would feel of no use to a brilliant lecturer providing a thoughtful treatise, an engaging scientist performing an experiment, or a skilled theater director placing people and props to rehearse a scene. If a traditional schedule school day is preserved, not every teacher will likely have the skill set or interest or passion for working with digital tools. Further, "allowing students choice and control in their learning process, taking responsibility in the learning process, and utilizing multiple pathways to individualize learning are key principles of this learner-centered approach to instruction" (McKnight et al, 2016, p. 195), but that may not be the teacher's strength or the school's wish.

So, one can see that the issues of educational technology usage are deeply bound to the issues of school and teacher philosophy. And maybe some students are shortchanged for their futures because of this ongoing debate and these issues? Maybe we will look back at these indecisive years and wonder why we did not force all schools to change towards a more inclusive stance regarding student outcomes and teaching and learning approaches? Maybe these problems

are manufactured by the machinery of the testing industry that write the tests whose scores are directly tied to the funding of the public schools? Who stands to lose if schools untether from the Educational Testing Service (ETS) and determine their own graduation expectations and outcomes based on the students' progress and achievements? Colleges and universities are already starting to question their blind allegiance to SAT and ACT scores as part of the admissions process. These critical theory questions are a matter of social justice and need to be investigated. Educational technology is another political landscape for those who ne'er-do-good.

Studies continue to be conducted in order to deepen the literature base that demonstrates how students benefit from the pedagogical shift that can occur when classrooms go digital. And while we ought to have a skeptic's eye on this persistent uphill struggle to "make the case" for computers in the classroom, again we still have a cry for more local control of materials, strategy, and subject matter:

> Results suggest that technology improved access for teachers as well as for students, to more up-to-date learning resources and to materials at anytime and anywhere. Technology also improved access for students with special circumstances and needs. At sites flipped or blended learning models, teachers observed that access to current and a wider variety of resources provided their students the opportunity to develop a deeper and more engaged understanding of the topic, as well as independence in selecting materials: They were no longer reliant on the teacher or the textbook for information. Moreover, teachers were able to match student interests to content via online resources such as YouTube and Pinterest. (McKnight et al., 2016, p. 202)

When appropriate or suitable to the actual people in the classroom, and when desired by them as the model, educational technology has latent power and potential to unleash a student's untapped

talents in a wide variety of ways. The continued repetition of learn via lecture, worksheet, quiz, and test may deaden passion and excitement for some students, while others could thrive. It may be that even an exciting and engaging teacher is still not enough to capture a student's attention and inspire study and work. It may be that a completely digital learning environment is overwhelming for some students and that they prefer to untether from the Internet when at school. Acknowledging that no single approach will work for all students is a fundamental principle of educating educators, and some criticism of inventing a new digital classroom is to be expected. However, the focus of proponents for educational technology ought to remain fixedly on the increased engagement of students and the power of sparking student choice and voice in their studies; we may find a greater need for balance with analog and digital time and space, with online and offline activities, with virtual and actual experiences. Rushing out to purchase an iPad for every student in the district is the wrong approach, but former Los Angeles Unified School District Superintendent John Deasy spent $1.3 billion with Apple in a non-competitive bid doing just that in 2012 (Gilbertson, 2014). Like every human endeavor, we need oversight to keep people honest, but even if that amount of money were properly governed without suspicion of wrongdoing, what exactly was the plan to impact the teaching and learning cycle?

A successful technology program to foster school improvement requires many simultaneous moving parts to be in constant multi-parallel stages of attention and focus. A significant study of award-winning secondary sites in 2013 by Levin and Schrum identified these eight focal points: "(a) vision, (b) leadership, (c) school culture, (d) technology planning and support, (e) professional development, (f) curriculum and instructional practices, (g) funding, and (h) partnerships." These areas worked in concert with each other and indicated a high level of organization required to make such massive changes to "how work gets done" in a school.

The power of tradition is strong not only in human psychology but perhaps more so in the default manner of running a school and classroom. Many teachers will report having chosen a behavior or approach as a result of a memory from how they themselves were taught. Since "vision" appears first in the list by Levin and Schrum, the conversation about educational technology moved to an important broad view about how we organize ourselves around a nucleus of thoughts that inspires drive with purpose. And with "leadership" second on the list, this suggested that even our school leaders are subordinate to the vision of the school—this important distinction can help all stakeholders to orient themselves in service of a greater purpose of society and thought. Seymour Papert (1980) named the pitfall of "technocentrism" in order to help educators identify a predilection for focusing on the acquisition of specific software or hardware tools in place of evaluating and creating a vision.

The process of developing a culture and practice infused with educational technology requires a confluence of attitudes and a mixture of events. Interested and knowledgeable educators must have an eye towards the future but also have time in their day to investigate what is possible. The marketplace changes frequently and this alone drives user response and methodology for expression. Teachers looking for new ways to incorporate new developments in educational technology must then be constantly in research mode. This positions them to lead classes in unique ways from which students can benefit:

> Many university professors choose to teach a course on the theory or topic of their research while they are actually working on it; so that the process of teaching and discussing their work with students, will enable them to clarify and refine their own ideas and theories. And it certainly seems to be the case in the educational software field, that the people who are having the most fun, and are learning the most, are the software

> designers and programmers. With most educational software today, especially the drill-and-practice kind, the users rarely gain deep understanding of the concepts taught, unless the software is supplemented by instruction and explanations from a good teacher. (Harel & Papert, 1990, p. 30)

Placing students in this type of learning environment provided them with a model of excellence for active research put into practice; further, the students then had a chance to test out new technologies that their teacher deemed energizing and useful. Emphasizing the need for teachers to supplement any software with instruction, Harel and Papert showed that they do not expect teachers to be replaced by the machine but rather that the teacher have an opportunity to explore learning with both machines and students.

In a videotaped discussion with Paulo Freire about school, technology, and philosophy, Seymour Papert articulated a large-scale problem that we still face with computer use in schools:

> So if you go into schools nowadays, you see a lot of computers, and almost everybody agrees that computers are not being very well used. Now the liberal discourse says, "The schools don't know how to use the computers. Let's do research and find out the best way to use the computers, and then they'll be used well and we will have all sorts of good results." Now, I think it's exactly the other way around. The school bureaucracies know very well how to use the computer . . . in order to reinforce their own concept of school. And I find it very interesting that . . . in the 1970s the first times I saw any microcomputers in schools, it was always through the efforts of a visionary and rebellious teacher who didn't like what he or she—often she—was supposed to be doing and saw the computer as the way of doing something different. And often . . . this is a bit romantic . . . they felt the potential of this thing and they wanted change. . . . So it was an

> instrument of radical change—that's what they thought it was. And then around about the middle of the 1980s . . . this computer got into the hands of school administrations and the ministries and the commissioners of education, state education departments.
>
> And now look what they did with them: no longer are there computers in the hands of visionary teachers in the classrooms. The establishment pulls together and now they've got a computer classroom, there's a computer curriculum, and there's a special computer teacher. In other words, the computer has been thoroughly assimilated to the way you do things in school. (Stager, 1988)

The freedom that both Freire and Papert advocated within schools and for students was hardly ever present in noticeable ways before the advent of the computer in the classroom. Once the machine joined the ranks of another teaching delivery vehicle it had already been relegated to the single desk in the corner. In the years since this interview, more computers have entered schools and ideas regarding how to use them have shifted somewhat, but what remains is this essential dilemma of the computer serving as the liberation tool that the school usurps. No other tool in school carries the power of the computer and therefore it should be handled with great care. Students can now freely access information of their choosing, arrange it as they wish, interpret it in some new manner, and then share their consumable remixed and reinterpreted artifacts with the world. Both Freire and Papert acknowledged the dangers of totalitarian power possible with a computer screen serving as the passive instrument of content delivery, but they were more intrigued by a student's agency and voice aided by the power and freedom that the computer signified, encouraged, and allowed.

Congressional Hearing in 1995, Technology in Education

A 1995 congressional hearing on Technology in Education brought together Professor Seymour Papert, Professor Alan Kay, Professor Chris Dede, and Mr. David Shaw in front of

House Representatives to discuss several issues current to the day that continue to have relevance to this day. Mr. Shaw's contribution as a business investor, who believed in the promise of technology positively impacting education, had interesting counterpoint to a few of the shared opinions that the professors held. Papert's position remained the most radical of the four witnesses: "I think there's an education establishment that has its head wedged in a culture that grew up over a century during which there was the most lethargic progress in education of all fields of human activity and they continue to suffer from being part of that culture" (Educational Technology in the 21st Century, 1995). This was in response to the non-educators trying to make sense of the philosophy that the three professors were sharing, however the language that congressional leaders and Mr. Shaw used indicated a focus more on instruction and teacher as the main source of learning. Professors Dede, Kay, and Papert all demonstrated from multiple angles the shortsightedness of that didactic approach, particularly when the committee's charge was to find new nexus points of technology in schools. Papert emphatically opined: "We have got to give up the idea that learning is instruction. Instruction is a small part of learning. The important part of learning is doing, and I think the big change is that we will move from an emphasis on instructionist thinking to constructionist thinking" (Educational Technology in the 21st Century, 1995). There was no argument about this position and for some representatives on the committee it was perhaps quite a bold statement.

Professor Alan Kay showed some of the folly in current approaches to technology in the classroom through powerful analogies that deemphasized some of the championed accomplishments of political to put a computer in every classroom. He pointed out the problem that if the concern were that parents wanted their students to exit school with a musical education, and a congressional committee decreed to put a piano in every classroom, we would

very easily fail at achieving the stated goal. This "technocentric" approach revealed the lack of vision and a hyper focus on simply plunking the teaching machine in the room. As shown already in this literature review, this approach was antithetical to best practices and "libertarian education". Alan Kay further explicated:

> Books are a perfect example of a great educational technology that has actually been co-opted into much more of a party line from what it could be. And I believe that is exactly what is going to happen to computers and is happening right now. [One hundred and fifty] years ago, the response was to put books in every classroom, but most teaching is done from textbooks. Books are all about diversity of opinion and learning at your own rate and as deeply as you want. It's individualized learning. But textbooks are lockstep. (Educational Technology in the 21st Century, 1995)

Summary

This literature review has shown that providing a wide and deep array of ideas for students to freely choose will result in students' greater development of skills, behaviors, and attitudes necessary for an unknown future. We can provide high speed Internet bandwidth and multiple computers for students to utilize, though these tools will not align with constructivist or constructionist goals if the students must move lockstep through some educational software with a closed loop data set at the heart of it. Just like the unopened novels sitting on the classroom shelves, the untapped potential of computers in classrooms is far too easy to ignore.

Without attributing malice, the focus of the computer in the classroom since the rise of the microprocessor has been relatively unimaginative and largely neutered in its ability to impact change in how "work gets done" in school. The classrooms of today are much like the classrooms over 100 years ago, and the amount of digitized paper that gets passed back and forth

between teacher and student shows us that we failed to reimagine the relationship and space in response to computers. Professor Chris Dede succinctly described this problem: “The major focus of educational technology implementation has been automating marginally effective models of presentational teaching rather than innovating via new models of learning through doing” (House Economic and Educational Opportunities Committee, 1995). We must question the difficulty that schools and educators face to have an impact on the way things happen in the classroom. Perhaps the computer was not fully understood before it was introduced into the classroom, and perhaps proper time was not dedicated to give teachers a chance to innovate and dream with the computer. Nevertheless, students bear the brunt of this confusion and lack of imagination. They may have already had experiences with computers that were creative and unusual, but when working at school, students were often dictated just exactly how to use the computer. School leaders could benefit from engaging students in open forum sessions regarding how they might reimagine the classroom with educational technology. As Professor Dede suggested, some new learning approaches and theories might just need discovery—maybe we do not yet know just what to do or what to call it.

Built from the histories, the literature review, and the discussion above, the following table shows the conversion of the main precepts found at the start of Chapter 2 into shorter codes to continue the work. These codes were used to read and parse the three seminal works. Any connection to one or more of the codes found in the careful reading of John Dewey's *Democracy and Education* (1916), Paulo Freire's *Pedagogy of the Oppressed* (1970), and Seymour Papert's *Mindstorms: Children, Computers, and Powerful Ideas* (1980) triggered an excerpting process, whereby this author typed each passage into the Dedoose research analysis software tool (version 8.0.35) and associated it with the relevant code. Most passages were associated with more than

one code. Additionally, any passages that were found redundant during the annotations and analysis in Chapter 4 were not included in the chapter but instead added to Appendix C for full representation of the process of this dissertation study.

Table 2
Conversion of the Precepts in Table 1 to the Codes Used in the Selection and Tagging of Excerpts in the Seminal Works

Extant Theory Precept	Code
The learner responds properly to the presented stimulus.	Banking Model (Dewey, 1916; Freire, 1970) Isolated Curricula (Papert, 1980)
The learner processes and applies patterns of presented information.	Predetermined Outcomes (Dewey, 1916)
The learner creates meaning and interpretation through experience with a body of information.	Constructivism (Bruner, 1961) Engagement (Bruner, 1961; Papert, 1972)
The learner discovers solutions in an active exploration of a problem to solve.	Discovery Learning (Dewey, 1916; Papert, 1993) Freedom and Individuality (Dewey, 1916; Freire, 1970) Shared Democracy (Freire, 1970)
The learner discovers solutions and creates meaning in a shared environment.	Connectivism (Siemens & Downes, 2005) Problem Posing Education (Freire, 1970)
The learner uses reflection as a tool to process presented information as well as personal interpretations.	Abstractions (Dewey, 1916) Observations on Life Itself (Dewey, 1916)
The learner applies social and cultural critique to all learned and individually developed interpretations.	Institutional Change (Freire, 1970; Papert, 1980) Oppression (Freire, 1970; Feenberg, 2002) Social Impact (Dewey, 1916; Freire, 1970)

Note: The concepts provided here are adapted from the literature review in order to generate a coding system to assign to excerpts from the seminal texts in the study found in Chapter 4.

For this dissertation, I named Critical Techno Constructivism as the next incarnation of the ideas contained herein. In Chapter 3 I will discuss the methodology I use to analyze the three seminal works by Dewey, Freire, and Papert. In Chapter 4 I will perform a document analysis whereby I synthesize the histories and extant theories in Chapter 2 with my educational and

research experience. In Chapter 5, I will discuss Critical Techno Constructivism and how it can be put into use.

CHAPTER 3

METHODOLOGY AND FRAMEWORK

Chapter 3 will provide a detailed description of the methodology and framework used in this dissertation to analyze the selected documents. A document analysis (Bowen, 2009) of seminal works by John Dewey, Paulo Freire, and Seymour Papert served as the main dissertation study and will be synthesized with discussions of distance education, the history of the computer, extant theory found in relevant literature, and research evidence. All this together, in a critical and thematic analysis following a hermeneutics approach, will be used to produce a new contribution towards a unifying learning theory for computers, computing, and digital learning environments.

Introduction

The purpose of this dissertation was to propose and contribute a unifying learning theory applicable to computers, computing, and digital learning environments. The theory offered will provide a new foundation upon which reimagined and renegotiated digital learning spaces can be born. Extant theories that formed the hive of ideas being recognized were first explicated and evaluated. Then, they were extended to create the new theory. Suggested applications of the new theory will comprise the final chapter of this dissertation.

The methodological approach was framed as a document analysis (Bowen, 2009) and synthesis of learning theories relevant to computers, computing, and digital learning environments. Additionally, an historical study of educational technology usage was developed to provide useful context for the theoretical ideas. Finally, this study drew from Elizabeth Steiner's *Methodology for Theory-Building* (1988) to construct the next steps.

Beginning with the recognition of the relevant learning theories, such as social constructivism and connectivism, this study described and interpreted those theories to be able to evaluate them and determine what is necessary to add. The study went on to identify and synthesize essential and relevant concepts from seminal works missing from those learning theories that pertain to classroom use of computers and computing, and also the creation and use of digital learning environments. These essential and relevant concepts found in the document analysis may also appear in this document as inspirational or referential throughout existing discussions of digital learning environments.

However, this deeper dive into primary sources revealed that much more is there, and has already been documented from years past, particularly when computers, computing, and digital learning environments did not exist. All of these materials and ideas, with the benefit of history, time, and computers, were placed on a single surface and joined together in a new manner. Three seminal works were identified as containing essential, and relevant, concepts that are not fully represented in existing theories applicable to digital learning environments: John Dewey's *Democracy and Education* (1916); Paulo Freire's *Pedagogy of the Oppressed* (1970); and Seymour Papert's *Mindstorms: Children, Computers, and Powerful Ideas* (1980). Other works by these three major education philosophers were also considered for inclusion in the study.

Combining the document analysis of these theoretical concepts with a historical study of distance learning, the development of the computer, the development of educational use software, as well as the history of educational technology methods, new possibilities emerged and need identification and explanation. The unifying learning theory for computers, computing, and digital learning environments came from the combination of the history and these concepts. A critical and thematic analysis was performed on the seminal works. Themes were derived from

the work done in Chapter 2 and codes were composed to help guide the study. Annotations of the books in the document analysis study were handled in chronological order within each text in order to preserve their original logic and argumentation.

Developing this unifying learning theory addressed a social justice concern absent from many discussions of digital learning environments: In what ways can technology help traditionally disenfranchised students? How can we best amplify and include the voices of marginalized students to shape curricula and inform practice?

To review, the main research questions in this dissertation are as follows:

1. How has the history of behaviorism and cognitivism impacted the development of using computers in the classroom as a transformational tool?
2. How can a techno-constructivist theory be expanded to meet the needs of modern learners and contemporary issues?

Methodology

Collect the Research Evidence

The articles analyzed for this study were primarily found online via the ERIC database (www.eric.ed.gov). In addition to ProQuest (www.proquest.com), some articles were found via Google Scholar (www.scholar.google.com) and by suggestion from LMU faculty working on the project. All database searches were narrowed to peer reviewed and full text articles. The search queries began broadly and then were narrowed as further study dictated. Keyword searches such as “Educational Technology” and “Technology in the Classroom” brought many results which then needed refining to “Techno-Constructivism” and “Learning with Computers.”

There was a noteworthy absence of articles containing the keyword “Techno-Constructivism” and all of its variants. Six variations of the phrase were searched in seven

databases containing published documents about education in June 2018. The search was then updated in April 2019 to discover that only a few more instances had been published. The following databases were searched: ERIC, ProQuest Dissertations and Theses Global, SAGE Research Methods (www.methods.sagepub.com), SAGE Journals (www.journals.sagepub.com), Education Full Text (library.lmu.edu), Google Scholar, OneSearch+ (library.lmu.edu), and Springer (www.link.springer.com). The following phrasal variations were searched: "technoconstructivist", "technoconstructivism", "techno-constructivist", "techno-constructivism", "techno constructivist", and "techno constructivism".

Table 3
Instances of "Technoconstructivism" Variants Appearing in FullText Searches (April 2019)

Phrasal Variation	**ERIC**	**ProQuest Dissertations and Theses Global**	**SAGE Research Methods**	**SAGE Journals**	**Education Full Text**	**Google Scholar**	**One Search +**	**Sprin -ger**
"technoconstructivist"	1	7	0	0	1	14	3	2
"technoconstructivism"	2	10	0	0	1	22	5	8
"techno-constructivist"	0	17	0	1	2	46	9	1
"techno-constructivism"	0	0	0	0	2	11	1	3
"techno constructivist"	0	17	0	1	1	46	9	1
"techno constructivism"	0	0	0	0	1	11	1	3

A wide range of research articles were gathered to create a broad view of the field and the topic. Many of the articles indicated predecessors who helped them build their view and those authors were additionally sought out as relevant and useful evidence to build the research body. For example, many articles written in the last twenty years point to the work of Seymour Papert as an instructive and guiding force in the field of educational technology. Papert's contributions are massive, not only in long form with the many books that form part of the seminal works this dissertation aims to study, but also with the research studies and articles that detail

groundbreaking work into the effectiveness of techno-constructivism, or what he called constructionism.

In 1987, the study conducted by Seymour Papert and Idit Harel (1990) indicated that classroom teachers could not rely on traditional teaching methods to ensure student success on traditional testing instruments. In fact, the students who participated in Papert and Harel's computer-based method of learning the same mathematics curriculum had achieved higher scores on the traditional paper-pencil testing instrument. A study of this impact created a need to seek out any related studies and articles done in a similar period of a time or with a similar approach so that results could be compared. A collection of relevant articles were found and so was a new angle to the study—an historical study of computers in the classroom.

The seminal works gathered for later in the study were determined to be relevant due to the ideation concordance with what is needed in current technoconstructivist and constructionist thinking. Aligning the research evidence in the literature review showed a need for greater connection with student voice and student inquiry. Selecting book-length works from John Dewey and Paulo Freire to study and relate to technoconstructivism responded directly to that need. The works of Seymour Papert were also selected because they deal directly with both the identified need in the research evidence and technology itself. Further, Papert's positions and approaches were informed by and anchored with Dewey and Freire's philosophies.

This triptych of authors served as the main body of work studied in this dissertation following the hermeneutics approach found in document analysis (Bowen, 2009). Triangulating the concepts found in the histories, the literature review, the seminal works, and this author’s own experience comprised a narrative that aimed, through its emergent identity, to propose and

contribute a unifying learning theory for classroom use of computers, computing, and digital learning environments.

Organize the Concepts

The first step in Elizabeth Steiner's (1988) *Methodology for Theory-Building* is to recognize what already exists. The main concepts this study were concerned with are as follows: predetermined outcomes of curricula; closed database sets; engagement of underrepresented students; inclusivity of marginalized voices; integration of technology into classroom practice; co-constructed truth; shared decision-making; problem solving; and integrated disciplines. These concepts were found in the research evidence and were the main concerns communicated through explicit and implicit means. Organizing the concepts helped create a pattern of thought that was then used for the recognition of existing theory: "One is not in a position to construct theory unless one comes to understand present theory and what, if anything, needs to be done to make the theory adequate" (Steiner, 1988, p. 92).

Existing theory ranged broadly from behaviorism up to connectivism. The history was necessary to trace because it aligned also with the birth of the computer and a previous network of distance education that existed before electricity. Behaviorism led to cognitivism and then constructivism. Of interest was also how some of the literature demonstrated that before constructivism was named as such, scholars were already discussing some of its main tenets. Seymour Papert's development from constructivism to constructionism played a significant role in the ideas herein and must be recognized and addressed; Papert pushed for the student to create tangible artifacts beyond the meaning-making happening as abstractions in the mind. The more recent development of connectivism showed the impact of networks and networked people on the development and experience of information and learning. With multiple entry points possible

and the decentering of classrooms and schools, students had a wide range of options for learning and developing a relationship to learning. Schools are now in competition with students themselves having access to everything they need to learn all the content that school can offer without ever having to go to school.

Derived from the literature review, the following codes were composed to use in the selection of excerpts from the three seminal works in the document analysis study: Abstractions; Banking Model; Connectivism; Constructivism; Discovery Learning; Engagement; Freedom and Individuality; Institutional Change; Isolated Curricula; Observations on Life; Oppression; Predetermined Outcomes; Problem Posing Education; Shared Democracy; and Social Impact. Two more codes were added, Pedagogy and Theory, in order to accommodate an outgrowth of discussion from Chapter 2 regarding the relationship between pedagogy and theory. In reading each of the three works from beginning to end, any excerpt that contained one or more of these codes was pulled out for further analysis.

Technology's rise to prominence through the development of the microprocessor impacts the focus and the literature, as scholars tried to figure out how to use constructivism with a computer but mostly relied on behaviorism instead. Also featuring prominently here in this dissertation will be Paulo Freire's work in critical theory. This choice was made because of its absence in the literature; through the years, there was an observable lack of documented critical questioning of the practices and products of educational technology. Very little focus on the issues and politics of race, class, wealth, and power were found in the literature. While more recent scholars showed a growing interest in explicating the personal and collective politics of software design, there remains much work to be done.

Constructivism, constructionism, connectivism, and critical theory were the most recent developments that can guide the work of schools toward some of the concepts identified in the research evidence. Where they fall short has a lot to do with the history of computers as a tool in the teaching and learning cycle, and how that history impacted the development of pedagogy, curricula, and philosophy in the classroom.

Align the History

The historical development of the computer as a tool for teaching and learning showed a reliance on a stimulus-response approach: a prompt was shown on the screen and the user replied using the interface. This early history played deeply into how computers were then used in classrooms during the major growth period of microprocessors in the 1970s and beyond—most classroom computers were standalone terminals where students would complete a software program to serve as demonstration of mastery of the content. With this history, even classrooms today with their abundance of hardware and software options struggle to find a new purpose for computers beyond the transactional approach.

A significant force in this history came from the marketplace itself which blossomed into a robust space where many products were available, however, when one looked more closely at the skills and content being addressed there was a preponderance of rote learning. This fact butted up against the larger intents and the scope of the work proposed by the theories of techno-constructivism, constructionism, connectivism, and critical theory. All these theories were interested in the learner's self-guided inquiry, yet the meeting ground of the theory with the computer in the classroom showed a philosophy at odds with the practice.

The historical view of the development of the computer revealed patterns that were noteworthy and relevant to this dissertation. A behavioral approach to learning, the only

approach possible with the early computers, may have stunted some of the imagination in the minds of developers and policy makers. Computers were often thought of as machines that could perform a function and serve a role. Still today it is challenging to engage in a conversation about computers in the classroom without meeting some determinist viewpoints regarding their role—few are engaging in conversations about how to transcend and transform the history of computers in the classroom.

Evaluate Seminal Works

Three major works identified for this study were read and annotated to add their value to extant theory regarding constructivism, constructionism, connectivism, and critical theory. *Democracy and Education* by John Dewey (1916), *Pedagogy of the Oppressed* by Paulo Freire (1970), and *Mindstorms: Children, Computers, and Powerful Ideas* by Seymour Papert (1980) were seminal works that each provide unique entry points into the discussion continuum of how to provide an excellent educational experience that consciously and purposefully includes marginalized voices and makes use of new technologies. Each of these texts and their authors believed in a transformational approach to teaching and learning. Their ideas proved valuable in seeking new ways to enter a conversation about teaching and learning with computers.

The process for annotating their works was to carefully read with the lens of a modern Educational Technology Specialist and experienced English Language Arts high school classroom teacher. Reading in this manner allowed for specifically looking for evidentiary support regarding current threads in the modern conversation. Additionally, another task was specifically looking for how the ideas presented in these texts ranging from over 100 years old to 40 years old have unintentional ripples of other educational conversations that can be heard and understood in a new way that posits new ideas and new approaches.

Synthesize Concepts via Document Analysis

By piecing together the concepts from the base evidence in the literature review with the extant theory, it was possible to identify the gaps in the current theories that can be addressed with the new annotations from this study. This formed the foundation of thought to then perform a document analysis (Bowen, 2009) and triangulate the materials. The methodology of document analysis was particularly helpful because the documents being analyzed range in age and were for theory-building purposes placed side-by-side here in this dissertation.

For example, all three authors of the seminal works are no longer alive. Interviews cannot be conducted, much to this author's chagrin. Instead, document analysis provided an opportunity to evaluate the primary source materials of these authors whose work pertained directly to the research questions.

Summary

This dissertation proposed a unifying theory for digital learning environments that educators can employ at many different levels within their organization. Administrators may choose to retool an entire school district and classroom teachers may choose to retool a single unit of instruction—with entry points possible at every level, this new learning theory bravely reimagined school as a negotiated space for inclusivity, imagination, and innovation. Using computers as the tools that we learn with, never at, this negotiated space encouraged students to inquire deeply, question broadly, and fashion new ideas. And this space encouraged teachers to use those student outcomes as marks of mastery in place of externally imposed outcomes.

CHAPTER 4

STUDY OF SEMINAL WORKS: DOCUMENT ANALYSIS

John Dewey, Paulo Freire, and Seymour Papert

Introduction

Chapter 4 will provide my annotations, notes, ideas, and contributions in studying John Dewey's *Democracy and Education* (1916), Paulo Freire's *Pedagogy of the Oppressed* (1970), and Seymour Papert's *Mindstorms: Children, Computers, and Powerful Ideas* (1980). These three philosophers and texts were selected specifically because they powerfully discuss issues that concern student liberation, educational technology, and constructivism. And these three areas are purposefully being joined together in this dissertation to form Critical Techno Constructivism as a unified learning theory for computers, computing, and digital learning environments.

Briefly reiterating my positionality here as author, educator, and researcher, I draw the reader's attention again to my own path in schools, as both a student and a teacher. The moments of misunderstanding and belonging are many: while I have certainly been misunderstood, I have also felt great kinship in school. As a researcher and scholar now, I can articulate the misunderstandings and connections all as expressions of the three central themes I am joining together here: critical theory, use of technology, and constructivism.

In this chapter, I will compose a narrative that chronologically moves through each of the named texts to perform a document analysis. Because I will later analyze the excerpted material by codes, moving chronologically through the books allows me to preserve the original logic and argumentation of each text. I will provide both a critical and thematic analysis throughout my annotations. The 155 selected excerpts from the three texts were imported into Dedoose, an

analytical research software useful for coding, tracking, and analyzing data. Given the focus of this dissertation on educational technology, the use of computer-aided analytics was a natural fit. Any concordances that Dedoose found independent from the author of this dissertation were duly noted. The combined notes and annotations were then added to extant theory and histories from Chapter 2 to amend and propose thoughts towards a unified learning theory for computers, computing, and digital learning environments (DLEs).

Before settling into the work of Chapter 4, it will be useful to remind the reader of the two research questions that guided this study:

1. How has the history of behaviorism and cognitivism impacted the development of using computers in the classroom as a transformational tool?
2. How can a techno-constructivist theory be expanded to meet the needs of modern learners and contemporary issues?

Exploring these questions with the backdrop of Chapter 2 helped to place all the puzzle pieces on the table at once. Looking ahead into the chapter that follows, the patterns that emerge through my annotations of the primary sources will begin to form what will heretofore be dubbed Critical Techno Constructivism.

To help guide the reader through what follows, I present the significant computer-aided results of the coded and analyzed 155 excerpts selected for study. Seventeen codes were composed from the literature review. I selected the excerpts from the seminal works when, in the process of reading the books, I encountered passages that showed intersection with any one of the codes. For each selected excerpt from the three seminal works, I attached the relevant code to it in the Dedoose research analysis software tool. Most excerpts had multiple codes attached to them (see Table 4).

Table 4
Significant Instances of Code Co-Occurrence on the Selected Excerpts of Seminal Works

Code	Co-Occurrence Instances
Banking Model	126
Constructivism	127
Discovery Learning	71
Engagement	135
Freedom and Individuality	75
Institutional Change	154
Isolated Curricula	76
Oppression	73
Pedagogy	71
Predetermined Outcomes	103
Problem Posing Education	88
Social Impact	120
Theory	80

Using the Dedoose software analysis tool to help further observe the data revealed that there were also significant instances of pairs of codes that co-occurred on the same excerpts. These pairings form the prominent themes from the literature review that are present in the seminal works by John Dewey, Paulo Freire, and Seymour Papert (see Table 5). Further, focusing on these themes will help the reader through what follows in the document analysis.

Table 5
Significant Instances of Code Pair Co-Occurrence on Excerpts from the Seminal Works

Code Pair	Co-Occurrence Instances
Banking Model and Institutional Change	16
Banking Model and Predetermined Outcomes	25
Banking Model and Social Impact	14
Constructivism and Engagement	21
Constructivism and Institutional Change	17
Engagement and Institutional Change	23

These pairs of codes represent the themes of this dissertation and are calling for the institution to pivot and change, to embrace the minds and lives of the students present in the classrooms, to engage them in work at school that helps them to make meaning, and to altogether eliminate the banking model of education. Dewey, Freire, and Papert have presented us with three gospels with many intersections—this dissertation aims to unify them.

John Dewey, Democracy and Education (1916)

Working through John Dewey's (1916) book, *Democracy and Education*, there are many intersections with not only modern dilemmas facing education but also many tie-ins to how educational technology can be used to help solve some of those dilemmas. Without knowing it, John Dewey shows much of the thinking that is currently at the heart of what educators are trying to solve by using computers and computing in classrooms.

Dewey begins his text with abstractions about the nature of life; he provides big picture thinking about a positive trait of humans and humanity: "The most notable distinction between living and inanimate beings is that the former maintain themselves by renewal" (Dewey, 1916, p. 4). This, however, is a complex problem in education. The renewal causes problems and frustration. The political pendulum swings too frequently and classroom procedures and materials are forced to change with each swing. As a result, we find ourselves in similar social and educational dilemmas today as 100 years ago despite constantly making ourselves anew.

Instead of improving conditions, we repeat histories even without knowledge of them. We abandon projects and start anew and rarely get to see things through. So, while renewal gives us another chance to try out new concepts and explore new methods, it is also an excuse for not seeing a project through to completion.

Part of our persistent human struggle may result from a weak understanding of how we grow together and how an education system can be used to assist in that growth and that understanding. The classroom can be a meeting ground for a multivalent narrative to emerge and for the greatest ideas of humanity to be debated and used: "The continuity of any experience, through renewing of the social group, is a literal fact. Education, in its broadest sense, is the means of this social continuity of life" (Dewey, 1916, p. 5). Our schools, in spirit and in theory, strive to provide a meaningful environment for our youth to retain a plasticity of mind and character, but this butts up against national, state, and local standards for graduation outcomes. Parents and educators alike are frequently embroiled in discussions regarding the value and use of any number of school programs and curricula. We have confounded change with good. We have normalized the need to be in perpetual rediscovery and eschewed being stuck: "Any social arrangement that remains vitally social, or vitally shared, is educative to those who participate in it. Only when it becomes cast in a mold and runs in a routine way does it lose its educative power" (Dewey, 1916, p. 9). But we are hardly breaking the old casts and molds—instead we find new names and new steps for old procedures, and new content like the old content. Renewal and routine are very similar in education, ironically, for we renew our routines and our routine is to renew. The students are very aware of the static nature of their education when they are asked to complete a rote task, fill out a worksheet packet, do the same project that last year's kids did, or fall in line with a program that adults have lined up for them.

The 2019 students, as opposed to those in 1916, however, have additional layers of complication in their experiences of school becoming a place that is cast and molded prior to their arrival—many have advanced microprocessor computers in their pockets when they enter school. Students today are interacting with culture and the world in methods that are far more advanced than what a sculpted, crafted, and cast curricular program from ten years ago can offer: "In an advanced culture much which has to be learned is stored in symbols. It is far from translation into familiar acts and objects. Such material is relatively technical and superficial. Taking the ordinary standard of reality as measure, it is artificial" (Dewey, 1916, p. 11). Dewey's observation is an important one that demonstrates a need to look further at the materials with which we ask students to engage. Further, educators must also investigate the students' advanced symbolic language external from what traditional schooling asks of them. In both, however, humans are abstracting reality into symbols and communicating in ways that have very little to do with the physical act of building a fence or milking a cow or cooking a meal. Classrooms more often engage in intellectual work without tangible experiential interactions designed for student learning. A mathematics course speaks in a symbolic language that is artificial in comparison to the launching of a bottle rocket; a student Internet conversation about gun violence via memes speaks in a symbolic language that is artificial in comparison to the Columbine or Parkland incidents. Recognizing this cognitive break with reality and how we discuss reality in symbols is essential to finding the pathways to bridge the two together. Dewey's work emphasizes the need to consciously do this.

Educational technology is not just a pathway; it is a series of pathways from multiple starting points to multiple ending points. It is the most powerful way we have today to help bridge the real and the artificial and help students have transformative and meaningful

experiences in school that adjust to their needs and experiences: “One of the weightiest problems with which the philosophy of education has to cope is the method of keeping a proper balance between the informal and the formal, the incidental and the intentional, modes of education” (Dewey, 1916, p. 12). Once we acknowledge that school does not have to remain responsible for containing all the knowledge that students ought to learn, then perhaps school can grow into a structured but unscripted place where that balance can be the goal. A school today that wishes to embrace the democratic space of having teachers and students grow and learn together in the pursuit of blending reality with the artificial symbolic languages will no doubt look for modern tools and solutions—advanced microprocessors, artificial intelligence, robots and robotics, simulations and software, 2019 has a plethora of approaches that students come to school expecting to see available for them to learn and work with, and for good reason.

Learning and living with Internet-connected devices has become more common to expect in the last five years. We currently have a mixed reality of computers and Internet with face-to-face physical human and environmental interactions. Of interest is how the youth are being raised in societies where what is remote, artificial, and symbolic has become increasingly real and important. Many young people would rather that you punish them by taking away all their belongings and privileges except for their cell phone: “Some things which are remote in space and time from a living creature, especially a human creature, may form his environment even more truly than some of the things close to him” (Dewey, 1916, p. 15). As industrial changes occur throughout the world, it is of great significance that educational changes to procedures and content have yet to fully embrace the presence of technology in students’ hands. It is far more common to see cell phone lockers in classrooms than it is to see innovative new uses for these mini-computers and how we might harness their power.

Students' realities and environments are daily shaped by what they experience remotely via the Internet. Online there are multitudes of subcultures, each complete with their own sets of rules and customs. One can belong to multiple subcultures, all of which inevitably bleed into life offline: "But with the development of commerce, transportation, intercommunication, and emigration, countries like the United States are composed of a combination of different groups with different traditional customs" (Dewey, 1916, p. 25). The vision of an open and democratic education has always had the charge of helping to bridge groups of people and help build empathy and intelligence across and among groups of people. Part of the challenge of today's charge is to also encourage that cross-communal understanding within and among growing sub-communities that form online: "The intermingling in the school of youth of different races, differing religions, and unlike customs creates for all a new and broader environment" (Dewey, 1916, p. 26). Teachers and administrators often talk and write about how to make our schools the exemplar of how all people can think, work, and live together; this is still a work in progress, and perhaps will always be. The informational exchange among the individual, her family, her online subculture, her school subculture, and the larger community is in constant contact and flux. Today's world versus Dewey's world simply has a greater number of influences, groupings, and variables. Teacher and administrator education programs likely do not have enough coursework specifically aimed at student psychology to prepare professionals to handle all that society asks of from its schools: "The school has the function also of coordinating within the disposition of each individual the diverse influences of the various social environments into which he enters" (Dewey, 1916, p. 26). Prepare them for college, prepare them for the job market, prepare them for working with a diverse group of people, prepare them for working on humanity's biggest challenges, and also make individualized adjustments for each individual student's disposition

and processing style—it is amazing how much we ask of schools and teachers given how often we also cut their budgets.

John Dewey's (1916) seminal work, *Democracy and Education*, unwittingly discusses a very modern dilemma that is more layered than 100 years ago, in that our students are familiar with a mixed reality environment that is heavily influenced by their use of Internet communities and advanced symbolic language. Further, the use of this new technology shifts the expectations of students for not only how to communicate and learn but also what content to spend time learning:

> The development within the young of the attitudes and dispositions necessary to the continuous and progressive life of a society cannot take place by direct conveyance of beliefs, emotions, and knowledge. It takes place through the intermediary of the environment. (Dewey, 1916, p. 26)

The environment has shifted and fractured into many sub-community or subculture environments that commingle and influence the larger society. And yet, there is often available for download a catalog and brochure touting the ready-made curriculum and predetermined outcomes available on any school's website. Further, we experience today, and also 100 years ago, the problem that Paulo Freire (1970) called "banking education". John Dewey wrote about it much earlier than Freire: "Why is it, in spite of the fact that teaching by pouring in, learning by a passive absorption, are universally condemned, that they are still so entrenched in practice?" (Dewey, 1916, p. 43). A preponderance of private schools and charter schools in today's market might demonstrate some anecdotal evidence of families looking for something other than what traditional and conventional schooling practices have to offer; although when one looks further, all schools are still tied to outcomes that lead to college admissions standards, which hamper

many educators in their efforts to fully embrace John Dewey's vision. But what if we have not yet explored how educational technology can serve students and teachers alike in providing the tools and vision that allows for a transformative educational experience? I contend that we have not.

Schools are growing and changing and equipping themselves with new computers to address the current needs of modern learners. There are many examples of this shift in the tools that are purchased, and, of course, this a big need. However, as any educator would attest, "its enactment into practice requires that the school environment be equipped with agencies for doing, with tools and physical materials, to an extent rarely attained" (Dewey, 1916, p. 44). We can purchase the tools we need, though to purchase the required time to retool how we instruct and administer is a cost that many schools struggle to bear. Dewey continues:

> It requires that methods of instruction and administration be modified to allow and to secure direct and continuous occupations with things. Not that the use of language as an educational resource should lessen; but that its use should be more vital and fruitful by having its normal connection with shared activities. "These things ought ye to have done, and not to have left the others undone." And for the school "these things" mean equipment with the instrumentalities of cooperative or joint activity. (Dewey, 1916, p. 44)

This is a story that has been told many times in classrooms, faculty meetings, community gatherings, graduate schools, and legislative halls: students need opportunities provided for them in school that allow them to learn and grow together in new collaborative ways where they can best model themselves after the career pathways that await them after finishing their degree programs. The latest creation tools are clearly Internet-connected and computer-based. What

conversations in schools are happening to foster a new way to teach and administer with computers and the Internet?

The external outcomes that determine much of what is taught and how it is taught have a firm grip on the psyche of parents and community members when the discussion comes around to being ready for college admissions. Certainly, there are other metrics that we can use to judge college readiness, however, there remains a belief that learning one set of skills or concepts will necessarily lead to the application of that knowledge to the next most difficult task. What is missing is an understanding that nurturing growth of skills and concepts is actually good enough just by itself; we need not acquire textbook knowledge level one only to be ready to go to level two:

> Growth is regarded as *having* an end, instead of *being* an end. The educational counterparts of the three fallacious ideas are first, failure to take account of the instinctive or native powers of the young; secondly, failure to develop initiative in coping with novel situations; thirdly, an undue emphasis upon drill and other devices which secure automatic skill at the expense of personal perception. (Dewey, 1916, p. 55)

Students have innate curiosity that needs constant stimulation; they also are quite good at figuring out problems with solutions that provide unique insight into conceptual and design thinking; and repetition to acquire automaticity with a limited skill set or data set has done more harm than good in offering promise and hope for an individual to develop an ability to perceive and think. Knowledge and wisdom and experience are ends and means and measures unto themselves: “Since in reality there is nothing to which growth is relative save more growth, there is nothing to which education is subordinate save more education” (Dewey, 1916, p. 56). Class will truly never end because thinking and learning will never end. Our error is quite simply that

we have chosen to allow obtaining degrees and landing jobs as the goals for all of the "stuff to learn" when in school—but what we needed more was a sense that education begets education. We need to trust that a creative intellectual who perceives well and can collaboratively communicate well to work together and solve problems will no doubt perform well in school and in a career.

Instruction, rather construction, that focuses on student inquiries and interests as the primary means of determining the curricula provides a positive feedback loop of where students can benefit not only from having greater engagement but also a greater sense of accomplishment. John Dewey continually returned often to his main argument that schools ought to give students places to experience and interpret their own world:

> When we abandon the attempt to define immaturity by means of fixed comparison with adult accomplishments, we are compelled to give up thinking of it as denoting lack of desired traits. Abandoning this notion, we are also forced to surrender our habit of thinking of instruction as a method of supplying this lack by pouring knowledge into a mental and moral hole which awaits filling. (Dewey, 1916, p. 56)

The work that students are asked to complete in school is typically determined long before the students arrive to the classrooms. Our adult standards of what it means to accomplish a course or acquire knowledge or hone skills are fixed points on a measurement scale. To ensure that students measure up to what has been done before (read: graduation requirements), we often resort to either directly or indirectly viewing them as empty vessels that need to be filled. One of the great advantages of educational technology in the student-school-society relationship is how it has the power to immerse a student in a digital learning environment that acknowledges her individuality as the primary interface for encountering, processing, and solving problems.

Ralph Waldo Emerson inspired John Dewey's thinking as evidenced by the inclusion of this philosophical position regarding the magic of children: "Respect the child. Keep his nature and arm it with knowledge in the very direction in which it points" (cited in Dewey, 1916, p. 57). These are controversial words only because they buck the institution, though many would find that their own parenting style of their own children aligns nicely with this idea: try to know who your child is and give her what she needs to best further her passions and interests. Further, John Dewey extended what is a common parenting approach and applies it to a common sense view of how we can make sense of how to understand whether or not our children's experiences in school are matching a desire for continued learning: "The criterion of the value of school education is the extent in which it creates a desire for continued growth and supplies means for making the desire effective in fact" (Dewey, 1916, p. 58). And this again is another important checkpoint in understanding how to combine an understanding of educational technology and John Dewey's approach to making a school. Learning begets learning. When we use the most powerful creation tools available in school and follow the interests of the children, their desire to keep creating and growing and learning will become increasingly powerful.

One foundational principle of the Internet is the connectivity of both information and users. The basics of searching on the web demonstrate quickly how one webpage leads to another and another. The interconnectedness of information and the ease with which we can access it has made instant research possible on many levels of inquiry. That students can access the world's greatest ideas from multiple entry points is a celebration and not a dilemma. That schools do not easily respond to the connectivist theoretical framework is not entirely surprising, though it does point to one of the more modern interpretations of information science worthy of consideration for teacher professional growth:

> Education is neither a process of unfolding from within nor is it a training of faculties resident in mind itself. It is rather the formation of mind by setting up certain associations or connections of content by means of a subject matter presented from without. (Dewey, 1916, p. 75)

Students are interested in learning and re-learning, deepening their relationship to ideas and wisdom, though the dependent variable here is their engagement and interest level. All material to study is external to students' minds—they did not write the world. But their own version of how this material can be put to use in a manner unique and bound to a series of connections of interpretations that is solely their own, quite simply, that is the purpose and process of education not school. There is a split. Schooling versus education. Dewey continued: "The business of education is rather to liberate the young from reviving and retraversing the past than to lead them to a recapitulation of it" (Dewey, 1916, p. 79). The setting of school may not be the place for education. If schools are bent on forcing students to study that which has already been studied, they may no longer be the solution—Dewey was talking about a dream and a hope that he tried to make happen but struggled to sustain. Perhaps education can and must take place elsewhere away from schools. So, what shall we do with all these schools? Perhaps they could be production studios combined with libraries and modern computing equipment, and perhaps students could work on many projects and skills, including self-governance and entrepreneurial design.

The externally imposed outcomes for graduation and the rigid rules of college admissions translate into a ready-to-wear experience for most students. Whether or not students understand what they are asked to study is often of little concern. With another test scheduled for next week,

and often even in the next hour for a different class, students become busy beehives of activity towards a bitter goal, about which Dewey said:

> But much work in school consists in setting up rules by which pupils are to act of such a sort that even after pupils have acted, they are not led to see the connection between the result—say the answer—and the method pursued. So far as they are concerned, the whole thing is a trick and a kind of miracle. (Dewey, 1916, p. 84)

The answers are at the back of the book and the obvious plot points and symbolism are printed after each excerpted passage. It is pure trickery to place these "answers" before pupils' eyes as though they are given facts of the agreed-upon universe. In fact, the many failures and experiments and drafts that comprise the process by which the world's greatest thinkers have arrived at the wisdom taught in schools are all exactly what schools are missing. Instead we compose endless permutations of the same sorts of problems to solve, print them on worksheets and in textbooks and online supplements, and call it "education".

Just as the family structure is ideally an educational unit aimed at safety, inclusion, honesty, improvement, and development, the formal creation of schooling became natural extensions of these goals. The social democracies that formed in students' home-away-from-home were largely influenced by the "parents", or schoolteachers, staff, and administrators, and thus began the incessant conversations regarding the human capital problems of hiring and firing the "correct" employees to suit the needs of the students and the institution. Many a student may have wondered about firing their own parents at home, but at school, their parents were of a different social status that bestowed upon them an air of authority. Will the voice of the teacher parrot the voice of the institution? Will the voice of the institution parrot the voice of the State? Does the student have a voice at all? These questions were much smaller in an age before

mandatory schooling, but today they carry great weight and purpose, for some still see education as the only path to restoring peace and equity in our cities. Yet the funding for education is perpetually a negotiable line item in the United States' annual operating budget:

> But we are doubtless far from realizing the potential efficacy of education as a constructive agency of improving society, from realizing that it represents not only a development of children and youth but also of the future society of which they will be the constituents. (Dewey, 1916, p. 85)

The pressure of time constraints from within and without, added to the persistent demands for higher test scores and GPAs, together with the complex natural socialization process of young people, make it an easy choice to not directly work on how the daily studies connect to improving conditions for all outside of school. Dewey's assertion that schools can do more to help prepare students to forge a better future for themselves and their unborn grandchildren is a song that is sung every year by philosophers, parents, and principals alike. However, I argue that they are missing Dewey's purpose, which was to critique the functionality and form of school towards meeting the growing of transforming the greater society. The obsession with grades and test scores in order to obtain a chance for financial success by hopefully "landing the dream job" with the right combination of university degrees and workplace experience—well, Dewey is right—we stopped talking about education, learning, thinking, and replaced it with a gauntlet of graduation requirements designed to make a child's mind split in at least seven directions each day of the week.

Replacing the mundanity of school with a vibrant set of offerings presents a healthy and difficult challenge to educators and community members. Teacher education programs may touch upon "alternative" methodologies but ultimately focus their trainings on the existing issues

in schools and how to best manage them. As an English teacher with over twenty years of classroom experience, I can tell you firsthand that many obstacles prevent students and teachers from creating intellectual and creative safe havens. Either the methods are not understood by outsiders or the restrictions on how time is spent make the experience rather severe: “Lack of the free and equitable intercourse which springs from a variety of shared interests makes intellectual stimulation unbalanced. Diversity of stimulation means novelty, and novelty means challenge to thought” (Dewey, 1916, p. 90). Quite honestly, students need help thriving and surviving in this kind of free-flowing economy of ideas. Many can retreat into their private spaces if they are not naturally gregarious and teachers must provide scaffolding to bring students along. This is the case for an inclusive and inquiry-driven educational model. Dewey pointed to the growing mismatch between schooling and education and noticed that it was the institution of school, and its rules of governance from behavior to learning, that had the greatest negative impact on the students and their ability to grow and work freely.

Schools fell into a need for design that captured students in rooms for extended periods of time. Mandatory schooling and a rise in population put strains on a very young system. The importance of these two events cannot be overstated. Significant changes to how we run schools in the USA happened during a massive enrollment change from 1890 to 1930. The organizational model and the rules of school that are commonplace now, and that have been exported worldwide for decades, could be viewed by many as a monumental achievement that needs very little monitoring at this late stage. Others may view the static commonalities of school management as a sign of weakness, due simply to its resistance to change. But again, when we view student life and student performance within school only through the lenses of their grades, test scores, transcripts, and college admissions, we miss the opportunities to talk about their

creativity, their intellect, their risk-taking, their dreams and visions for their own future, and ultimately their whole selves. Ideally, and perhaps idealistically, the school community is a dynamically shifting body of people all working in service of improving individuals and the greater society:

> A democracy is more than a form of government; it is primarily a mode of associated living, of conjoint communicated experience. The extension in space of the number of individuals who participate in an interest so that each has to refer his own action to that of others, and to consider the action of others to give point and direction to his own, is equivalent to the breaking down of those barriers of class, race, and national territory which kept men from perceiving the full import of their activity. (Dewey, 1916, p. 93)

The positive impact of a school on its inhabitants does not have to be a dream unrealized, and there are growing attempts to address issues of race, class, and power inside of the curriculum and adjacent programs. Many administrators create "special assemblies" that are viewed by students and faculty alike as good in theory but low in impact—the follow-through is hardly ever there and if it were, it is typically added on to regular duties and thus ignored. Schools are notorious for starting new ideas and letting them die on the vine simply because of an unwillingness to let go of any of the other requirements placed on students and teachers. A few documentary films or special guest lectures about the virtues of an integrated society and shared resources will have little impact if the daily work of the classroom is still harping on the blunt tool of 40 students, 40 tests, 40 pencils, 40 minutes, 40 points—be silent, keep your eyes on your own paper, your work must be your own, and I cannot help you because you should have studied. That sounds like a classroom. And it also sounds like a place that does not work on the lofty goals to which the classroom can create pathways.

To create a democratic and inclusive society is hard work. We are still working on it worldwide and here in the United States of America. This dissertation is aimed at looking closely into how a reliance on behaviorism and teaching with technology in a limited manner predetermines student outcomes to their detriment; these long-standing traditions in the school systems limit creativity and innovation. This author wishes to wonder about the possible connections between the human society we wish to create and the methods we use to create it:

> An education could be given which would sift individuals, discovering what they were good for, and supplying a method of assigning each to the work in life for which his nature fits him. Each doing his own part, and never transgressing, the order and unity of the whole would be maintained. (Dewey, 1916, p. 95)

And while we could do that, we should not do that, because that system works against what we know about the innate ability to learn, grow, and change. It does not give students a fair chance to discover their passions and interests. However, in many ways, this sorting and sifting of students is already baked into the institution. Course placement, particularly with regards to Honors and Advanced Placement, has traditionally favored Caucasian students; for many years, schools have been tasked with addressing this inequity. Applied to the daily life of a student, who works on varied tasks of varying degrees of interest and purpose, a student might prefer to work on fewer things, but again, whose choices dictate the topics and the outcomes? We have default activity based on traditions that were created in another era of exclusivity and inequity.

Many parents of today's school-going teenagers grew out of the 1960s and 1970s, a time that brought about much of the multicultural and socio-emotional curricula that is now standard practice in schools. There have been major changes for the benefit of the greater good since school desegregation, though that work never truly ends due to the social justice battles that

persist in arenas that are less visible to the public. The parents of today ask different questions of their schools and for their children, and yet still diminished is the view that students should co-create the programming and work with educators to construct a meaningful and student-directed inquiry-based curriculum:

> Each generation is inclined to educate its young so as to get along in the present world instead of with a view to the proper end of education: the promotion of the best possible realization of humanity as humanity. Parents educated their children so that they may get on; princes educate their subjects as instruments of their own purposes. Who, then, shall conduct education so that humanity may improve? (Dewey, 1916, p. 101)

It may be that we have solved so many of society's ills in the past sixty years that we have grown complacent in the strive for more schools to represent the population and its wishes, or perhaps the population and its wishes have grown too scattered to be unified towards a goal of student engagement as a primary concern in their studies; but we are still test-obsessed and grade-obsessed and "big data" obsessed to the extent that schools might actually think that this is our idea and not theirs. Families only know that they should care about this data because schools have held it as the functional truth that families should care about this data. With funding tied to it, big data becomes the school's end game. Then, this message gets repeated and echoed through all media channels. Perhaps we are unable to see the dangers and dilemmas of our current strategies and methodologies simply because they have risen to prominence at a slow enough rate that we did not realize we needed to question just how standardized in our measures and programming we really wanted to become.

However, I will say it: the worksheet curriculum is an old, rubbery, overcooked waste of time in school. It should be questioned every time it appears. Parents need to be educated on the

values and virtues of student engagement and student inquiry as they are important advocates for their children's opportunities now and in the future. A social justice problem of epic scale is that most parents are in a financial bind and are too busy earning salaries to advocate for their children's well-being in school, therefore they may put full trust in the school as a default method. Why not trust the school? Teachers want to improve the world, do they not? However, educators do not always know best, particularly when what they know has been force-fed to them by a corrupt and broken system that reifies the racial and social inequities it says it will eradicate; and when educators deliver a curriculum built on their narrow view of society or a curriculum comprised of an endless series of tasks and tests, neither serves the student well, yet we continue to see this over and over again:

> Since aims relate always to results, the first thing to look to when it is a question of aims, is whether the work assigned possesses intrinsic continuity. Or is it a mere serial aggregate of acts, first doing one thing and then another? To talk about an educational aim when approximately each act of a pupil is dictated by the teacher, when the only order in the sequence of his acts is that which comes from the assignment of lessons and the giving of directions by another, is to talk nonsense. (Dewey, 1916, p. 108)

Where is the spark of imagination? Where is the boundless creativity? Where is the call of the intellect? Where is the yearning of the soul? The teacher was not invented simply to lead students through a carbon copy process, nor to stultify their senses, nor limit their wild wonder. The teacher was invented to help guide the student to become the best version of herself as determined from a dynamically changing set of data with which the student interfaces in a shared and global learning environment. School is not the world, and the world is certainly not a school, yet education happens whether one attends school or not. To pretend that the students will only

learn through a prescribed, and often imported, worksheet and test-on-Friday curriculum is to pretend that the students are nothing more than empty receptacles awaiting further instructions.

Our charge as educators is to study the past, envision the future, and then create a meaningful and dynamic present with which students can interact, learn, and grow towards something that is of value and consequence in their own individual pursuits. This perpetual present shifts every year, every month, every week, every day, every hour, and certainly with every student in every geographical location on the planet:

> A farmer who should passively accept things just as he finds them would make as great a mistake as he who framed his plans in complete disregard of what soil, climate, etc., permit. One of the evils of an abstract or remote external aim in education is that its very inapplicability in practice is likely to react into a haphazard snatching at immediate conditions. A good aim surveys the present state of experience of pupils, and forming a tentative plan of treatment, keeps the plan constantly in view and yet modifies it as conditions develop. The aim, in short, is experimental, and hence constantly growing as it is tested in action. (Dewey, 1916, p. 112)

School as experiment is today relegated to only a few institutions who go against the grain, as most are either public, private, or parochial schools that follow the national and state mandates with some exception given to the non-publics. In my experience, I have witnessed private schools provide a small school experience with more elective hours for students to take non-academic coursework, however the main fountainhead of their core curricula is founded on the same unimaginative worksheet concept that drives most things. On top of that, you often must pay an exorbitant tuition to guarantee a seat, and later pay again when it is fundraising season. Parochial school tuitions are often lower than private schools, but again do not stray so far from

the "expected programming" that the public schools will guarantee. The few maverick schools that decide to go against this stagnant approach do not always survive the economic tidal wave that drowns them, and it is hard to blame families for not supporting these outliers—we have heard the bell rung from Harvard to Reggio that our little babies will not be judged for their character or their ingenuity and all that parents love about their progeny, but rather it will be their scores and their accomplishments. Ask any high school student about their true passions and interests and if they line up with the volunteer work they are doing after school. Ask them if their clubs and community service hours are a true reflection of how they wish to spend their time versus padding their *curriculum vitae* for college admissions.

So, we are stuck. We know enough in this late stage of economies, schooling, technology, history, human development, and psychology that allows us to perceive the confluence of factors causing a deadened or lifeless education for many students. We know enough to feel the pull for something else that is more meaningful. We know enough to demand something more, something different, something that takes back the control of our children's lives. The system, as is, has served its purpose and exhausted its imagination. School is not education. John Dewey articulated something important for us to consider:

> And it is well to remind ourselves that education as such has no aims. Only persons, parents, and teachers, etc., have aims, not an abstract idea like education. And consequently their purposes are indefinitely varied, differing with different children, changing as children grow and with the growth of experience on the part of the one who teaches. (Dewey, 1916, p. 114)

Have you heard the common complaint when students move from one teacher to another in the same subject area in each successive year? They talk about how they must get used to the new

teacher's approach and ideas. It is fascinating that this is a complaint! It is a feature, not a bug! A student benefits greatly from the variation that comes with multiple perspectives and styles, however most administrations work tirelessly to "lock that down" so that students have a seamless experience. One of the great mysteries and beauties of life itself is change and variation and multiplicity. Students and teachers alike should not be held to externally determined notions of what it means to learn or what it means to have an education. The administration rarely involves itself in the daily function of a classroom, so who could rightly lay claim to what happens there but the teachers and students? They alone should oversee their education, not a remote authority figure in the main office or the district or governmental office.

That John Dewey wrote about this problem in 1916 and that we are still dealing with it does not actually give me much hope, but I still wake up trying each day. I see our continued failure in importing predetermined outcomes as likely the most major flaw education has encountered for it can be analyzed as connected to so many issues. And while there are certainly successes to be heralded where educators are forging a new approach and a new image, the return each year to packaged curricula impacts the outside perception of school and morphs it into an iconic widget factory. For those who wish to investigate the metaphor, though, the only "flaws" in the machinery are the people who are forced into the cast and mold; the leftover parts of their personalities and interests are never eradicated as the machine press tries to shape them into something preset. This might be viewed as a success, however, for it points to the impossibility of crushing the human spirit and potential. However, we have all read too often about young people committing suicide or engaging in risky behavior with drugs and sex as a result of "not being seen" at school by their teachers or the system itself—they feel misled by their parents to engage in a game that has nothing to do with learning or bettering themselves,

but instead are composing profiles for competition with their collegebound classmates. Dewey continued:

> The vice of externally imposed ends has deep roots. Teachers receive them from superior authorities; these authorities accept them from what is current in the community. The teachers impose them upon children. As a first consequence, the intelligence of the teacher is not free; it is confined to receiving the aims laid down from above. Too rarely is the individual teacher so free from the dictation of the authoritative supervisor, textbook on methods, prescribed course of study, etc., that he can let his mind come to close quarters with the pupil's mind and the subject matter. This distrust of the teacher's experience is then reflected in the lack of confidence in the responses of pupils. The latter receive their aims through a double or triple external imposition, and are constantly confused by the conflict between the aims which are natural to their own experience at the time and those in which they are taught to acquiesce. Until the democratic criterion of the intrinsic significance of every growing experience is recognized, we shall be intellectually confused by the demand for adaptation to external aims. (Dewey, 1916, pp. 115-116)

We are utterly confused. Dewey was correct and he is still correct. That test scores are being bought by the wealthy would not surprise him. That students are overloading their course schedules would not surprise him. That parents are hiring tutors to help with homework would not surprise him. And as the final ironic piece, that colleges and universities ask students to reveal their true selves, which have been otherwise shrouded by the curriculum, would not surprise him. The scandal is less that it happened and more that it is still happening. How many lawmakers have considered these problems and kicked them down the road? How many more

will do the same? This is a call to action! How many more students will need to be put through the paces of a prescribed curriculum with predetermined outcomes and have their individual interests, passions, whims, fancies, and souls be ignored? How many more educators will read John Dewey's work and return to work the next day unchanged in their direction or attitude toward the work with students? Better yet, how many educators will never read John Dewey's work and they are in the classroom right now teaching your children?

The work we ask of our students to complete during their time in school has already been completed by other students before them. This does not confer upon their studies any kind of special qualities or impart to students any assurance that this work will "see them" in any culturally relevant manner—this schoolwork will be done again after they are long gone from the institution. In fact, only the teacher is doomed to repeat the same material year after year. Students enter a course, receive a syllabus, attend the lessons, complete the activities, chip away at the longer assignments, and sit for the tests. The prescribed curriculum is so normal that it does not faze our sensibilities; we have grown numb to the reality, and few wait around expecting anything except for school to look this way for many years to come. Perhaps all that is left are the dreamers dreaming of a school day created by the inquiries of the students:

> A true aim is thus opposed at every point to an aim which is imposed upon a process of action from without. The latter is fixed and rigid; it is not a stimulus to intelligence in the given situation, but is an externally dictated order to do such and such things. Instead of connecting directly with present activities, it is remote, divorced from the means by which it is to be reached. Instead of suggesting a freer and better balanced activity, it is a limit set to activity. In education, the currency of these externally imposed aims is responsible for the emphasis put upon the notion of preparation for a remote future and

> for rendering the work of both teacher and pupil mechanical and slavish. (Dewey, 1916, p. 117)

In an observation of a classroom full of bright pupils engaged in boring activities with a limp, lifelessness about them, the conclusion should be to question the teacher about her purpose: what was the objective of the lesson and could the students be seen working towards that objective? Now, certainly students could use to learn a thing or two, that is not in question, but just what is it that they are learning: that ought to be in question. The human creature is a complicated creature full of potential and possibility. There has never been one way to learn anything nor one way to organize all the information known to humanity. It is the multiplicity that educators discuss in the abstract, in university courses, in faculty meetings, in collaborative efforts, as a "good thing", but the methods we have mostly used thus far in the history of education do not nurture the human potential to achieve our goal of diverse and divergent thinkers—the simple obstacle is that we continue to allow predetermined aims and outcomes to take precedence over the experience and ideation of the child.

Dewey returned to this subject again and again. He saw that there was an inextricably bound link between the value and power of democracy and the educational methods that we use to shape the minds of our youth. If there could have been just one activity that Dewey wanted children to engage in most, it would be to think. To think with purpose and with interest, to think with engagement and passion, to think with the knowledge that their ideas were worthy of exploration and that they belonged in school, in the lessons, in the curricula:

> Parents and teachers often complain—and correctly—that children "do not want to hear, or want to understand." Their minds are not upon the subject precisely because it does not touch them; it does not enter into their concerns. This is a state of things that needs to be

> remedied, but the remedy is not in the use of methods which increase indifference and aversion. Even punishing a child for inattention is one way of trying to make him realize that the matter is *not* a thing of complete unconcern; it is one way of arousing "interest," or bringing about a sense of connection. In the long run, its value is measured by whether it supplies a mere physical excitation to act in the way desired by the adult or whether it leads the child "to think"—that is, to reflect upon his acts and impregnate them with aims. (Dewey, 1916, p. 136)

An adult can find joy and satisfaction in a child's parroting of their elder thoughts and behavior. It is certainly cute. When extrapolated into a school pedagogy, cute it is no longer, and instead becomes problematic and potentially harmful to the intellectual and socio-emotional growth of the child. Occasionally a student will have a chance to use his or her own interests to drive a project or paper. However, most people remembering their time in school will think back on the dread of worksheets and the joy of class projects. Whether or not Johnny can read is an important question, but can he think? Does he care about thinking? When was he encouraged to develop his own way of patterning the world and making sense of it in a manner that was solely his? Or did we pay too much attention to Johnny's standardized test scores to notice if he was engaged or happy or, shudder, both? Students shuffle through days and hallways delighting in the shared hidden language of friends before settling into seats silently awaiting instructions from their superior.

Without overstating or exaggerating what happens in schools, one can fairly expect that students are the recipients of their education more than they are the agents of their education. Even though school itself as a work-in-progress has been discussed by educators, social scientists, and philosophers for over 100 years, the nature and methods of school have remained

relatively unchanged throughout that time. Progressive and constructivist thinking are considered as possible approaches one studies in a teacher preparation program—they are ancillary or auxiliary concepts found in a chapter or a unit of study. A typical textbook will show a timeline of ideas and approaches to education that includes alternatives to the tradition, but a traditional approach is most likely used to introduce these alternatives! The ends and outcomes are predetermined and prescribed. Thus we have already entered the tragic and ironic phase of training teachers through traditional methods about alternative methods that they might think about using if the conditions were different—and as you might imagine, this becomes mostly a history lesson instead of a true training session. It seems more and more that we have let John Dewey down:

> To organize education so that natural active tendencies shall be fully enlisted in doing something, while seeing to it that the doing requires observation, the acquisition of information, and the use of a constructive imagination, is what most needs to be done to improve social conditions. To oscillate between drill exercises that strive to attain efficiency in outward doing without the use of intelligence, and an accumulation of knowledge that is supposed to be an ultimate end in itself, means that education accepts the present social conditions as final, and thereby takes upon itself the responsibility for perpetuating them. A reorganization of education so that learning takes place in connection with the intelligent carrying forward of purposeful activities is a slow work. It can only be accomplished piecemeal, a step at a time. But this is not a reason for nominally accepting one educational philosophy and accommodating ourselves in practice to another. It is a challenge to undertake the task of reorganization courageously and to keep at it persistently. (Dewey, 1916, p. 144)

The slow progress of humanity's shared intellectual value and impact cannot be oversold or underestimated. And we ought to acknowledge that we can damage our chief resource and export, mental horsepower, through inferior methods in our children's classrooms. Dewey saw the connection between, and there were many strands to the connection, a thriving democracy and a healthy education. Lectures and worksheets have long ago been considered problematic despite being so frequently used in schools. It is common for students to have three or four tests in a single day simply because their teachers did not synchronize their calendars. Is there a direct link between this oppressive model of education and a thriving democracy?

What John Dewey isolates so beautifully in this seminal work is a simple yet powerful conceptual framework that the human mind is best suited as a tool for learning when it finds stimulating and engaging subject matter. It is faulty to assume that the brain can successfully be applied to ready-made materials that are, at that time, of no interest. Instead, the mind will induce the optimal functions for learning when it is engaged, and from this experience knowledge can be formed. The implications for mandatory schooling should be readily apparent: like any other object in the known universe that the mind encounters, so are the standards of a ready-to-wear curriculum—not of any interest until one's mind perceives them as interesting. I can already hear the cries for a teacher who makes the subject relevant and relatable to students. Yes! That should be the work of teachers, but it is the work of teachers within a system that is battered and bruised. That teachers need to "dress up" the work ought to signal a problem, a dilemma, nay, a major fracture in the promise for student joy in learning:

> The significance of this doctrine for the theory of education is twofold. On the one hand it protects us from the notion that mind and mental states are something complete in themselves, which then happen to be applied to some ready-made objects and topics so

> that knowledge results. It shows that mind and intelligent or purposeful engagement in a course of action in which things enter are identical. Hence to develop and train minds is to provide an environment which induces such activity. On the other side, it protects us from the notion that subject matter on its side is something isolated and independent. It shows that subject matter of learning is identical with all the objects, ideas, and principles which enter as resources or obstacles into the continuous intentional pursuit of a course of action. The developing course of action, whose end and conditions are perceived, is the unity which holds together what are often divided into an independent mind on one side and independent world of objects and facts on the other. (Dewey, 1916, p. 145)

This major distinction acknowledges the power of the mind while also acknowledging the power of engagement. Dewey also urges us to recognize that knowledge building, learning, and true education will only occur in school once we create nurturing conditions for minds and objects and facts to naturally commingle. Preschools are quite good at this kind of commingling, but all too soon the race is on for college admissions and preparation—it is common for students to receive homework as kindergarteners, worksheet homework, even. And there we have it: the hopes and dreams of a soul unsatisfied through a method of drudgery created solely for the ease of the teacher, the systems of grades and matriculation, and to satisfy a notion founded in fear and misinformation that students must always be working towards college preparation. It is comical and sad and misguided that we have allowed ourselves to believe that children filling in the blanks on an Internet-downloaded worksheet will lead them to success. Wake up, world!

The constructivists saw the artificial split we created with the activity of school separate from meaning-making. Their analyses of the behavioral and cognitive approaches presented the worlds of brain research and educators with an invigorated passion that some schools picked up

in the 1960s and carried forward. John Dewey saw this problem even earlier but the momentum of mandatory schooling and a population increase did his work no favors. The standardized curriculum and testing movements won the favor of the public and the politicians, despite the scientific and anecdotal evidence suggesting another way:

> Experience is primarily an active-passive affair; it is not primarily cognitive. But the *measure of the value* of an experience lies in the perception of relationships or continuities to which it leads up. It includes cognition in the degree in which it is cumulative or amounts to something, or has meaning. In schools, those under instruction are too customarily looked upon as acquiring knowledge by direct energy of intellect. The very word pupil has almost come to mean one who is engaged not in having fruitful experiences but in absorbing knowledge directly. Something which is called mind or consciousness is severed from the physical organs of activity. The former is then thought to be purely intellectual and cognitive; the latter to be an irrelevant and intruding physical factor. The intimate union of activity and undergoing its consequences which leads to recognition of meaning is broken; instead we have two fragments: mere bodily action on one side, and meaning directly grasped by "spiritual" activity on the other. (Dewey, 1916, p. 147)

Kids are always looking for something to do. They are in need of constant stimulation to figure out who they are and what they think. Strikingly, we demand at earlier and earlier ages of schoolchildren that they have a cognitive experience in school instead of a physical one. It is unclear, given the research already available, how we could demand that students sit still for so many hours in a chair to complete worksheets or essays or projects—and most often not

concerning topics that students choose, but also constructed in a manner that turns potentially creative work into a rote learning experience.

And then we not only wonder why Johnny does not read but why Johnny does not stay in his seat. Why does Johnny have to get up so often out of his seat or call attention to himself when sitting as told? The behavioral issues that take up the air space and mind space in classrooms are most often linked to teachers' and administrators' unexamined practices and attitudes towards curricula and learning—however, the students are typically blamed and punished for their misunderstood rupture of the classroom:

> The chief source of the "problem of discipline" in schools is that the teacher has often to spend the larger part of the time in suppressing the bodily activities which take the mind away from its material. A premium is put on physical quietude; on silence, on rigid uniformity of posture and movement; upon a machine-like simulation of the attitudes of intelligent interest. The teachers' business is to hold the pupils up to these requirements and to punish inevitable deviations which occur. It may be seriously asserted that a chief cause for the remarkable achievements of Greek education was that it was never misled by false notions into an attempted separation of mind and body. (Dewey, 1916, p. 148)

It is the contention of the constructionists that students must be building things during their school day, and in an era where students can have their physical education courses curtailed due to budgeting, that hands-on experience has an important role. However, the more widespread belief is that students should have more rigorous exercise during their school day, and this quite simply does not happen with the same reliability and volume as in previous decades. It is strange to make that observation when John Dewey noticed in 1916 that students were already experiencing a curtailed physical exercise time compared to previous generations—I look back

to the 1970s fondly recalling much more "runaround time" outside than is made possible for students today. So, there is a relative problem with regards to the amount of time that students actually have to use their bodies to feel physical exertion, but the problem remains. There exists a direct correlative link between the amount of energy that goes unused in a human's body, particularly a young human, and the periods of unengaged behavior in the classroom; the energy must be transferred to something in the course of a day. If the student is "cooped up" inside forced to complete work that is of little interest, the adults at the school ought not be surprised by the oppositional behavior. The argument for student engagement is the central component of many pedagogies and theories, however to create a nurturing place for engagement to occur might be a topic for future research and study: the three major branches of this dissertation are purposefully being placed together to create a new engagement for both teachers and students. Critical Techno Constructivism is the theoretical approach postulated here and while it does connect to student voice, choice, agency, and engagement, there are larger infrastructural and structural issues involved in operating a school that stem from teacher training to school funding based on standardized testing.

Moving the students through the work that they did not ask to complete becomes the job of the teacher. The administrative faculty creates the environment for that to occur and the parents support the work at home. Meanwhile, the students are to comply or face consequences. In order to make this system work, we create curricula and pedagogy to accomplish these goals and move students through the K-12 continuum. Certainly there are talented and life-changing educators who interface with students every day in classrooms worldwide, and certainly those very same people are up against challenges that have very little to do with the art and science of teaching but more to do with the institution. This is where action is necessary—it is time for the

educators to rise up and take charge of their own profession rather than wait for the external measures to determine their fate, their path, their work. John Dewey saw this need even in how we teach students to read in the classroom:

> It is customary for teachers to urge children to read with expression, so as to bring out the meaning. But if they originally learned the sensory-motor technique of reading—the ability to identify forms and to reproduce the sounds they stand for—by methods which did not call for attention to meaning, a mechanical habit was established which makes it difficult to read subsequently with intelligence. The vocal organs have been trained to go their own way automatically in isolation; and meaning cannot be tied on at will. (Dewey, 1916, p. 149)

Too often have teachers heard the familiar "bored in school" reading voice when students perform aloud any passage or lines from a play. Many times the divorced meaning from the words themselves is due to not selecting reading material that connects to a student's experience. Sometimes students just do not know what they are reading because the words do not make sense to them, and other times they simply do not connect to what is being communicated. Teachers have a direct influence on this experience for their students; they can address the dilemma by helping students to engage with materials that give more opportunities to have a connected and meaningful experience while practicing skills that ultimately will be judged and assessed externally. Schools are made by the students and faculty who work in them and not by the rules and tests that stand on the outside of the campus gates.

More and more, school leaders have been charged with the task of making school more relevant to their enrolled students, and more and more, school leaders have been bumping against obstacles and dilemmas that make this a difficult goal to meet. When the college admissions

examinations are comprised of an unchanging set of content standards, what are the chances that individual classroom teachers can take students on a journey charted by their interests? It is more expected that those experiences happen prior to high school, given the direct impact that one's high school course selection, grades, and test scores have on the future—and that right there is where we continue to be stuck and keep turning over control of the classroom, the curriculum, the pedagogy, the theory, to the abstract concept of college degrees and career success and financial freedom. Students have real problems now that can we help them incorporate into their studies and the abstraction of a college degree would likely become a concrete and tangible pathway that they could help craft. It is this absence of reality in their work now that causes the most confusion in leading towards something that makes sense:

> As a consequence of the absence of the materials and occupations which generate real problems, the pupil's problems are not his; or, rather, they are his *only as* a pupil, not as a human being. Hence the lamentable waste in carrying over such expertness that is achieved in dealing with them to the affairs of life beyond the schoolroom. A pupil has a problem, but it is the problem of meeting the peculiar requirements set by the teacher. His problem becomes that of finding out what the teacher wants, what will satisfy the teacher in recitation and examination and outward deportment. Relationship to subject matter is no longer direct. The occasions and material of thought are not found in the arithmetic or the history or geography itself, but in skillfully adapting that material to the teacher's requirements. The pupil studies, but unconsciously to himself the objects of his study are the conventions and standards of the school system and school authority, not the nominal "studies." (Dewey, 1916, pp. 162-163)

In this scenario, the student is a guest in the classroom and if she does not share in the interest of the material selected by the faculty and administration, well, then years of neglect will ensue. There will occasionally be a classroom environment that allows a student to connect with the teacher and the other students, but the connection to the material studied will be rare, if at all. That we have known this to be the problem in schools since Dewey's observations should give us pause: we have abdicated the responsibility of teaching the actual children before us and instead replaced this noble notion with preparing children for an impersonal and systematic approach to short-term memory and recall. That we discuss "lifelong learning" inside this context of standardized testing and predetermined curricula should be exactly where we focus, deeply and meditatively, our critical analysis of the ends and the means.

Many times the constructivist classroom is seen as a "free-for-all" for those untrained in what to look for when the classroom is de-centered. A teacher evaluator may come in and see that a teacher is not lecturing from the podium or forcing students to move "lockstep" through a downloaded or reproduced worksheet of problems, and for these "crimes" would be considered as going too slowly or not meeting performance standards: one might wonder where exactly this evaluator gets her ideas for what happens in school and whether or not it is the teacher who is in school or the students. Nevertheless, these are real glimpses of how schools operate—the fear that a constructivist teacher is non-performing has more to do with a misinformed perception of meeting the needs of all students. When the teacher is involved in the process of each student's pathway in the work, that teacher might be thought of as not teaching, and as strange as that sounds, it is true simply because teacher and administrative training courses do little to provide opportunities to practice anything but traditional methods:

> This does not mean that the teacher is to stand off and look on; the alternative to furnishing ready-made subject matter and listening to the accuracy with which it is reproduced is not quiescence, but participation, sharing, in an activity. In such shared activity, the teacher is a learner, and the learner is, without knowing it, a teacher—and upon the whole, the less consciousness there is, on either side, of either giving or receiving instruction, the better. (Dewey, 1916, p. 167)

Schools face a human resource problem in that the people available for hire are not all open to taking non-traditional stances or viewpoints regarding how education "gets done"—the transformative power of the classroom always sits latent ready for teachers and students to access, if they are allowed. Sharing in the learning process provides opportunities for growth that can easily go undocumented due to the absence of quantifiable measures in the qualitative endeavor. How might one turn the teacher-as-student and student-as-teacher symbiotic relationship into a standardized, norm-referenced set of examination questions? That would run counter to the very nature of that approach to the classroom. Thus, when the untrained evaluator enters the room and sees "abnormal" behavior in how learning happens it might conjure up fear that the students are being shortchanged in meeting those almighty external goals. So, you see, the reframing of the classroom space is constantly thwarted by the lack of vision from those who sign the teacher contracts and for over 100 years, we have continued this cycle of fear and misunderstanding.

We bemoan that our children have less free time for free play, but we demand that they are competitive for college admissions. We bemoan that our schools have little personal connection to our children, but we demand that they provide an education similar to our own. We bemoan that teachers use outdated textbooks and worksheets to educate our children, but we

demand that they can recall facts and figures to demonstrate cultural literacy. All in all, the schizophrenic Hydra we constructed is also the same one that benefits the educational industry which has profited into the billions selling us curriculum packages and standardized tests in every state of the union. But deep down, we likely know that this is all wrong and are waiting for something that never happens, on a national level, to change:

> All educational reformers, as we have had occasion to remark, are given to attacking the passivity of traditional education. They have opposed pouring in from without, and absorbing like a sponge; they have attacked drilling in material as into hard and resisting rock. But it is not easy to secure conditions which will make the getting of an idea identical with having an experience which widens and makes more precise our contact with the environment. Activity, even self-activity, is too easily thought of as something merely mental, cooped up within the head, or finding expression only through the vocal organs. (Dewey, 1916, pp. 167-168)

John Dewey identified one of our biggest challenges in pushing for a reformed approach—our thinking. We tend to think of school as a place that cannot change or should not change, however, even if we dared to dream about what school might be, we then are still hindered by the definition we collectively share of seeing students and teachers engaged in activity. As previously stated in this chapter, many adults would be okay with more experiential education for younger students but the fear of college admissions has a stranglehold on creating a high school program with more freedom and free space. So, Dewey is correct in how we view the activity of learning as something that occurs within the head and most be spoken about: we have a tendency to discount other expressions of knowledge and learning growth, and this may have more to do with the dominant culture and its economic values. The performance of our students

as they appear in writing or test results or oration carries great weight versus sculpture, painting, robotic invention, song, or scientific discovery. The intersections of dominant culture values, college admissions, and creative intellectual expressions could become yet another topic of research investigation. Suffice to say, however, that we are suffering from a lack of imagination with how to run our schools, and most "solutions" are attempts to redirect or reinvent a traditional informational instructional model of teaching and learning—we stop short of reinventing school itself.

Comprised of an experience not of their choosing and methods not of their liking, students move through their days and hallways always vaguely wondering if there is something else to learning that could excite them. And those that figure it out, might seek a home school model or skip the college "readiness" pathway and create their own business from art or music or service they can provide. Students' relationship to knowledge and wisdom is threatened by the traditional school model for it makes ideas exist in an artificial space separate from their creation. Memorizing theorems and dates and rhetorical devices do little in comparison to using them or creating your own. Again and again, we speak idly of the creative forces necessary for true learning to take place when we allow our schools to exist in a falsely created parallel universe where studying is memorization and knowledge is a commodity:

> However this may be, there can be no doubt that a peculiar artificiality attaches to much of what is learned in schools. It can hardly be said that many students consciously think of the subject matter as unreal; but it assuredly does not possess for them the kind of reality which the subject matter of their vital experiences possesses. They learn not to expect that sort of reality of it; they become habituated to treating it as having reality for the purposes of recitations, lessons, and examinations. That it should remain inert for the

> experiences of daily life is more or less a matter of course. The bad effects are twofold. Ordinary experience does not receive the enrichment which it should; it is not fertilized by school learning. And the attitudes which spring from getting used to and accepting half-understood and ill-digested material weaken vigor and efficiency of thought. (Dewey, 1916, p. 168)

That "weakened vigor" is perhaps the most noticeable attribute of the youth as they grapple with school drudgery—of note, though, is that most adults will blame the child for his boredom and unenthusiastic demeanor towards school. Can you believe that someone who is given the opportunity to learn would take it for granted and be so emboldened and entitled as to say his teachers are boring and the material means nothing to him? The nerve! We make a mockery of the problem that we created for our youth when we twist unto them the burden of guilt for school being such a drag. We already know what school is because we were there and we also did very little to demand that it change; we were grateful to exit school and "move on with our lives" into the business of our choosing to satisfy our soul's yearnings, unless we are stuck in dead-end jobs that do not allow for upward mobility. That adult may look back at what our K-12 education provided and wonder if it did enough to allow him to seek out greater opportunities. What happens in "real life" that school does not teach? What businesses are exciting and innovative with which school does not interface? These questions have existed for decades; save the college and career center on many high school campuses, what happens in daily classes that gives students direct opportunities to live in the real world whilst living in school?

In the last ten years, more schools have created maker spaces to include robotics and computer programming and crafts as part of their elective program. Some schools are creating independent study courses or auxiliary programs to "ride on top" of the traditional academic

coursework so students can have places to explore ideas and concepts of their own choosing. These are positive developments and they will serve to keep students more engaged during their time at school. Few, if any, of these programs try to upend the traditional model, so the success will be dependent upon how free the students are to do something completely independent. But there are other ways to feed students' imagination and birth a new approach for teachers and administrators to joyously engage in the work:

> Where schools are equipped with laboratories, shops, and gardens, where dramatizations, plays, and games are freely used, opportunities exist for reproducing situations of life, and for acquiring and applying information and ideas in the carrying forward of progressive experiences. Ideas are not segregated, they do not form an isolated island. They animate and enrich the ordinary course of life. (Dewey, 1916, p. 169)

These sanctuaries of experience have made their way into some schools and they should be preserved. To further develop these programs so that more traditionally isolated content areas are blended together inside of these larger aims would provide a rich life at school for students and teachers alike. There exists no short supply of possible uses for one's education and growing knowledge; likewise, there ought to be no short supply of possible hands-on reproductions of situated learning inside of schools so that students can elect to move freely through them and find out more about themselves and all of these ways of studying and thinking and doing. Where we fail in this venture is to "worksheet" the experience by forcing students to evaluate its effectiveness and their retention of information through a canned unit of traditional study that tests for whether or not the experience was successful. This presents yet another topic for further study: how can schools retain the constructive experiential learning model without forcing it to be a mainstream traditional quantity demonstrated with "results" to report on a data sheet?

John Dewey (1916) articulated over 100 years ago in *Democracy and Education* even more about the dilemmas facing schools and it pertains to how teachers teach. We know already that the environments and conditions can be changed to simulate more of what happens outside of school. We know already that the relationship to knowledge and information can be changed to focus more on that which the students have interest. We know already that the cultural norms regarding college admissions and workplace readiness can be changed to pivot towards a holistic approach that allows for developmental learning in place of a lockstep testing mindset. Not yet discussed are the teaching methods and how they are derived. Common sense hunches, and also years of research, construct the caveat that exporting a design from one instance of success will lead to failure elsewhere. In other words, a classroom teacher must design methods with her actual students:

> There can be no discovery of a method without cases to be studied. The method is derived from observation of what actually happens, with a view to seeing that it happen better next time. But in instruction and discipline, there is rarely sufficiently opportunity for children and youth to have the direct normal experiences from which educators might derive an idea of method or order of best development. Experiences are had under conditions of such constraint that they throw little or no light upon the normal course of an experience to its fruition. "Methods" have then to be authoritatively recommended to teachers, instead of being an expression of their own intelligent observations. Under such circumstances, they have a mechanical uniformity, assumed to be alike for all minds. (Dewey, 1916, p. 175)

A hallway full of classrooms all teaching the same lesson in the same way to the same aged students on the same day might raise some doubts, however it is something that many

administrators would look for in their observational rounds. Approaching school like this completely misses teaching the actual students in the room, and also completely misses understanding that the teacher is not a replaceable robot. Assuming that all of the brains in the room are the same is a ludicrous supposition, and yet selling lesson plans for lockstep delivery is a lucrative business. Treating students as individuals is the gold standard, but teachers do not always have that standard applied to them and are seen more as part of the mechanics of delivering an education to the students. To stifle teacher creativity and autonomy can nearly ensure student misery: when the teacher is a lifeless robot, do not expect the students to accidentally find joy in their learning experience. Further, if teachers are starved of the opportunity to experiment with their students, innovation in learning that meets the needs of the students present in the room is also starved. The school administration has a big role to play in helping teachers to know that their individuality is valued. The administrative role in education transformation could usher in a revival in which we return the classroom to the students.

Thus, the full transformation of schools stops short. Administrators evaluate based on criteria that values rote learning. Teachers are prevented from creating an experience tailored to their students. Students are taught that knowledge is useful for passing tests. Meanwhile, a whole world of possibility and creativity sits waiting outside of the campus perimeter while everyone engaged in the work of school is busy thinking about speed, pacing, test results, and percentages. Where is the excitement about learning? It is incumbent upon us that we find out:

> No one can tell in how many schoolrooms children reciting in arithmetic or grammar are compelled to go through, under the alleged sanction of method, certain preordained verbal formulae. Instead of being encouraged to attack their topics directly, experimenting with methods that seem promising and learning to discriminate by the

> consequences that accrue, it is assumed that there is one fixed method to be followed. It is also naively assumed that if the pupils make their statements and explanations in a certain form of "analysis," their mental habits will in time conform. Nothing has brought pedagogical theory into greater disrepute than the belief that it is identified with handing out to teachers recipes and models to be followed in teaching. Flexibility and initiative in dealing with problems are characteristic of any conception to which method is a way of managing material to develop a conclusion. Mechanical rigid woodenness is an inevitable corollary of any theory which separates mind from activity motivated by a purpose. (Dewey, 1916, p. 176-177)

Teachers need a chance to work with their students and this is stripped from them when the conditions do not nurture individuality to blossom and bloom. Further, the flexibility that we want from our students must be modeled by our teachers. Again, this opportunity is stripped from them when teachers are forced to be in lockstep with the neighboring classrooms. And these admonitions and warnings are still bounded by a curricular and pedagogical model that is removed from experiential learning: in other words, if we do not change school to include more hands-on experiences for students and teachers to work together, which would be ideal, and we still insist that teachers behave mechanically, then we are dooming humanity to a future of nonsense. Teachers who are hindered by the school itself to perform their best, most innovative work within the restrictive confines of a test-obsessed system will eventually leave the profession—with the teacher shortage already in full swing, it is safe to say that we have created quite a mess.

Taking stock of the current variables and factors relative to what John Dewey observed over 100 years ago continues to make for a head-spinning argument for reform, only because if

there were something that we could have done by now, we likely would have done it. But before throwing in the towel or raising the white flag, one more dive down into this haunting and eerie account of nearly everything that could be criticized as wrong in schools today brings us to the concept of points. All of the activities of school are converted into points earned divided by the points possible to earn. Even if a teacher were to grade students on their creative risk-taking or their brilliant innovation, it would ultimately become expressed as a point value in the semester grade. Only a few high schools in the USA today have bucked the system and sought out narratives to tell the story of students' grades and assessment—most use traditional letter grades, point values, and percentages. Before we meet the students, we lock in what percentage of their semester grade will come from any number of activities in which they will be forced to engage. This token economy as applied to learning and developing knowledge and wisdom ought to sound like a mismatch because it is; but in its stead are only modified versions of turning learning into points. The messaging here is simple: correct test answers and parroting teachers equals higher grades and more access to exclusive universities. The reward outshines the process:

> Motivation through rewards extraneous to the thing to be done has a like effect. Everything that makes schooling merely preparatory works in this direction. Ends being beyond the pupil's present grasp, other agencies have to be found to procure immediate attention to assigned tasks. Some responses are secured, but desires and affections not enlisted must find other outlets. Not less serious is exaggerated emphasis upon drill exercises designed to produce skill in action, independent of any engagement of thought––exercises having no purpose but the production of automatic skill. Nature abhors a mental vacuum. What do teachers imagine is happening to thought and emotion when the

> latter get no outlet in the things of immediate activity? Were they merely kept in temporary abeyance, or even only calloused, it would not be a matter of so much moment. But they are not abolished; they are not suspended; they are not suppressed—save with reference to the task in question. They follow their own chaotic and undisciplined course. (Dewey, 1916, p. 185)

The imagined classroom space where students are doing exactly as they are told is not a vision worth pursuing for it only propagates the notion that people are machines. Students burst with energy and ideas and emotions each day even when the institution has designs to squelch their voice and agency. They cannot be stopped and we ought to help them stay fresh and unhinged and unbounded. The external rewards are far too abstract and often not a good fit for students once they have arrived at the desired college or career for which the institution groomed them. So much happens in the single hour of class that could be put to better use if the teacher were allowed by the administration and the culture allowed instead of test prep. John Dewey has practical analyses here that take on spiritual qualities for they question the connections between our work on earth and our inner lives.

Each student arrives at school with deep contexts and relationship that are in different stages of formation. The student sees the world through these contexts and has no choice but to view the world this way. One's nurture and nature are the lenses through everything external is experienced and this core center impacts each student's experience in school:

> It is not true that the experience of the young is unorganized—that it consists of isolated scraps. But it is organized in connection with direct practical centres of interest. The child's home is, for example, the organizing centre of his geographical knowledge. His

> own movements about the locality, his journeys abroad, the tales of his friends, give the ties which hold his items of information together. (Dewey, 1916, p. 191)

A responsive classroom and curriculum would recognize these idiosyncrasies and eccentricities as value-added to the dynamic, shared experience of learning together in a group. Each student is a world unto herself and can offer unique interpretations of the material studied. With a trusted and experienced teacher, each of these individual knowledge centers can act as important anchors to make the work relevant, interesting, relatable, and grounded in what matters to the youth. Teachers also benefit from this simply because the interpretations then do not solely focus on what the adults already know and believe; teachers need opportunities to expand their minds as well, and what better way than through the freshly minted ideas of the youth.

That precisely is what frightens some educators, that the fresh ideas might topple their control of information in the room, and decenter the narrative. The fear, though, stems from bleak imagination or years of negligence towards the classroom as an intellectual and creative space. I do not blame educators, I blame the system for breeding self-perpetuating irrelevance: "Only in education, never in the life of a farmer, sailor, merchant, physician, or laboratory experimenter, does knowledge mean primarily a store of information aloof from doing" (Dewey, 1916, p. 193). We sit in desks trying to use our words and numbers to talk and write about the great mysteries of discovery that all occurred through experience. Boiling down years of great thinkers' lives to a few textbook pages of information that can be quizzed certainly would strike most people as rather silly, until it is revealed how college admissions works via using words and numbers to talk and write about the great ideas of humanity. Just to make the "numbers cut" with an SAT or ACT score plus a grade point average (GPA) at any of the top 100 colleges and universities requires that students give up large portions of their free time and dedicate it to

studying, memorizing, and regurgitating an endless supply of facts and figures. This is not "doing" as one who farms, or makes music, or creates a business—this is a mechanical existence.

Interacting with new ideas—what if that were the function of the classroom? We can remember our children before they attended school and how their genuine curiosity drove their learning cycle. The dominant cultural norms are to relinquish that curiosity and replace it with predetermined curricular packages and irrelevant methodologies. Constructing actual products or ideas can be the business of school, but instead so much energy is spent combing through materials:

> Information is the name usually given to this kind of subject matter. The place of communication in personal doing supplies us with a criterion for estimating the value of informational material in school. Does it grow naturally out of some question with which the student is concerned? Does it fit into his more direct acquaintance so as to increase its efficacy and deepen its meaning? If it meets these two requirements, it is educative. The amount heard or read is of no importance—the more the better, *provided* the student has a need for it and can apply it in some situation of his own. But it is not so easy to fulfill these requirements in actual practice as it is to lay them down in theory. (Dewey, 1916, p. 194)

Students need opportunities to put their studies into action, to operationalize their cognitive powers through experiences with making products. All of the talking and reading and writing and calculating needs a place to develop into something tangible or else students wonder the purpose; just test scores and GPA are not enough of an incentive for most.

However, school does a tremendously well-oiled job of incentivizing learning with the promise of degrees and careers after the K-12 experience that make most stay on the gravy train.

Teachers are brought on to faculties as delivery mechanisms for the vision of the school, when it is really no different from any other school: keep things safe and secure, do not let the children rule the asylum, and make sure they can pass the standardized tests. The more busy the students are with homework, the less time they will have to figure out that their homework is probably not going to help them be successful in college or a career:

> It is much easier to swamp a pupil with this than to work it into his direct experiences. All too frequently it forms another strange world which just overlies the world of personal acquaintance. The sole problem of the student is to learn, for school purposes, for purposes of recitations and promotions, the constituent parts of this strange world. Probably the most conspicuous connotation of the word knowledge for most persons today is just the body of facts and truths ascertained by others; the material found in the rows and rows of atlases, cyclopedias, histories, biographies, books of travel, scientific treatises, on the shelves of libraries. (Dewey, 1916, pp. 194-195)

Knowing things versus creating knowledge presents a splintering of the purported purpose of school, for the brochures and guides that entice families to join are loaded with language about an individualized experience for their child. The truth of the matter is that teacher training programs do not adequately prepare their students to be the teachers that the idealized version of school needs, and John Dewey's railing against what we created in this industrialized model has gone unchecked now for more than 100 years. Even in private school, students still do not have the idyllic intellectual and creative space to discover and make things and ideas—they are just as burdened as their public school counterparts with busy work and worksheets and tests on Friday.

The books on the shelf, or now on the computer, are there ready to be consumed, memorized, and regurgitated. The test questions have been written and the answers are

predetermined. One almost need not attend school and instead simply ask last year's students what they covered—you would hear in ten minutes whatever key ideas worthy of further study, should you wish. School prolongs the reading of books, the explanations of trends, the solving of problems into weeks and months spent in drudgery that teachers and school leaders applaud as diverse "units":

> If this identification of knowledge with propositions stating information has fastened itself upon logicians and philosophers, it is not surprising that the same ideal has almost dominated instruction. The "course of study" consists largely of information distributed into various branches of study, each study being subdivided into lessons presenting in serial cut-off portions of the total store. In the 17th century, the store was still small enough so that men set up the ideal of a complete encyclopedic mastery of it. It is now so bulky that the impossibility of any one man's coming into possession of it all is obvious. But the educational ideal has not been much affected. Acquisition of a modicum of information in each branch of learning, or at least in a selected group, remains the principle by which the curriculum, from elementary school through college, is formed; the easier portions being assigned to the earlier years, the more difficult to the later. The complaints of educators that learning does not enter into character and affect conduct; the protests against memo-writer work, against cramming, against gradgrind preoccupations with "facts," against devotion to wire-drawn distinctions and ill-understood rules and principles, all follow from this state of affairs. Knowledge which is mainly secondhand, other men's knowledge, tends to become merely verbal. It is no objection to information that it is clothed in words; communication necessarily takes place through words. But in the degree in which what is communicated cannot be organized into the existing

> experience of the learner, it becomes *mere* words: that is, pure sense-stimuli, lacking in meaning. Then it operates to call out mechanical reactions, ability to use the vocal organs to repeat statements, or the hand to write or do "sums." (Dewey, 1916, pp. 195-196)

The language that educators use to discuss what they want from their students is problematic: the fluidity and automaticity of factual recall and formula application makes most parents pleased and frightens philosophers like me and John Dewey. Younger and younger are students placed in tutoring programs to develop the speed at which they can churn out facts and figures—the mechanical response might be impressive and certainly shows a particular kind of talent, but it also shows a particular kind of value created by the social norms. The lonely American hero who can best his competition with the lightning speed of his spelling words and state capitals and times tables still earns a spot on the nightly news, while slowly simmering brilliant ideas often move quietly within one's mind—even sadly dissipating into nothing due to a lack of nurture.

The case for a school environment that recognizes its current students and teachers should be well stated here within Dewey's text. Focusing on work irrelevant to the people in the room should be an approach that strikes many as unnecessary, if not absurd. Facing the facts that the sheer volume of people that are required to receive mandatory schooling in any given year is an overwhelming amount, the reaction for industrializing school as a factory was simply the best idea with the largest consensus over 100 years ago. Many elements of daily life on planet Earth have changed since then, and our school systems ought to be an obvious place to try new strategies. Certainly some new concepts and texts have entered the classroom since the first one room schoolhouse, though it is not altogether surprising that a great deal of the subject matter has gone unchanged, unaltered, unresponsive to the present students and families the schools serve:

> All information and systematized scientific subject matter have been worked out under the conditions of social life and have been transmitted by social means. But this does not prove that all is of equal value for the purposes of forming the disposition and supplying the equipment of members of present society. The scheme of a curriculum must take account of the adaptation of studies to the needs of the existing community life; it must select with the intention of improving the life we live in common so that the future shall be better than the past. Moreover, the curriculum must be planned with reference to placing essentials first, and refinements second. The things which are socially most fundamental, that is, which have to do with the experiences in which the widest groups share, are the essentials. The things which represent the needs of specialized groups and technical pursuits are secondary. (Dewey, 1916, p. 199)

The teacher planning of what to do in school will not necessarily allow students to achieve greatness when the external and predetermined outcomes are the main measure by which courses are constructed and judged. This is simply because the students are unknown during the planning and the planning must occur with the group; learning is a social endeavor created through collaboration and exploration. Categorization of data and sorting students according to the test score results is exactly what it sounds like and does not imply or guarantee that deep learning takes place. We can likely agree that schooling and education are two separate concepts, and that schooling does not guarantee education. Education, though, more likely happens through experience, and if the school day does not provide opportunities for experience, then students will seek it out elsewhere.

The learning that occurs in traditional schooling is of a different nature than that which John Dewey rallies us to support and help create. His premise is that a democratic public forum

depends on an inclusive and responsive schooling experience. This aligns with many researchers in the 100 years since this book was published and continues to be the core premise of social justice programs in the School of Education at most universities. A backwards planning approach would allow for education professionals to design an ideal set of parameters for students to flourish into the engaged career professionals and engaged citizens that Dewey imagined. This dissertation study exists primarily to synthesize the writings that can make the case for a new kind of school that brings John Dewey's vision into the future of computers and computing while authentically pursuing critical theory ideals of social justice and equity as the heartbeat center:

> Democracy cannot flourish where the chief influences in selecting subject matter of instruction are utilitarian ends narrowly conceived for the masses, and, for the higher education of the few, the traditions of a specialized cultivated class. The notion that the "essentials" of elementary education are the three R's mechanically treated, is based upon ignorance of the essentials needed for realization of democratic ideals. Unconsciously it assumes that these ideals are unrealizable; it assumes that in the future, as in the past, getting a livelihood, "making a living," must signify for most men and women doing things which are not significant, freely chosen, and ennobling to those who do them; doing things which serve ends unrecognized by those engaged in them, carried on under the direction of others for the sake of pecuniary reward. For preparation of large numbers for a life of this sort, and only for this purpose, are mechanical efficiency in reading, writing, spelling and figuring, together with attainment of a certain amount of muscular dexterity, "essentials." (Dewey, 1916, p. 200)

We have witnessed the experiment of rote learning and standardized test taking, but we have not attempted a mainstream fully scaled model for an open classroom. There are many educators and

resources available for molding a new approach, but there must be some lightning rod moment that catapults the whole of society into striving for a new model. A population increase caused the scramble for the model that has lasted all these years; perhaps now that we are facing a biblical teacher shortage we might have enough traction to reinvent the system. It will not be long before high speed Internet connectivity will be wirelessly available in just about every nook and cranny of the country, and with that will come more opportunities to leverage student choice. Furthermore, for those who have ever asked their pocket computers to answer a trivia or mathematical question typically found on a standardized test, I do not need to explain the speed and ease of fact and figure regurgitation—why must we memorize information that the computer can recall for us? Our brains can be put to some other use once we make better use of our tools.

The discovery of the teaching machine and its value in freeing the teacher to become a creative innovator of seeking knowledge and a coach for students in their own inquiries is still a dream not yet realized. The conditions in this late age of constructivism and computing have revealed possibilities of change within our schools, though the focus on economic health as a result of one's schooling persists as a key factor in what the dominant culture creates as its requirements—and that leads us right back to degrees and testing and memorization:

> If the mass of mankind has usually found in its industrial occupations nothing but evils which had to be endured for the sake of maintaining existence, the fault is not in the occupations, but in the conditions under which they are carried on. The continually increasing importance of economic factors in contemporary life makes it the more needed that education should reveal their scientific content and their social value. For in schools, occupations are not carried on for pecuniary gain but for their own content. Freed from extraneous associations and from the pressure of wage-earning, they supply modes of

> experience which are intrinsically valuable; they are truly liberalizing in quality. (Dewey, 1916, p. 208)

Economic stability is no laughing matter; it is a requirement in this capitalistic democracy. Time spent in school can most certainly lead to a viable career, but why not cultivate it sooner? Dewey's thoughts on this matter remain pure, though, and the pressure of money he would rather remove from the specter of student life. He may likely be correct, though the replacement of his pure vision of school and education with the standardized testing model did not meet with his approval. Perhaps a modified version of both that acknowledged the presence and influence of the Educational Testing Services (ETS) while concurrently cultivating student choice, voice, agency, and inquiry into education: perhaps there is a model of school that we have not yet invented. Perhaps we can still dismantle the ETS. Perhaps.

As we reach back into the histories to find some validation for what we know is right and true, a common theme revolves around following the child's lead. Also noteworthy is the inclination to push aside adult world concerns and let children play. These two educational beliefs are also parenting beliefs. Over the past 100 years, we have extended the adult world further down into the elementary school years while simultaneously reducing the number of hours of free play. On the other end of the schooling experience, we have significantly increased the grade point average and SAT scores necessary for college admission at the top schools and decreased the freedom of course selection in favor of constructing transcripts that appear rigorous. And in keeping with the reduced hours of play for high school students, they are also required to complete community service or service learning hours and many hours of homework each night. Family time and free time has been obliterated, and if a high school student needs to have a job to contribute to his family's expenses, then his fate has been sealed. It feels

disingenuous to discuss curiosity and inquiry and choice in this current context; it is criminal how our youth are continuously stripped of their well-being and individuality by the system:

> Normally every activity engaged in for its own sake reaches out beyond its immediate self. It does not passively wait for information to be bestowed which will increase its meaning; it seeks it out. Curiosity is not an accidental isolated possession; it is a necessary consequence of the fact that an experience is a moving, changing thing, involving all kinds of connections with other things. Curiosity is but the tendency to make these connections perceptible. It is the business of educators to supply an environment so that this reaching out of an experience may be fruitfully rewarded and kept continuously active. (Dewey, 1916, p. 217)

The school might serve as the safest place in a student's life and might be relied on for more than is known by the teachers and administrators and staff. The students may not tell us everything about their lives and we are left to create the most supportive environment possible even without knowing what exactly students need. Therefore, if we continue to insist that we know best through our curricular planning that all students must complete the standard work that has been completed millions of times before by other humans who passed through those doors, well, we are then participating in a form of neglect that we are not used to facing.

Again and again, we isolate the subjects as though they occur separately from each other in some sort of bizarre universe where you can only do math right now because all the other forms of thinking have somehow frozen and are irrelevant. No! Of course we know that life happens in multivalent, multinarrative, multigenre streams of concurrent and simultaneous action that are almost all completely out of our local control. And knowing this, we still do not topple

the traditional structure of schooling with the same fervor that we put into political causes and social justice campaigns:

> The parts of a flower have been studied, for example, apart from the flower as an organ; the flower apart from the plant; the plant apart from the soil, air, and light in which and through which it lives. The result is an inevitable deadness of topics to which attention is invited, but which as so isolated that they do not feed imagination. (Dewey, 1916, p. 221)

This theme is central to Dewey's argument—the artificial isolation of subjects causes more harm than good in the student's intellectual and creative development. Once the student realizes what is happening, it is revealed that this traditional isolation approach only benefits teachers' lesson planning and grading systems. There is no logical reason to break apart everything that belongs together naturally in order to understand it. That does not foster imagination or student interest. More than likely, the test questions on the unit have already been composed, and the master scantron answer sheet has already been fed into the machine that will check for correct answers: this expediency is what drives the activity of the classroom.

Some educators have forged new ways of approaching material that engages students in big picture thinking or critical thinking, and for those efforts, we celebrate. That they did so under less-than-ideal conditions is even more reason to celebrate. In the summary analysis, we will find that teachers work above and beyond their paid job descriptions to meet the needs of their students. However, that they must do so in order for a transformative experience to happen is precisely the problem. I cannot think of another intellectual career that puts such demands on paid workers outside of paid time. Nonetheless, ideas are abound! And to find the right mix of administration and teacher colleagues to inspire thinking, a restructure of the curriculum can be exciting for everyone in the room:

> Surely no better way could be devised of instilling a genuine sense of the part which mind has to play in life than a study of history which makes plain how the entire advance of humanity from savagery to civilization has been dependent upon intellectual discoveries and inventions, and the extent to which the things which ordinarily figure most largely in historical writings have been side issues, or even obstructions for intelligence to overcome. Pursued in this fashion, history would most naturally become of ethical value in teaching. (Dewey, 1916, p. 225)

In place of memorizing dates and names, we can remix and refresh what is done in classrooms even if we are stuck with isolated subject matter. Dewey's example provides a clear pathway to see history class with new purpose and vigor. If we could then create a team of teachers from all the core subjects to advise and adjust how they together could put their content expertise into a single focus, then a new school model begins to emerge, and as it should, it will be different at every school site.

Somehow we have managed to propagate a big lie that there is a precious, safeguarded, perfected version of what students ought to know. The textbook companies and the testing companies hold monopolies and the college admissions pathways are well-worn by many travelers. New parents have a very good idea of what exactly their unique child will encounter in school—it is about the same as what they encountered. And where along the way does the child's uniqueness have an influence on what is pursued and learned? And what is the value of one child learning what millions of children before have already learned? This is the big lie:

> There is a strong temptation to assume that presenting subject matter in its perfected form provides a royal road to learning. What more natural than to suppose that the immature can be saved time and energy, and be protected from needless error by commencing

> where competent inquirers have left off? The outcome is written large in the history of education. Pupils begin their study of science with texts in which the subject is organized into topics according to the order of the specialist. The pupils learn a "science" instead of learning the scientific way of treating the familiar material of ordinary experience. (Dewey, 1916, p. 228)

Students need to do things, they need to create products from their imagination and from their studies. Not one of us could espouse knowledge about any number of possible human endeavors without doing it first, and even then, we would need to return to this activity multiple times in order to really know anything about it. But traditional school does not provide enough of those opportunities and instead relegates most knowledge and learning to rote memorization of facts about other people who actually did something. Memorizing the great composers and scientists and builders is not nearly as interesting as composing and experimenting and building.

Students in the K-12 schooling system are still human beings with ideas and agency. That we should treat them as though they do not know any better than to take what is given to them in the form of a sanitized curriculum says more about the adults running the system:

> The engagement of the imagination is the only thing that makes any activity more than mechanical. Unfortunately, it is too customary to identify the imaginative with the imaginary, rather than with a warm and intimate taking in of the full scope of a situation. This leads to an exaggerated estimate of fairy tales, myths, fanciful symbols, verse, and something labeled "Fine Art," as agencies for developing imagination and appreciation; and, by neglecting imaginative vision in other matters, leads to methods which reduce much instruction to an unimaginative acquiring of specialized skill and amassing of loads of information. (Dewey, 1916, p. 245)

By now it should be clear that John Dewey has little respect for the ways that we have managed to systematize and make mechanical that which makes the human being such a special creature. Our imaginations and our sense of wonder in discovery through activity provide us with great joy and life-altering innovations. To make a list of those innovations, of the biographical details in the lives of those who innovated, and of the attitudes and behaviors or the innovators, and ask students to memorize this information for an examination will one day be viewed by historians as absurd, negligent, and abusive. Each human creature is capable of being a creator, so why should we imprison ourselves to passively observe other humans as creators?

We have our rallying cry, both from our own experiences and from history. Educators can take back the schools in service of students and parents can join in the battle for what is best for their children. The sheer volume of dollars at play here is enough to make education an attractive source of investment for the textbook and testing companies, and they have claimed their stake. If we choose to persist with a general lack of political involvement in this problem, then we are choosing a general lack of engagement for our youth:

> Thus in education we have that systematic depreciation of interest which has been noted, plus the necessity in practice, with most pupils, of recourse to extraneous and irrelevant rewards and penalties in order to induce the person who has a mind (much as his clothes have a pocket) to apply that mind to the truths to be known. Thus we have the spectacle of professional educators decrying appeal to interest while they uphold with great dignity the need of reliance upon examinations, marks, promotions and demotions, prizes, and the time-honored paraphernalia of rewards and punishments. The effect of this situation in crippling the teacher's sense of humor has not received the attention which it deserves. (Dewey, 1916, pp. 345-346)

Mini-economies have shown up to support teachers in their efforts to deliver points and awards and prizes to their students. For example, Teachers Pay Teachers (www.teacherspayteachers.com) is a marketplace where teachers buy materials from other teachers. That teachers are not giving these materials away for free ought to signal that they are both not paid enough and also that they are playing the game that has been defined by external forces. As long as planning materials and token economies and cute bulletin boards are the necessary gear required of teachers to fulfill the job as defined by the traditional system, a decrease in originality and innovation will ensue. How this chain of events dominoes from textbooks and testing, college admissions, administrator preparation programs, teacher preparation programs, state boards, local boards, school sites, and on down to the individual classroom with a random assortment of students for which a teacher must guide, is an astonishing number of transfers of energies and ideals. The sum total, though, is that teachers' jobs are threatened for stepping out of bounds and into the lives of the children, and the students' engagement and knowledge transfer is threatened by participating in a predetermined, rote curriculum. So, we may ask, what governing authority has chosen this fate for our teachers and students?

John Dewey was likely most known for his contention that school is not preparation for life but that it is life itself. It would seem that most attempts at running a civilization have either forgotten, obscured, or maybe ignored Dewey's maxim. The small minority of educators that pursue the creation of alternative schools to address the mismatch between life and school, the ruptured co-existence of the two, have successes and failures unto themselves but do not, as of yet, impact the larger societal trends here in the US. No imagination need be stretched to

conceive of a school that is more connected to what students do when not at school, but the market forces that dictate any school's survival are the most consequential factors:

> The learning in school should be continuous with that out of school. There should be a free interplay between the two. This is possible only when there are numerous points of contact between the social interests of the one and of the other. A school is conceivable in which there should be a spirit of companionship and shared activity, but where its social life would no more represent or typify that of the world beyond the school walls than that of a monastery. (Dewey, 1916, pp. 368-369)

So while we may understand in theory that schooling and education are different, and that our students and teachers could be doing something else, we are confined by the money supporting the model. If the market trended towards the John Dewey school, we would see more of them in operation. The foundational work of Dewey is essential to study and discuss so we can bring the focus back to what is best for students and teachers as thinking, creative beings. The marketplace analysis will be informed by critical theory, but we must have a preferred model of school to point to and demand that we want it. Once that vision is clear, the social justice issues intermingled with how we run schools will need to be named and discussed. Meanwhile, we ought to hold on to Dewey's vision and make it our own, for the school without walls is the one where we would all thrive and find happiness.

We cycle again and again through the predetermined curriculum and outcomes and move each new generation through what was done before with only slight modification as the decades pass. School could be so much more if we were not only open to change but also demanding it:

> Discipline, culture, social efficiency, personal refinement, improvement of character are but phases of the growth of capacity nobly to share in such a balanced experience. And

> education is not a mere means to such a life. Education is such a life. To maintain capacity for such education is the essence of morals. For conscious life is a continual beginning afresh. (Dewey, 1916, pp. 369-370)

Alas, the call for beginning again and again in new ways each year, rather than, for efficiency and expediency, using what we did last year this year: the soul of the human yearns for more than what traditional schooling offers. Now we just need to convince people that the health of our democracy and economy is tied to John Dewey's philosophy of education.

Paulo Freire's *Pedagogy of the Oppressed* (1970)

True oppression that results from a racist government or laws that discriminate creates conditions for people that cause great suffering. Human history has sadly produced some of the worst events we have known. Oppression is serious in all forms, but it must be first acknowledged that physical oppression, even death, due to racism and social injustice are not on a scale comparable with what is discussed here in this study. Paulo Freire's seminal work has influenced many thinkers and it is not lightly that freedom and oppression are topics used for analyzing the school and the classroom; rather, it is with this awareness that we proceed.

Students suffering in school have the disadvantage of their youth working against them, for the world of adults tends to believe adults more than children. Couple that with an expectation from most adults that the youth ought to have a similar education to theirs, the local district and state mandates regarding standardized testing, and you have an educational model that cannot help but oppress children—it is practically designed to do so. This is less about preference and more about a systemic problem. An important feature of Freire's work was the lesson regarding how those who are oppressed then behave:

> The oppressed, having internalized the image of the oppressor and adopted his guidelines, are fearful of freedom. Freedom would require them to eject this image and replace it with autonomy and responsibility. Freedom is acquired by conquest, not by gift. It must be pursued constantly and responsibly. Freedom is not an ideal located outside of man; nor is it an idea which becomes myth. It is rather the indispensable condition for the quest for human completion. (Freire, 1970, p. 47)

The design of an oppressive traditional system is far-reaching in that it creates people that are then challenged to see anything but the system that did them harm as the measure of excellence. Put another way: the victims come to expect the conditions that victimized them. Freire contends that the oppressed go so far as to be afraid of the absence of oppression, of freedom. In the lives of students who already struggle to be understand by the adult world, it becomes much easier to accept and obey the conditions handed to them by school. The majority of students who strive for freedom end up in meetings with the guidance counselor, the principal, parents, and sometimes even correctional officers. They suffer from Saturday school, detention, demerits, poor grades, low test scores, and a lack of respect and regard from teachers and staff. Freedom within the confines, parameters, and boundaries of traditional school can even lead to expulsion––to challenge the teacher's authority, intellectually, creatively, may result in a claim of insubordination. There are few teachers who create an open dialogue space for the students to be heard; the inflexible system wins more than it loses.

I have found that most students are keenly aware of their double lives in school, particularly at the high school age, which developmentally presents many existential challenges. The addition of school's oppression of teenagers' individuation process further complicates matters—students already struggle to understand their behavior and to what exactly they are

reacting, so to have another set of adults in their daily lives who then push irrelevant work tied to semester grades and college admissions, the stress and struggle exponentially builds. The lack of sleep and the increased stress in American students today has grown to an epidemic, but the solutions are not forthcoming. The system is bigger than we can manage and to even dream about dismantling it makes one dizzy. Students feel the crush of work required of them and have no voice or agency in the choice to stop the onslaught—and that is only the volume of work, let alone the disconnect many students feel with the topics selected by teachers, administrators, and external authorities. All this goes on while the students are asked to engage in an authentic journey of becoming lifelong learners who explore and express their unique, individual selves:

> The oppressed suffer from the duality which has established itself in their innermost being. They discover that without freedom they cannot exist authentically. Yet, although they desire authentic existence, they fear it. They are at one and the same time themselves and the oppressor whose consciousness they have internalized. The conflict lies in the choice between being wholly themselves or being divided; between ejecting the oppressor within or not ejecting them; between human solidarity or alienation; between following prescriptions or having choices; between being spectators or actors; between acting or having the illusion of acting through the action of the oppressors; between speaking out or being silent, castrated in their power to create and re-create, in their power to transform the world. This is the tragic dilemma of the oppressed which their education must take into account. (Freire, 1970, p. 48)

If the machine of a school made time and space for students to inject their own voice on how things happen, and if the school then changed according to those students' desires, then that school would be an island unto itself. Even at a private school, though, the students act in

accordance with the adult choices. The few open schools around the planet purposefully construct their programs to follow student choice and inquiry, but the vast majority present traditional means and measures as the business of school. The fascinating element here is that students who complain behind closed doors often relinquish their rebuffs when offered a chance to speak publicly to authorities. Freire found a sociological and behavioral problem in his study; an educational program recreates and reifies itself through the inability of its oppressed students to have comfort and ease doing anything but that which causes them harm.

It may be an unpleasant thought for victims to think of themselves as part of the problem, but that is precisely the issue. Convincing the subjected person to believe in her own safety as a subject, a subjugated person, nearly guarantees a positive result in favor of the oppressive cycle. I have personally witnessed students who get very upset with their classmates when non-traditional ideas emerge. A student who wants to explore a classroom topic but without the threat of grades and tests is often ridiculed for trying to beat the game or avoid penalty for "being lazy," according to his classmates. Accusations fly that typically range from commentary on the student's character to his abilities in school. But why? How could the same students who wished they were given something more interesting to do rail on their fellow classmate who took it a step further and started to design that very curriculum? Freire found that the imagination and the will were sucked out of the victims of an oppressive school system—they knew no other place than the reliability of subordination:

> The central problem is this: How can the oppressed, as divided, unauthentic beings, participate in developing the pedagogy of their liberation? Only as they discover themselves to be "hosts" of the oppressor can they contribute to the midwifery of their liberating pedagogy. As long as they live in the duality in which *to be* is *to be like*, and *to*

> *be like* is *to be like the oppressor*, this contribution is impossible. The pedagogy of the oppressed is an instrument for their critical discovery that both they and their oppressors are manifestations of dehumanization. (Freire, 1970, p. 48)

Herein lies the work to be done. Critical theory moves the goal of creating a democratic citizenry even further along to also consider the issues of social and racial injustice as part and parcel of rethinking society. To entertain the thought that our schoolroom teachers dehumanize our students is a disturbing one: it is also one that we must consider if we are going to advance the cause of an authentic and conscious civilization.

A concern for educators who perceive the classroom as a malleable space is how to help their students to discover their subjugation in a manner that does not further alienate them. Further, the educators who understand the plight of the subjugated must also allow for enough flexibility for the students to also turn against them as they try to liberate themselves. This problem of perception and action must play itself out in a natural way or the subjugated students will only experience another round of oppression from their teachers and administrators. And in the situation where the educators are not open to engage with students in their self-discovery process, the students will have a harder time coming into power although it will be more meaningful. One of the dangerous problems of having a teacher who is relatable to the students is that the fight for liberation falls away; the students need an enemy to rise up against as much as they need an understanding adult. This fascinating dilemma points to the need for the victimized to self-realize even when in the context of one who is willing to be sympathetic to their cause:

> In order for the oppressed to be able to wage the struggle for their liberation, they must perceive the reality of oppression not as a closed world from which there is no exit, but as

> a limiting situation which they can transform. This perception is a necessary but not a sufficient condition for liberation; it must become the motivating force for liberating action. Nor does the discovery by the oppressed that they exist in dialectical relationship to the oppressor, as his antithesis—that without them the oppressor could not exist—in itself constitute liberation. The oppressed can overcome the contradiction in which they are caught only when this perception enlists them in the struggle to free themselves. (Freire, 1970, p. 49)

For the world is a vast and open place that is truly capable of being transformed, however, the mindset of those who have suffered within the existing governmental and economic programs are typically less likely to believe that change is possible. When this is applied to the school classroom, students will undoubtedly relate; they have school "happen to them" more often than they wish. This is a result of the systems, decades-old systems, that have created school in its current state and are in no hurry to change. The financial dependence that many companies have on the school system to pay for their products that are then used as limiting factors in the student experience ought to be exposed as a form of abuse and negligence. The cycle perpetuates itself.

In place of what currently exists, a new school system that knows itself as a system and its inherent limitations will be necessary to create. A format of this nature will likely frighten most traditionalists, for the tradition was founded upon principles that are destructive at their core. Freire further articulates the problem by distinguishing between humanist and humanitarian aims; the former maintaining the essence and soul interests of humanity and humankind in its efforts versus the latter which easily becomes a savior relationship whereby defeating the cause of seeking equity and equality. A school system based on humankind, humanity, and humane goals would have to reevaluate its obsession with planned curricula, grades, and tests. The

pedagogy of the oppressed, as written by Freire, may put a date too far ahead into the future of a possible dismantling—those who are alive now need this change now, and to offer a pathway for students that may not give them the change they may desire in the timeline they require strikes me as a big request:

> The pedagogy of the oppressed, animated by authentic, humanist (not humanitarian) generosity, presents itself as a pedagogy of humankind. Pedagogy which begins with the egoistic interests of the oppressors (an egoism cloaked in the false generosity of paternalism) and makes of the oppressed the objects of its humanitarianism, itself maintains and embodies oppression. (Freire, 1970, p. 54)

It is now nearly 50 years since this text was written and the big machines of governments and capitalism that drive much of the decision-making in education have grown in size and power. The oppressed in schools are not any better off, and teaching individual classes and students about the concepts of revolution seem trite at this stage in history. What appears to be left is to create a large-scale movement based on Freire's principles by empowering families with the missing information they need to discuss the dilemmas in mandatory schooling, rote learning, and big testing data mechanisms for funding. The students are well aware of the problems but are shackled, but the parents can access their memories of what school was and use them to put forth a new vision informed by these influential philosophers. An informed democratic citizenry depends on an educational model that is inclusive and malleable to the interests and contributions of its members. To insist upon a model that outsources its materials and methodologies to profitable business ventures is worrisome and cause for public alarm.

Ranking and sorting children via grade point averages (GPA) and test scores causes more harm than good. Materials are selected by external agencies and testing companies are contracted

with to provide the assessment tools, and the relationships where millions of dollars exchange hands in every school district are vast and wide. The constant conversations initiated by school and district administrators regarding "the data" show the great strain and limitation placed on the system and the student; these conversations happen in place of humanistic or engaged dialogue regarding an authentic meeting of students' needs. Moving the data to a higher striation on the banding is actually something that school officials discuss. This is a replacement for discussing student voice, student choice, student agency; this is a replacement for discussing student engagement, student happiness, student health—in fact, more discussion about student health happens in the context of asking how many high-level courses should they take and whether or not they can handle all of the homework hours outside of school hours. The science and technology that we invented to make our lives run more efficiently has created a backlash on the education system through assessment hysteria. And to think that we could have been using science and technology in a constructive manner to empower children in school instead of using it as a tool to track, measure, rank, and sort them:

> More and more, the oppressors are using science and technology as unquestionably powerful instruments for their purpose: the maintenance of the oppressive order through manipulation and repression. The oppressed, as objects, as "things," have no purposes except those their oppressors prescribe for them. (Freire, 1970, p. 60)

That school "happens to students" is of primary concern and can be a publicly accessible idea to comprehend and begin a public debate. Students are precious and their lives have value. To let school go unchecked in its impact would be a crime; the continual improvement that is possible in each student's life and in the work of school ought to be our focus. Instead we either look away or we focus on the competition of college admissions. Students meanwhile wonder what

will come next in a relentless battering of homework, tests, essays, projects, and material selected for them to complete—distracting them from finding their calling.

The students, as a result of their years of training, place themselves under their teachers and see their own worth as diminished when in their presence. Even in the most inclusive and dialogue-based classroom full of students engaged in lively exploration, there is a marked tone shift and deference to the teacher who might only be observing the exuberance:

> Not infrequently, peasants in education projects begin to discuss a generative theme in a lively manner, then stop suddenly and say to the educator: "Excuse us, we ought to keep quiet and let you talk. You are the one who knows, we don't know anything." They often insist that there is no difference between them and the animals; when they do admit a difference, it favors the animals. "They are freer than we are." (Freire, 1970, p. 63)

The comparison to animals is noteworthy and students have a real dehumanized and diminished value in schools. They perceive their worth by their accomplishments and impact they have during the day—sadly, they do not have much agency at all and thus judge themselves subjugated. The hallways are monitored if they leave the room and the gradebooks are monitored if they miss an assignment. Hungry for a way to spend their day that makes sense, students might even wonder if animals have more freedom. Again, the work of the social justice educator is clearly articulated: engage in authentic dialogue with the people at your school and together plan what will next become your work.

Treating as a possibility that the work of school is a dynamic and collaborative effort gives new shape and purpose to methodology, pedagogy, curriculum, assessment, and matriculation. In essence, the entire system from top to bottom will incur changes put into

motion at any stage of revolutionary action towards liberation. The question for the political elites is whether or not they are willing to support and join in the intentional shift:

> A revolutionary leadership must accordingly practice *co-intentional* education. Teachers and students (leadership and people), co-intent on reality, are both Subjects, not only in the task of unveiling that reality, and thereby coming to know it critically, but in the task of re-creating that knowledge. As they attain this knowledge of reality through common reflection and action, they discover themselves as its permanent re-creators. In this way, the presence of the oppressed in the struggle for their liberation will be what it should be: not pseudo-participation, but committed involvement. (Freire, 1970, p. 69)

An important intersection with John Dewey's (1916) *Democracy and Education* is this concept of constant renewal, constant re-creation. The predictability of outcomes falls away, the predictability of engaging topics falls away, what is left is the raw exposed beams of a foundational construct, namely democracy. The representation of our students' voices and ideas in schools is largely absent while we ask them to suffer through years of subjugation and neglect. If educators, parents, and lawmakers were to view their roles as necessary co-creators of knowledge with students through the work done in schools, then we would have more honesty and action, more engagement and interest, more joy and innovation. When parents participate in schools by bringing in donuts or serving ice cream, they are superficially engaged in the lives of the youth. This cute and relatively harmless relationship becomes the standard, though, and devalues the potential that adults can bring.

As a total package, with the administration paying contracts for external assessment measures, and parents having artificial connections to the daily life of school, a great weight then falls on teachers to control the narrative of the room. They implement the curricular packages

and import the methodologies. They follow the dictums of the leadership team and assess the artifacts produced by the students. And by most accounts, the teachers are the dominant voices in classrooms—their final say, their final explanation, their charming anecdote:

> A careful analysis of the teacher-student relationship at any level, inside or outside the school, reveals its fundamentally *narrative* character. This relationship involves a narrating Subject (the teacher) and patient, listening objects (the students). The contents, whether values or empirical dimensions of reality, tend in the process of being narrated to become lifeless and petrified. Education is suffering from narration sickness. The teacher talks about reality as if it were motionless, static, compartmentalized, and predictable. Or else he expounds on a topic completely alien to the existential experience of the students. His task is to "fill" the students with the contents of his narration—contents which are detached from reality, disconnected from the totality that engendered them and could give them significance. (Freire, 1970, p. 71)

Teachers who receive celebration and laudatory comments from their peers, students, and leadership teams often engage in teaching practices that devalue student voice. Many times the most celebrated teachers can be heard talking for more than half of every class period. Many times these teachers are left alone to continue in this manner because they do as they are told and their students are not loud or disruptive. A profile of the ideal teacher emerges as something that is instructive not constructive, as narrating the curriculum not engaging with it. The teacher evaluation templates betray the mission statements. What administrators are looking for on a daily basis in the classroom is not what parents read on the mission statement; put another way, once you know what really happens inside the walls of a school, you know that the public-facing

documents are simply window dressing to get families to believe that democracy is alive and well in the classroom. Think again.

The narration of humanity's great ideas via the biased perspectives of a series of teachers in one student's life demonstrates a significant flaw in the educational system. Educators will applaud their work in creating units and projects that give students a chance to "do their own thing" but the steps required for completion along the way remove agency and interest. Students end up dully and mindlessly "doing schoolwork" rather than engaging in a true learning experience. School tends to make reality artificial quite quickly. Worse still is the fill-in-the-blank curriculum that morphs knowledge and wisdom into little more than bits of spoken or written communication that one ought to recall when asked:

> Worse yet, it turns them into "containers," into "receptacles" to be "filled" by the teacher. The more completely she fills the receptacles, the better a teacher she is. The more meekly the receptacles permit themselves to be filled, the better students they are. Education thus becomes an act of depositing, in which the students are the depositories and the teacher is the depositor. Instead of communicating, the teacher issues communiqués and makes deposits which the students patiently receive, memorize, and repeat. This is the "banking" concept of education, in which the scope of action allowed to the students extends only as far as receiving, filing, and storing the deposits. They do, it is true, have the opportunity to become collectors or cataloguers of the things they store. But in the last analysis, it is the people themselves who are filed away through the lack of creativity, transformation, and knowledge in this (at best) misguided system. (Freire, 1970, p. 72)

This description is all-too-familiar for most people and that is of concern. That we persist in this manner, though, is perhaps even more concerning. Where is the revolution? If we understand that learning does not happen by treating students as brainless automatons, then why have we not toppled this monopoly? In part, we can lay blame at the lack of a viable replacement, but even more we can point to the system's success in stripping people of their agency and self-advocacy. The view of leadership and authority that benefits the system's perpetuation is baked into how it subjugates its citizens; the methods of antidialogical teaching create the conditions to continue avoiding engaged and active dialogue with students. This becomes a normalizing quality in the world outside of the school walls and informs how citizens interact with, or avoid, the lawmakers who govern over them.

For the dreamers and the seekers, there is another path and it involves a not-so-subtle dismantling of the classroom space and in its place creating an inclusive, dialogue-based approach that seeks to educate through collaboration. The textbook and testing companies do not hold a monopoly on this approach to the classroom and they will not like it. Lawmakers who receive free lunches or checks from the companies that place their products in schools with a little help from their friends in congressional buildings will not like this classroom. Parents who are not trained to understand and have no experience to reference will not like this classroom, though they are more open to it once they understand the benefits to their children. Engaging in this work to counter the traditional model ought not to be a lifelong journey, but it appears that it is no matter what:

> The *raison d'etre* of libertarian education, on the other hand, lies in its drive towards reconciliation. Education must begin with the solution of the teacher-student contradiction, by reconciling the poles of the contradiction so that both are

> simultaneously teachers *and* students. The solution is not (nor can it be) found in the banking concept. (Freire, 1970, pp. 72-73)

Many people wonder instantly about school reform if it would mean that grades and assessment would disappear. The typical line of questioning then involves college admissions and wondering how that would happen. This is simultaneous in an era where standardized test scores are being thought of as less significant for entrance into Harvard University; hence, we are confused about who we are and where we are going as a society. The old standards and normative statements of what constitutes college readiness and what college degrees actually achieve have all lost some of their footing. Many articles are now written about the homeschool students who do not have any of those traditional transcripts or test scores, and how their elasticity of mind and fresh intuition in problem solving are far more valuable to college admissions officers. To address the social justice equity issue of preserving our democracy, schools need to provide families with these entry and access points to power. We must find a solution that leverages what we know about how to improve school with the existing infrastructure. It is a privilege that few working families have to home school their children—instead we must reform our schools to eradicate the banking concept of education.

A behaviorist approach to school would allow for a heavy reliance on rote memorization and answer recall. A cognitivist approach would allow for a heavy reliance on seeking to understand the context and connections for a student's answers to those questions. But a constructivist approach to the classroom would rely more heavily on joining together with students in pursuit of topics and issues and questions that they find engaging. Freire's analysis revealed his disappointment and alarm with an educational model that worked to create an objectified and subjugated citizenry:

> The teacher teaches and the students are taught; the teacher knows everything and the students know nothing; the teacher thinks and the students are thought about; the teacher talks and the students listen—meekly; the teacher disciplines and the students are disciplined; the teacher chooses and enforces his choice, and the students comply; the teacher acts and the students have the illusion of acting through the action of the teacher; the teacher chooses the program content, and the students (who were not consulted) adapt to it; the teacher confuses the authority of knowledge with his or her own professional authority, which she and he sets in opposition to the freedom of the students; the teacher is the Subject of the learning process, while the pupils are mere objects. (Freire, 1970, p. 73)

In schools where the agenda and materials are selected by the central office, the department chairs, the site administrators, the message is still the same, only the teacher has a somewhat diminished role in the chain of communication. In these situations where the teacher does not choose any of the material, she is also stripped of autonomy but still bears the responsibility of being the ventriloquist for those choices. The student experience is the same no matter who chooses the material; they are forced to engage in material they may have no interest in and yet are still held accountable for it as though it were their responsibility. Most critics of student behavior in school discuss coping mechanisms and how life is not fair—few people interrogate the relationship that students have to their teachers and the material for study.

Educational models impact the formative years of our children. Freire's analysis showed great alarm because of the destructive implications of today's poor teaching on tomorrow's adults. In fact, one could choose to assign a hidden or conspiratorial agenda given the deep effects that a banking model education has on shifting one's trust in their own innate creative and

intellectual power. John Dewey saw this problem as having a deep impact on the democracy as well—if those in power could find a way to stay in power, it would likely be through a miseducation of the youth:

> It is not surprising that the banking concept of education regards men as adaptable, manageable beings. The more students work at storing the deposits entrusted to them, the less they develop the critical consciousness which would result from their intervention in the world as transformers of that world. The more completely they accept the passive role imposed on them, the more they tend simply to adapt to the world as it is and to the fragmented view of reality deposited in them. The capability of banking education to minimize or annul the students' creative power and to stimulate their credulity serves the interests of the oppressors, who care neither to have the world revealed nor to see it transformed. The oppressors use their "humanitarianism" to preserve a profitable situation. Thus they react almost instinctively against any experiment in education which stimulates the critical faculties and is not content with a partial view of reality but always seeks out the ties which link one point to another and one problem to another. (Freire, 1970, pp. 73-74)

The effects of banking education are probably deeper than we know at this late stage of computers and constructivism. The difficulties we face in even finding places to have conversations about education that go beyond the mundanity of test scores and grade point averages and college admissions points to the problem. We have a generational decline into a warped sense of accomplishment hidden inside an educational model that devalues risk-taking and innovation. Lawmakers and district officials worry about testing data because the dollars entering the school coffers from public money are now tied to improvement over last year's

scores. And those scores come from students sitting for exams that teachers need to prepare them to take—a childhood can just slip away with this kind of rote learning for purposes that have little to do with the children whose souls are present in the room. After completing high school, most students have been well trained to accept as normal the machine of society and all its requirements for paperwork and rule-following. Along the way, there are always students who buck the system and require that their humanity and freedom are foremost; these students may have the most trouble fitting in but they also may have preserved their unique spark of brilliance. For future research, I would recommend that educators study the students that do not fit the mold and track their progress through colleges and careers. This could be informative for the field.

Perhaps students who already see themselves in opposition to school are also the ones who see themselves as more aligned with the world. School tends to get in their way of achieving goals that they can already see for themselves. The volume of irrelevant work and requirements for deadlines all tear them away from their possible accomplishments. They may have missing assignments, low test scores, or find themselves talking to guidance counselors every week, but they also might be the ones who are strong willed enough to not let school bully them into believing that the banking concept is the preferred method of learning. These students seek a constructivist and open model because, for various reasons, they consciously place a value on existence and being alive:

> Implicit in the banking concept is the assumption of a dichotomy between human beings and the world: a person is merely *in* the world, not *with* the world or with others; the individual is spectator, not re-creator. In this view, the person is not a conscious being (*corpo consciente*); he or she is rather possessor of *a* consciousness: an empty "mind"

> passively open to the reception of deposits of reality from the world outside. (Freire, 1970, p. 75)

The impacts and effects are more subtle in the younger grades, but traditional schooling drives a wedge between a human and her world. The lack of experiential learning during school hours alone should be the warning sign. Many elementary schools differentiate between upper and lower grades, and as students approach middle school or junior high, a concern is raised that the lower grade play time did not do enough to prepare for upper grade study. These fears are built out of generations of neglect and abuse of the human spirit. We have allowed for the beauty and wonder of learning in authentic ways to be considered problematic or a waste of time or getting in the way of the real work of school.

The teacher has less to do with a student's trajectory in her quest for knowledge because the predetermined outcomes have already been set and the teacher merely operates the machine to deliver and assess the student's progress. The test-on-Friday curriculum is so well known that few think that school ought to be or can be anything else. Fitting in to the existing paradigm is a desirable trait. Some administrators will go as far as to suggest that the teacher ought to serve and function in such a manner as to be replaceable, in case she were ever out sick. This is all precisely the problem with school and simultaneously the nearly intractable nature of school that designed itself, safeguarded itself, against its own destruction:

> It follows logically from the banking notion of consciousness that the educator's role is to regulate the way the world "enters into" the students. The teacher's task is to organize a process which already occurs spontaneously, to "fill" the students by making deposits of information which he or she considers to constitute true knowledge. And since people "receive" the world as passive entities, education should make them more passive still,

> and adapt them to the world. The educated individual is the adapted person, because she or he is better "fit" for the world. Translated into practice, this concept is well suited to the purposes of the oppressors, whose tranquility rests on how well people fit the world the oppressors have created, and how little they question it. (Freire, 1970, p. 76)

We have little doubt that the powerful elite create conditions for their continued rule; and yet, the traditional model of education which breeds subservience is so often left untouched and unquestioned. Even in the teacher preparation programs and doctoral programs, the call for revolution is faint and distant. Many educators bemoan their graduate level coursework consisting of methodologies and assignments and assessments that betray the espoused philosophies of the school and the professors—do as I say, not as I do. Is it for pure survival reasons that many professionals tend to cringe and smile at the mere mention of a shake-up, a toppling, of the institution?

Last year's curriculum worked for last year's students, so why would it not work for this year's students? We have the tests written and the major benchmark assessments that the district wants are already set up in the online system. Using those again would allow us to see if our data changes. I came up with some new lessons for the core text this year, and I would like a chance to try them again next year. That would save me some time as well. I already planned the entire year but I still do not know how to get the students' essays back to them more quickly. They probably will not want to revise them anyhow: "Verbalistic lessons, reading requirements, the methods for evaluating "knowledge," the distance between the teacher and the taught, the criteria for promotion: everything in this ready-to-wear approach serves to obviate thinking" (Freire, 1970, p. 76). Days turn into weeks turn into months turn into years, and before long teachers have drawers and drawers full of handouts and lessons and decorations that almost take

themselves out and put themselves away when it is time. The conceptual framework for the teacher in this society is so far removed from a personal and authentic guide who can interact with students; rather, the teacher is the warm adult body in the room making sure that students are quiet during the announcements so they can hear in which room will be detention today after school. We persist in this manner and we diminish the possible possibilities of our students. We cannot know what they will come up with in an open classroom because we do not give the world a chance to find out.

John Dewey created schools that followed the students' inquiries, but these institutions bent under the weight of mandatory schooling and a population increase. We have come far enough since then to see the lessons of history teaching us that we are desperate for a new model:

> Those truly committed to liberation must reject the banking concept in its entirety, adopting instead a concept of women and men as conscious beings, and consciousness as consciousness intent upon the world. They must abandon the educational goal of deposit-making and replace it with the posing of the problems of human beings in their relations with the world. "Problem-posing" education, responding to the essence of consciousness –*intentionality*—rejects communiqués and embodies communication. (Freire, 1970, p. 79)

If more universities and colleges and businesses took a stand against banking education, a great change would occur. As things are, there are only but a few private schools and home schools taking matters into their own hands, and some families are able to afford the financial burden of going down this preferred road. The social justice problem is right there, plain and simple. The public system, paid for by tax dollars, and not requiring a tuition or a work-life shift, has been co-opted by for-profit businesses that sell schools their curricular and testing materials. This then

is supported by the state and federal lawmakers and politicians who administer large budgets—and we now have, many years and many budgets later, an immovable behemoth.

Engaging with students about Freire's ideas regarding school often produces expected results. The students can easily identify where banking education exists and its impact on their lives. Many of them start to point to the adults controlling their lives through tests and materials for which the students have little interest. In other words, the students know what is happening but do not have opportunities to break through the layers of authority and control to pose school as a problem they might solve. Teachers also rarely have opportunities to pose school as a problem, but if the structure changed so that they could freely engage with intellectual and creative pursuits, the ideal learning environment would exist:

> The teacher is no longer merely the-one-who-teaches, but one who is himself taught in dialogue with the students, who in turn while being taught also teach. They become jointly responsible for a process in which all grow. In this process, arguments based on "authority" are no longer valid; in order to function, authority must be *on the side of* freedom, not *against* it. Here, no one teachers another, nor is anyone self-taught. People teach each other, mediated by the world, by the cognizable objects which in banking education are "owned" by the teacher. (Freire, 1970, p. 80)

Easily forgotten, teachers grow and thrive when they too engage in learning and thinking in the classroom. Teachers as expert learners. They need opportunities just as students do to further their intellectual pursuits; combined with fresh ideas of classrooms, teachers can be important catalysts and bridges in helping students accelerate and connect their wild brainstorming into meaningful study. Freire's term "cognizable objects" is useful and indicative of the kind of intellectual play that the author of this dissertation is interested in pursuing further in combining

constructivism, critical theory, and technology. The object world in computing is a direct translation of how the mind perceives ideas and things, each as movable objects. When the mind is free to transform each object to suit its choice and inquiry, innovation emerges. Computers and computing make this possible today in new forms that allow us to see our work in physical space with mixed reality and holograms. This conceptual approach that all knowledge perceivable and cognizable can be movable objects stems from a desire to see school more as a maker space. This tracks to the constructivists and earlier who wished to transform the world through thought and creation.

By now the focus of this dissertation study has clearly pointed to an unmasking of the corporate and political takeover of education in order to empower students and teachers to engage in authentic discovery and study that follows student inquiry. Also clear should be the desire to transform the learning process away from predetermined outcomes, planned curriculum, and standardized testing. More harm than good has been done from these practices and the literature attests to the fact that we have known for a long time that a healthier model exists. Insisting that students' instincts are either wrong or not worth listening to then creates another series of problems in the pursuit of crafting democratic-minded citizens and a democracy; the political elite benefits from a brainless populace unwilling to demand for itself what it sees as in its own interest:

> Whereas banking education anesthetizes and inhibits creative power, problem-posing education involves a constant unveiling of reality. The former attempts to maintain the *submersion* of consciousness; the latter strives for the *emergence* of consciousness and *critical intervention* in reality. (Freire, 1970, p. 81)

To interrogate one's own reality is the chief purpose of consciousness; to critically interpret and manipulate one's own reality, intervene on your own behalf or to improve the reality of your community, these are the gold standards of consciousness. Numbed into submission by years of neglect and abuse in school, the mind grows weak and flabby without the critical exercise that problem posing necessitates. Humans are creative intellectual creatures with potential for innovation far greater than they can see at any one point in time. The sum total of one's potential comes into view through the daily practice of transforming reality through consciousness. And yet, during the largest formative period of the human brain, we have young minds sitting dully in rows of desks receiving information instead of actively and engaging with a long history of movable objects of human thought.

Dewey and Freire both call for the society and school to be one in the same, and that the same openness afforded people to create a business or an invention or a film in the "real world" happens also in school. Many people since Dewey and Freire have also made this plea, and while some schools have responded and made space and time for students to "do creative projects", very few schools have seen the need as a reason to transform outcomes, expectations, curricula, methodologies, pedagogies, and tools. Most schools still use the rows of desks and the worksheets and tests to achieve their goals. However, there is much more to do:

> It is as transforming and creative beings that humans, in their permanent relations with reality, produce not only material goods—tangible objects—but also social institutions, ideas, and concepts. Through their continuing praxis, men and women simultaneously create history and become historical-social beings. Because—in contrast to animals—people can tri-dimensionalize time into the past, the present, and the future; their history, in function of their own creations, develops as a constant process of transformation

> within which epochal units materialize. These epochal units are not closed periods of time, static compartments within which people are confined. (Freire, 1970, p. 101)

There is great power in the human capacity to conceive of time and ideas in the abstract viewing space of the mind. The imagination landscape is broad, vast, deep, unending, and replete with personal associations, collective meanings, memories, and newly constructed data. There are no known ways to quantify a limit to the permutations and mutations possible inside the human mind. Freire's fascination with that power, though, is in part to empower people to recall their potential and not fall victim to the oppressive structures that confine them. One issue with Freire's naming procedure here is that the audience for this text is more often the educated and sometimes liberated minds. Nevertheless, we can use these thoughts to bring together the rebel forces who can help liberate students from schools before they have to suffer the cycle of anesthetized rote learning and limp political and civic involvement.

The fractured curriculum serves the specialist teacher and the accounting system more than it does the student. An adult who only has to train in one subject matter for a career pathway has fewer challenges than with another model that requires knowledge from multiple content areas. And to account for student progress through this one branch of human thought, a single gradebook assessment scheme for each subject-specific artifact is much more manageable than another method. However, this ease of use for the teacher does not create a better system or experience for the student; the benefits are to the advantage of the adults and the system itself. Students are not thought of as more than clients that move through a system. Freire contended that the fractured curriculum also further isolates people's minds and prevents them from engaging in the natural play of human imagination and conceptual strength. He was right:

> When people lack a critical understanding of their reality, apprehending it in fragments which they do not perceive as interacting constituent elements of the whole, they cannot truly know that reality. To truly know it, they would have to reverse their starting point: they would need to have a total vision of the context in order subsequently to separate and isolate its constituent elements and by means of this analysis achieve a clearer perception of the whole. (Freire, 1970, p. 104)

This is a pedagogical model for how to run a school. The cognizable objects are knowledge and wisdom, facts and figures, theorems and formulas, conjectures and interpretations. Each can be broken apart or separated from their contexts, and then moved into new relationships or into combinations with objects never-before placed at its side. Traditional schooling does not recognize this possibility and places all information in the context of its historical and chronological order, albeit often biased, to present a "truth" to students, albeit an altered teacher or school truth. The revolutionary concept herein described is less revolution and more acknowledgment of the simultaneous concurrent nature of all things. There is a persistent stream of time and history and ideas and people always available to consider in the creative process of inquiry and imagination work. Innovation as collaboration further creates an exponential growth of possibility. Dewey and Freire both saw the transformational power that education could have within school; they also both saw that we almost completely blew it.

Many discuss the journey as more important than the destination, though this maxim is applied more generally to travelling or finding the right career path or trying to make something original. Few discuss this same maxim in the context of a school or as an educational model. Why is that we "get it" in our self-help books, our religious teachings, and philosophical stances, but we completely "miss it" in our schools and schooling? Playing by the rules in school might

bring satisfaction for the human mind enjoys completion and pleasing others. But just think about the sheer volume of brain power that goes unused each day in classrooms across the globe:

> The investigation will be most educational when it is most critical, and most critical when it avoids the narrow outlines of partial or "focalized" views of reality, and sticks to the comprehension of *total* reality. Thus, the process of searching for the meaningful thematics should include a concern for the links between themes, a concern to post these themes as problems, and a concern for their historical-cultural context. Just as the educator may not elaborate a program to present *to* the people, neither may the investigator elaborate "itineraries" for researching the thematic universe, starting from points which *he* has predetermined. Both education and the investigation designed to support it must be "sympathetic" activities, in the etymological sense of the word. That is, they must consist of communication and of the common experience of a reality perceived in the complexity of its constant "becoming". (Freire, 1970, p. 108)

Course textbooks have done the work that belongs to the student: comprehending, meaning-making, connecting, interpreting, linking, postulating, theorizing, analyzing, synthesizing, articulating, and presenting. All of that is the student's sole purpose in an institution. To strip these basic rights and functions is to suggest that the student is incapable of such tasks. Education diminishes in importance and schooling takes prominence, a schooling that tells students what they should and can think, and what they should and can recall, when it should happen, and precisely what it all means. A textbook is an assault on our intelligence and is not of any comfort nor convenience. The human intellect deserves better than to be utterly ignored.

A school that exists to stimulate innovation, creativity, and critical thinking is the school that we need. Perhaps those schools even need different teaching and learning tools in this late

stage of computers, computing, and constructivism, but nevertheless, we need different schools. There have been positive strides towards multidisciplinary and interdisciplinary approaches, and some schools even build in some "free time" of sorts for students to pursue topics of their choosing. It is not all dreary, but not enough has changed—not enough takes the piles and piles of cash away from the profiteering textbook and testing companies:

> In contrast with the antidialogical and non-communicative "deposits" of the banking method of education, the program content of the problem-posing method—dialogical par excellence—is constituted and organized by the students' view of the world, where their own generative themes are found. The content thus constantly expands and renews itself. The task of the dialogical teacher in an interdisciplinary team working on the thematic universe revealed by their investigation is to "re-present" that universe to the people from whom she or he first received it—and "re-present" it not as a lecture, but as a problem. (Freire, 1970, p. 109)

Following the students and their interests in creating a curriculum presents a new challenge to educators that graduate and credential programs do not address. A teacher currently in the classroom using traditional methods would need retraining, which costs money and time. How can the system respond to those needs? We will need to address them. But the aims are worthwhile and will require an interdisciplinary team to collaboratively pose school as a problem to solve. Bring together parents, students, lawmakers, professors, scientists, business experts, literally all members of all functions in a community and pose school as a problem that needs solving—something will emerge and it will have value in the pursuit.

The critics who do not see the conflict as the opportunity to apply the very skills proposed to that very conflict have missed the point. Freire articulates for us the simple first step

in helping the oppressed to begin to see their subjugation and soon-to-be-discovered, and utilized, power in transforming their own reality. So, I say it again, we ought to bring together the very community members with whom we share a city and pose the problem of school:

> The important thing, from the point of view of libertarian education, is for the people to come to feel like master of their thinking by discussing the thinking and views of the world explicitly or implicitly manifest in their own suggestions and those of their comrades. Because this view of education starts with the conviction that it cannot present its own program but must search for this program dialogically with the people, it serves to introduce the pedagogy of the oppressed, in the elaboration of which the oppressed must participate. (Freire, 1970, p. 124)

A school must find itself if it plans to respond to its inhabitants. And as enrollment and staffing changes, the school would then naturally change. With dialogue at the center of the work, it would be impossible to predetermine the curriculum and the outcomes. Last year's tests would be of no use if we view education in this manner. Freire's ideas liberate us from the stranglehold of testing and textbook companies. Who is willing to step up to help lead and coordinate these efforts? We need strong leaders who see their public service as a humanistic effort.

Just as teacher and credential programs must shift, so must administrator and leadership programs. The burden of leadership has to be a transformative act and not a transactional one. The leaders for the libertarian educational model must be less concerned with their own ego and the dictums from their local and state board authorities. These school leaders would need to consciously join in and help empower teachers and students to form the curricula from dialogue:

> The leaders do bear the responsibility for coordination and, at times, direction—but leaders who deny praxis to the oppressed thereby invalidate their own praxis. By

> imposing their word on others, they falsify that word and establish a contradiction between their methods and their objectives. If they are truly committed to liberation, their action and reflection cannot proceed without the action and reflection of others. (Freire, 1970, p. 126)

An experienced leader will tune in to the will and wishes of the group as ideas emerge. The leader's desire for a particular result will only work against the good of the group. Students grow as a direct result of their participation in the process of owning their own thinking and education. This is what most educators and onlookers get wrong: the consistent failure of students when involved in their own inquiry-based education demonstrates their care and engagement, and that eventually they will prevail in a desired result. Teachers and school leaders who insist on predetermined outcomes no matter what strip this essential cognitive experience from students, and as a result, students tend to become passive and uncaring towards learning. The psychology of learning might be more important than any artifacts produced from the learning experience.

School leaders will need to be mindful of the language that students use when they are engaged in their learning. These will be the cues and keys to help guide a program that also involves some form of mindfulness education. There will be damage and trauma that students will cycle back into when they are working at school, especially if they are new to the antidialogical approach, and likely they are. Teachers and leaders have typically presented a fixed, immovable, static version of reality and called it the curriculum to memorize and recall. Venturing into a new educational model will have its difficulties at first. Teachers and leaders will also need to be mindful of their own reflexes built from years of experiencing, most likely, a traditional model themselves. They may unwittingly retract from the wiggly nature of the antidialogical school and reify the damaging past they know so well:

> The desire for conquest (or rather the necessity of conquest) is at all times present in antidialogical action. To this end the oppressors attempt to destroy in the oppressed their quality as "considerers" of the world. Since the oppressors cannot totally achieve this destruction, they must *mythicize* the world. In order to present for the consideration of the oppressed and subjugated a world of deceit designed to increase their alienation and passivity, the oppressors develop a series of methods precluding any presentation of the world as a problem and showing it rather as a fixed entity, as something given—something to which people, as mere spectators, must adapt. (Freire, 1970, p. 139)

The training by traditional methods dominates the world's schools and educational models. We have an enormous network of institutions and resources whose aim is to maintain things as they are, simply through existence and persistence. No malice necessary, most people have agreed on their own or through the coercion of school that learning happens when one can correctly recall information previously encountered. Innovation, creativity, and experience have been relegated to some other intangible definition space that devalues their importance in learning; it is almost as though they are considered niceties or luxuries, but not truly part of learning. The teachers who enforce this world view on their students do indeed achieve a conquest over their minds and for that they should repay the lost years of potential. Good luck, right?

Those same students with their formative and wildly innovative years interrupted by a traditional rote model then become citizens of democracy without any experience voicing their concerns or trusting their voice. Who is it that benefits in this turn of events? Many students enter the world and are of voting age without the skills of openly debating culture, politics, values, human behavior, and ideals. Most teachers are unwitting participants in shoddily

preparing students for their political life, but others stand quite literally in the way of their intellectual development and self-consciousness blooming into an intellectual tool:

> People are fulfilled only to the extent that they create their world (which is a human world), and create it with their transforming labor. The fulfillment of humankind as human beings lies, then, in the fulfillment of the world. If for a person to be in the world of work is to be totally dependent, insecure, and permanently threatened—if their work does not belong to them—the person cannot be fulfilled. Work that is not free ceases to be a fulfilling pursuit and becomes an effective means of dehumanization. (Freire, 1970, p. 145)

The interrelated activities of learning, creativity, schooling, education, political involvement, civic action, innovation, business, entrepreneurship, and discovery exist simultaneously in human organizations and institutions. Freedom to move among them in service of one's work is the gold standard that Freire wishes for humans to pursue and achieve—as an educational model in schools or community organizations. Similar to John Dewey's vision for how humans spend their days moving on and off campus, pursuing work that does not distinguish between the two, Paulo Freire's articulated vision comes with strong warnings for the dangers, dilemmas, and downfalls that we face when blindly engaging in the traditional and dominant model.

In closing, these critical theory fundamentals serve as an important baseline in looking for progress towards placing students at the center of an educational program. The emergent questions from this study will be applicable in a checklist of positive attributes to observe and nurture. One might consider that the day we do not need Freire's text will serve as the final measure of its success:

> This work deals with a very obvious truth: just as the oppressor, in order to oppress, needs a theory of oppressive action, so the oppressed, in order to become free, also need a theory of action. The oppressor elaborates his theory of action without the people, for he stands against them. Nor can the people—as long as they are crushed and oppressed, internalizing the image of the oppressor—construct by themselves the theory of their liberating action. Only in the encounter of the people with the revolutionary leaders—in their communion, in their praxis—can this theory be built. (Freire, 1970, p. 183)

If you are reading this, you are probably one of the revolutionary leaders who is charged with the essential work of standing with your community and co-constructing their confidence to develop their own reality and freedom—freedom from oppressors and oppressive policies, freedom to create what benefits them and satisfies their curiosity and creativity. Get to work.

Seymour Papert's *Mindstorms: Children, Computers, and Powerful Ideas* (1980)

Seymour Papert's (1980) seminal text was the final work I annotated in this study. It was published chronologically after the first two, hence the order, but also I placed it importantly at the end for another reason: through a revision of classroom computer usage, the visions and fundamentals of both John Dewey and Paulo Freire can coexist and transform learning forever.

Papert's work was the direct beneficiary of Jean Piaget's work in constructivism, something that both Dewey and Freire were both keen on applying. Papert went further, however, by developing constructionism to postulate that students quite literally need to construct things as part of their collaborative, dynamic, shared, and self-guided inquiries. All three philosophers believe in turning the classroom over to the students, and their individual responses to this same dilemma are what I am using to put forth Critical Techno Constructivism

as the next, all inclusive, theoretical algorithm for use in classrooms and teacher preparation programs.

Relating that which you do not know to that which you do know is a common methodology taught in teacher preparation, yet it is also an immediate, natural process that the brain engages in every day. Recognizing the neurological function of the mind makes for a simple and wonderful discussion of the classroom:

> My proud father suggested "being clever" as an explanation. But I was painfully aware that some people who could not understand the differential could easily do things I found much more difficult. Slowly I began to formulate what I still consider the fundamental fact about learning: Anything is easy if you can assimilate it to your collection of models. If you can't, anything can be painfully difficult. (Papert, 1980, p. vii)

When encountering new material, the inclination is to try to comprehend it through associating it by pattern or design or essence. This scaffolding model can force teacher-constructed associations, however, and ought to be questioned when the students lack control over processing and assimilating new data. Papert's childhood memory to open the text sets the stage for his spirit and attitude—this seminal work prods us to accept as given the principles set forth by Dewey and Freire, and instead focus on joyful work production and the diversity of results when we honor the voice and choice of individuals.

Papert also sets out to show in this text that the computer is our best teaching and learning tool to achieve the transformational goals of constructivism, constructionism, and critical theory. Quite simply, Papert's text was a galvanizing and alchemical force for me as a researcher and thinker in education. The future of our democracy and the future of our children's lives depends on a rapid and radical reformation of schooling:

> The computer is the Proteus of machines. Its essence is its universality, its power to simulate. Because it can take on a thousand forms and can serve a thousand functions, it can appeal to a thousand tastes. This book is the result of my own attempts over the past decade to turn computers into instruments flexible enough so that many children can each create for themselves something like what the gears were for me. (Papert, 1980, p. viii)

The inventors of computers may not have imagined what these machines would do in classrooms. In fact, the creators did that which I am calling for in this dissertation—they made something that interested them to make. Ironic, then, to place these computers in classrooms to run software programs replete with scripted experiences, closed loop data sets, and predetermined outcomes. Papert worked against that tide and produced the Turtle Logo software with a team determined to give students a tool that allowed for intellectual and creative emphases all at once in their free play. The marketplace, however, quickly became overrun with too many software products antithetical to what Papert wished to see.

Free market capitalism is an essential part of democracy and freedom, but that does not mean that the products created are aligned with transformative educational goals. Quite the contrary, in 2019, and also at the time of Papert's publication, in 1980, many software companies aimed their efforts at replacing paper with digital spreadsheets and typewriters, replacing shopping in the mall with long-distance digital transactions, replacing the accountant's work with your own income tax software package, and replacing board games or imagination games with fictional games to entertain you on the screen:

> Most writers emphasized using computers for games, entertainment, income tax, electronic mail, shopping, and banking. A few talked about the computer as a teaching machine. This book too poses the question of what will be done with personal computers,

> but in a very different way. I shall be talking about how computers may affect the way people think and learn. I begin to characterize my perspective by noting a distinction between two ways computers might enhance thinking and change patterns of access to knowledge. (Papert, 1980, p. 3)

What has been missing for decades is the radical restructuring of school to be able to accept the computer as its most powerful tool for teaching and learning. Thinking patterns can be altered not only by decentering the teacher's voice in the classroom but more so by differentiating how students do work and access information. Most software programs written for classroom consumption have a team of learning scientists, brain researchers, and curriculum designers informing the coding engineers on what the latest journal articles discuss for how best to learn. What does not happen is to empower the children to write their own software tools. It seems that there is a fundamental misunderstanding of the accessibility of computers and computing—kids can absolutely learn to program and manipulate computer hardware. They can also use those experiences to guide them in figuring out how to scale their projects to include studying what is traditionally relegated to single subject classrooms.

Students today are increasingly on the Internet and using their own handheld microcomputers for many social and creative activities. Fewer are using them for research and business, but that could easily change with a shift in the culture. Entertainment through gaming and social sharing dominates the handheld mobile device usage of children and teenagers. Even with this exponential increase in the numbers of students with access to technology and the Internet, it remains true that the students rarely see themselves as capable of acting as creators and innovators of modern inventions:

> Many children who grow up in our cities are surrounded by the artifacts of science but have good reason to see them as belonging to "the others"; in many case they are perceived as belonging to the social enemy. Still other obstacles are more abstract, though ultimately of the same nature. Most branches of the most sophisticated modern culture of Europe and the United States are so deeply "mathophobic" that many privileged children are as effectively (if more gently) kept from appropriating science as their own. In my vision, space-age objects, in the form of small computers, will cross these cultural barriers to enter the private worlds of children everywhere. They will do so not as mere physical objects. This book is about how computers can be carriers of powerful ideas and of the seeds of cultural change, how they can help people form new relationships with knowledge that cut across the traditional lines separating humanities from sciences and knowledge of the self from both of these. (Papert, 1980, p. 4)

We have witnessed a groundswell by 2019, and young people around the world have increased access to space age tiny computers. Certainly they are experiencing new relationships to information and creating information. The read-write web has leveraged the publishing companies through personal, professional, and anonymous posting of content by anyone with an Internet connection and a device. Students discover more topics and ideas on their own than ever before. They live in a far more integrated information society than schools and educators have ever witnessed; our training does little to nothing about this new relationship to knowledge, and almost 40 years after Papert's book was published, we still have not agreed to a set of principles that allows us to intelligently and freely explore knowledge and learning in schools. We have instead a couple of widely held traditions that control the marketplace, the tests, the curricular packages, and the college admissions.

For what exactly are the goals of schooling? Do we have consensus on why we insist on maintaining the traditional model? Are the alternatives cast aside simply because they are alternative and we cannot assimilate them? Whatever the case may be, the computer's role in society has shifted from just the scientist and engineer's tool to something more inclusive. However, our thinking about the predetermined outcomes and programmed learning using a computer still persist:

> All of us, professionals as well as laymen, must consciously break the habits we bring to thinking about the computer. Computation is in its infancy. It is hard to think about computers of the future without projecting onto them the properties and the limitations of those we think we know today. And nowhere is this more true than in imagining how computers can enter the world of education. It is not true to say that the image of a child's relationship with a computer I shall develop here goes far beyond what is common in today's schools. My image does not go beyond: It goes in the opposite direction. (Papert, 1980, p. 5)

The opposite direction is where my compass points as well. I acknowledge the many exciting people and projects in schools that look for innovative uses of educational technology; I also acknowledge that these efforts are hindered and hampered by the predetermined outcomes which call them into the classroom. Schools have found ways to include computers, computing, computer science, information technology, and educational technology, but by turning them into yet another subject to study with outcomes to demonstrate and quantify learning, the transformative potential is skipped right over. Our limitations in reimagining the space and time of school is what holds us back—we have forsaken reimagining the many barriers of school:

time, age, grade level, subject matter, and outcomes. With the most powerful technology tools available, and so many educators who can articulate the vision, the time is now for change.

The fundamental dilemma of computers in classrooms is our reliance on software programs to teach and to aid in instruction. A constructive approach would provide more entry points for students, however. We make this mistake again and again; we tout the latest software program, as twenty-first century learning, or the use of technology, when it is little more than students responding to stimuli on a computer screen. The relationship to information and knowledge is far too basic to constitute a space age philosophy or approach:

> In many schools today, the phrase "computer-aided instruction" means making the computer teach the child. One might say the *computer is being used to program* the child. In my vision, *the child programs the computer* and, in doing so, both acquires a sense of mastery over a piece of the most modern and powerful technology and establishes an intimate contact with some of the deepest ideas from science, from mathematics, and from the art of intellectual model building. (Papert, 1980, p. 5)

Students never have a short supply of ideas. I tend to ask them for their ideas as a regular practice because I have experienced the wide variety that comes next. New topics for study and new instructional designs for units and assignments are always being born through dialogue with students. With this same trust for doing good meaningful work as intellectuals and creatives in an English Language Arts context, I know that engaging students in making their own computer programs would be just as engaging and important for them. Nurturing a space for students to design and build the tools that allow them to complete the work they wish to pursue—that sounds like the Dewey, Freire, and Papert school we are missing.

Classrooms are in short supply of opportunities to immerse students in a natural and organic interplay of ideas, learning, projects, and building or making things. This dearth comes from the many barriers that were put in place to create an efficient and expedient system. Although discussed as a theoretical possibility, school leaders and state lawmakers have not been hungry looking for a new way to synthesize the ideas of constructivism with technology to serve social justice needs and solve social justice problems. Seymour Papert was, and so am I:

> Two fundamental ideas run through this book. The first is that it is possible to design computers so that learning to communicate with them can be a natural process, more like learning French by living in France than like trying to learn it through the unnatural process of American foreign-language instruction in classrooms. Second, learning to communicate with a computer may change the way other learning takes place. The computer can be a mathematics-speaking and an alphabetic-speaking entity. We are learning how to make computers with which children love to communicate. When this communication occurs, children learn mathematics as a living language. Moreover, mathematical communication and alphabetic communication are thereby both transformed from the alien and therefore difficult things they are for most children into natural and therefore easy ones. The idea of "talking mathematics" to a computer can be generalized to a view of learning mathematics in "Mathland"; that is to say, in a context which is to learning mathematics what living in France is to learning French." (Papert, 1980, p. 6)

It is no doubt that we just did not quite know what to do with the computer in school which led us to the befuddled state we are in now. Since it was primarily a behaviorist rote learning machine at its onset, the computer evolved to have more graphical and thinking capabilities,

which were promptly converted to be the location of software programs. So the programmed learning from Dr. Pressey's teaching machines 100 years ago have mostly been upgraded with sound, video, and greater interactivity. Our core standards for what students ought to learn and the outcomes on a timetable by which they need to demonstrate their evidence were coming into being alongside the development of the microprocessor. Once the *A Nation at Risk* (1983) study was published, families were all but convinced that schools needed to drill this information into our children's heads or we would risk economic and social depression (United States. National Commission on Excellence in Education, 1983). The not-so-subtle recommendations of that study reinforced a belief that schools should require more college preparatory courses and focus more heavily on increasing student scores on standardized tests. The infamous "dire statistics" on student test scores reported in the study were not an accurate portrayal of nationwide scores, and were not disaggregated, but that was only part of the story. The incendiary language of the report and the seeming suggestion that teachers should work harder even if their salary and resources might diminish were also troubling—name another public service profession suffers this kind of political and public punishment.

Sure enough, most people trust the educators to make wise decisions, and for a profession that is known for its deep sacrifice of time and money to create a new generation of thinkers, it is a wise move to make that leap of faith. With due respect, though, to educators everywhere, the system of education, the institution of education is not functioning well, however, and that is not because educators need to do more—rather, the entire system needs to be doing something else. The hyper focus on grades and test scores and data is delivering the fatal message that knowledge and wisdom and information are commodities to be traded. We do not have a reliable

nationwide model for how to inspire students and deliver them with a nurturing environment to develop their minds. Papert's analogy was hysterical and sadly accurate:

> If we had to base our opinions on observation of how poorly children learned French in American schools, we would have to conclude that most people were incapable of mastering it. But we know that all normal children would learn it very easily if they lived in France. My conjecture is that much of what now see as too "formal" or "too mathematical" will be learned just as easily when children grow up in the computer-rich world of the very near future. (Papert, 1980, p. 7)

Testing students on material that the container of the classroom cannot adequately support will lead to failure every time. And to conclude that students do not have the ability to advance into higher levels of coursework based on their performance in a poor learning environment is madness. To think that a student is prevented by school officials and grade point requirements from continuing to learn more specialized and advanced material, again albeit in a largely ineffectual learning environment, strikes this author as criminal.

Instead of continuing as we have done, we ought to sculpt and craft new guidelines and new spaces for students to engage with ideas, create products, develop businesses, produce art and media content, and ultimately become deeply committed learners who see daily results of their learning. The school model that we have allowed to persist primarily treats students as empty vessels and then wonders why they do not like school very much at all:

> I see the classroom as an artificial and inefficient learning environment that society has been forced to invent because its informal environments fail in certain essential learning domains, such as writing or grammar or school math. I believe that the computer presence will enable us to so modify the learning environment outside the classrooms that

> much if not all the knowledge schools presently try to teach with such pain and expense and such limited success will be learned, as the child learns to talk, painlessly, successfully, and without organized instruction. This obviously implies that schools as we know them today will have no place in the future. But it is an open question whether they will adapt by transforming themselves into something new or wither away and be replaced. (Papert, 1980, pp. 8-9)

Remaining immersed in all the subject matter that we are currently obsessed with students knowing for their standardized tests, it is also possible for students to learn through application, trial, failure, and experimentation with much of what we profess to be teaching them—perhaps they will learn more. But if they learn less of the currently required material, we may wish to ask some questions about the content matter for which they did not show evidence for learning. Was it replaced with other work and knowledge? Or did students opt out of knowing some content as a conscious choice? These are questions that we do not have the chance to think about when we continue to plow ahead—what if students do not really need to know the material that we force upon them? Would society crumble? Would civilization shift? Would these changes be for the better? For what purpose do we persist?

That the computer has been placed in the corner, or relegated to one hour a week, these are not viable methods for allowing students to learn with computers. And in the schools where students are given each a device or bring their own, there is an overemphasis on software programs and packages that replace paper and pen or simply walk users through a battery of stimulus response questions. The intellectual developments that could take place when we step back and ask students to pursue their own questions are not fully understood—because we rarely take that risk:

> When I have thought about what these studies mean I am left with two clear impressions. First that all children will, under the right conditions, acquire a proficiency with programming that will make it one of their more advanced intellectual accomplishments. Second, that the "right conditions" are very different from the kind of access to computers that is now becoming established as the norm in schools. The conditions necessary for the kind of relationships with a computer that I will be writing about in this book require more and freer access to the computer than educational planners currently anticipate. And they require a kind of computer language and a learning environment around that language very different from those the schools are now providing. They even require a kind of computer rather different from those that the schools are currently buying. (Papert, 1980, p. 16)

Lately there have been some developments in programming languages and hardware that have signaled new promise in activating classroom computer usage. Scratch and LEGO Mindstorms and LittleBits have made an impact. Of note, though, is the trend toward science. Many people think of computers as belonging to science and mathematics. This is easily done and does not foretell a problem. However, for a lack of trying we have left out the history and English courses. Papert saw that the default nature of how schools and educators and families think of computers was what doomed its categorized use. This will not be a simple undoing to correct but will require a demonstration of the computer and computing as useful for the study of history, art, music, language, English, and theater. What will already be clear for some readers is that all of the subject areas are always already integrated—the computer is but the most powerful tool we have to work with anything we choose to do and does not belong anywhere particularly, it belongs everywhere categorically.

The computer is omnipresent in 2019. There is no surprise to see one anymore. In fact, there are some debates about the over-reliance on computers, particularly for young children, as a learning tool. Some have bemoaned the desire of children to trade hands-on play with blocks and paint and dirt for the touch-screen interactivity of building, drawing, and making with creativity or gaming apps. This is certainly a concern that we must address, for so much of the research on early child development is connected to hands-on experiences, and we simply do not have the longitudinal data to say anything but that computers for young children can be to their detriment. I imagine that some studies are already underway. But for the most part, children using apps instead of digging holes in the yard are, in my view, suffering more from their time spent on a program that has defined the limits of what they can do:

> I believe that certain uses of very powerful computational technology and computational ideas can provide children with new possibilities for learning, thinking, and growing emotionally as well as cognitively. But I want my readers to be very clear that what is "utopian" in my vision and in this book is a particular way of using computers, of forging new relationships between computers and people—that the computer will be there to be used is simply a conservative premise. (Papert, 1980, pp. 17-18)

Moving the aims of education away from telling students what they need to learn and know and instead replacing the school day with opportunities for students to develop their own individualized neural pathways will require a shift so major that it would grind the current system to a halt; this is the radical center of this chapter. Schools are not meeting the needs of their students because they cannot do so. Some overworked educators will reach some students and they will be lifelong compatriots, but this is not a success rate worth repeating. That we have the technology to provide each student with a novel and new approach to learning and education

in schools should be celebrated! Instead we set up our computer labs and projects integrating technology and think we have done well by our children. No, the new relationships to knowledge and the creation of new artifacts and ideas—these are measures of growth and success that we can celebrate, but we must reconfigure the school day and resources to get there.

Papert calls for educators to create learning environments where the computers are used as programming tools rather than terminals for students to complete a battery of questions. This approach would instantly shift the marketplace and have wide-reaching impact, for so many billions of dollars are spent each year on software curricula and testing material—and these need updates and upgrades later that also incur a fee for schools. To redesign the school day and the graduation outcomes so that students could learn programming languages to then engage in posing their own problems and finding solutions, well, that starts to sound like something that most people would relegate to home school or private school. This kind of specialization makes people afraid that students would graduate unprepared to enter college or the workforce, but where is the evidence that suggests that? So we persist in this old model:

> In most contemporary educational situations where children come into contact with computers the computer is used to put children through their paces, to provide exercises of an appropriate level of difficulty, to provide feedback, and to dispense information. The computer programming the child. In the LOGO environment, the relationship is reverse: The child, even at preschool ages, is in control: The child programs the computer. And in teaching the computer how to think, children embark on an exploration about how they themselves think. The experience can be heady: Thinking about thinking turns the child into an epistemologist, an experience not even shared by most adults. (Papert, 1980, p. 19)

At many points along the way in my own K-12 education, I felt I was mismatched with the work being asked of me. Perhaps the most significant negative experience I had was in third grade when my teacher gave the class fifty pages of math problems to complete over a period of weeks. I enjoyed the work so much, found it satisfying to answer these little questions correctly, that I completed all of them far ahead of schedule. Beaming with pride, one morning I presented my completed, and 100% accurate, work to my teacher. She yelled at me for going ahead of the class and sat me in the corner with an eraser; she ordered me to erase "back to where the class was supposed to be," and, with unstoppable tears, I did as I was told. This experience taught me many lessons about the irrationality of school and teacher demands on students, and also the need for students to be heard in authentic dialogue. Now, the irony here, is that this referential point in my own journey as an educator centers around a traditional approach to learning mathematics which I found oddly satisfying. On the other hand, I did not actually learn from the exercises because those math problems were clearly below my level of understanding, hence the speed with which I could accurately solve them. If I had been presented with an open opportunity to design work with my peers or with my teacher that met my intellectual needs, the impact would have been decidedly different—it would also have been something immeasurable and unquantifiable, and I fear that is our major obstacle to overcome. We need to staff our teacher education programs with leaders who can train new teachers how to teach, guide, collaborate, observe, and assess in formative ways that do not interrupt the organic endpoints of student work. And we need schools where teachers can emerge from those preparation programs and work as they have been trained.

As much as I love *Sesame Street*, I would have to agree with Seymour Papert that the passive experience of learning will always be inferior to the active experience. Children and

students are an incredibly lucrative market for curricular materials, though, so to cause an upheaval in that well-worn financial groove would make many nervous. The capitalistic analysis of learning and school is monumentally depressing, so perhaps that is why we let it go unchecked. Though it stands to reason that before we place our children in organized schooling, we tend to let them do as they please and explore the world; we claim that they are figuring things out and making sense of their reality, even defining their reality. Why do we abandon this perspective when they leave the house for school? Why do we not expect the same sort of experimentation and wonder at school?

> Even the best of educational television is limited to offering quantitative improvements in the kinds of learning that existed without it. "Sesame Street" might offer better and more engaging explanations than a child can get from some parents or nursery school teachers, but the child is still in the position of listening to explanations. By contrast, when a child learns to program, the process of learning is transformed. It becomes more active and self-directed. In particular, the knowledge is acquired for a recognizable personal purpose. The child does something with it. The new knowledge is a source of power and is experienced as such from the moment it begins to form in the child's mind. (Papert, 1980, pp. 20-21)

Shuffling them away from home to go engage in some other content disconnected from other aspects of their lives makes little sense. But again, the financial demands on families make home school almost impossible—we are left to trust the system. But for over 100 years, the system has not made sense. Honoring the child, respecting her intellect and value, nurturing her creativity, encouraging her progress in the creation of new ideas and inventions—that is what school can be. No more passive experiences, we need to demand more from our schools.

Asking students to fall in line with the restrictions of predetermined outcomes can result in success for some, but certainly not all. As students get older they tend to understand more clearly the rules and regulations of school as immovable boundaries and they may join the ranks of their peers following directions. In the teenage years, there is a natural rebellion that ensues and sometimes this kind of school model is the most toxic for students who then act out in ways that get them ousted from the institution. At the center of the traditional model is a simple yes or no. The student obeys or does not. The student listens attentively or does not. The student gets the right answer or does not:

> Many children are held back in their learning because they have a model of learning in which you have either "got it" or "got it wrong." But when you learn to program a computer you almost never get it right the first time. Learning to be a master programmer is learning to become highly skilled at isolating and correcting "bugs," the parts that keep the program from working. The question to ask about the program is not whether it is right or wrong, but if it is fixable. If this way of looking at intellectual products were generalized to how the larger culture thinks about knowledge and its acquisition, we all might be less intimidated by our fears of "being wrong." This potential influence of the computer on changing our notion of a black and white version of our successes and failures is an example of using the computer as an "object-to-think-with." (Papert, 1980, p. 23)

A powerful new classroom space starts to emerge when we rethink the resources and activities with students' freedom at the center. A class where if you are not wrong you cannot go forward in your work, that is a wholly different model. The trauma of failing in front of your peers would simply not exist because the errors in computer programming are necessary to find useful

solutions to build the desired product. Thinking with the computer is considered a radical act, though there will likely come a time in human history that looking back at 2019 will provide a good chuckle at our stubbornness in insisting on a traditional model when we have the tools and philosophies to do otherwise. The analysis and discussion provided here in this dissertation will hopefully contribute to accelerating our progress towards new learning theories and schools and experiences for students.

In 1980, we had powerful computers but they were large and expensive. As predicted, today in 2019 there are inexpensive computers inside many household items and in our hands as we walk about town. More and more schools are stocked with computers and tablets, and many students arrive with their own handheld computers; they are in abundance even though we do not put them all to use:

> More and more complex circuitry can be squeezed onto a chip, and the computer power than can be produced for less than a dollar increases. I predict that long before the end of the century, people will buy children toys with as much computer power as the great IBM computers currently selling for millions of dollars. And as for computers to be used as such, the main cost of these machines will be the peripheral devices, such as the keyboard. Even if these do not fall in price, it is likely that a supercomputer will be equivalent in price to a typewriter and a television set. (Papert, 1980, p. 24)

The argument that students will be nothing but distracted by their own personal devices might prove true, particularly when they are asked to engage in work not of their choosing. But if we found a more constructive method for students to use their own devices at school towards a self-guided outcome, all that collaboration they do as distraction might be instead aimed at

accomplishing and achieving work. We need to encourage a new mindset and to then provide pathways for the newly conceived work to happen.

Papert was interested also in helping students to become skilled in thinking about thinking—the epistemological method is rich with potential for developing innovation and deep connection to ideas. Coming from his training with Dr. Jean Piaget in constructivism, there was a seamlessness in adding the computer. Constructionism can be thought of as a form of techno constructivism, for they share the same principles and aims: students should design their outcomes and work and then engage with technology to achieve the goals they perceive and solve the problems they pose:

> The intellectual environments offered to children by today's cultures are poor in opportunities to bring their thinking about thinking into the open, to learn to talk about it and to test their ideas by externalizing them. Access to computers can dramatically change this situation. (Papert, 1980, pp. 27-28)

When programming, the reaction of the machine to the human's input is immediate; this relationship allows for thinking aloud to become normal and to move through the stages of development in a rapid fail environment. Success becomes redefined as nothing more than a problem that was solved on the way to achieving something else, something bigger, something more aligned with a student's vision for the work. Computer programming as problem posing education in a collaborative and restriction-free environment without predetermined outcomes gives new shape and purpose to schools and classrooms. Again, we would need to dismantle the premise where the computer is used as a teaching machine with programmed learning software presented to students as the sole use of the computer terminal. Additionally, we would need to move students away from viewing the computer as the most impressive video game system

where their play is the primary function. Students could be writing the programs for their own learning and gaming. I am talking about seeing school as a place where students come to work and produce in efforts developed from their interests and inquiries. Very few schools are engaging students in the experience of learning programming languages for the purpose of coding programs that serve a functional importance in their lives.

There is a direct link between the experiences that students have in school and their role in the economy. We have seen this demonstrated in a number of ways. Papert asked the same question but from within the niche of his focus on computer usage in classrooms. Perhaps those who consume more passive experiences with computers received those experiences as students:

> People often ask whether in the future children will program computers or become absorbed by pre-programmed activities. The answer must be that some children will do the one, some the other, some both and some neither. But which children, and most importantly, which social classes of children, will fall into each category will be influenced by the kind of computer activities and the kind of environments created around them. (Papert, 1980, pp. 29-30)

We cannot separate our work from that of the world outside of school because the social justice issues do not stop once we step foot inside of school. In fact, they are inextricably linked. The nomenclature of school often says “achievement gap” when what we have is an “opportunity gap” for students in underprivileged neighborhoods. The sheer quantity of options for enrichment classes or art happenings or cultural events in some areas versus others can be seen falling along socioeconomic lines; these opportunities make a difference in children’s lives for one never knows the impact one experience alone can have on the trajectory of one single person. The point is simply that our work in school is influenced by the opportunities out of

school and vice versa. Educators and community leaders can work together to create more seamless programming that ties students' work together in and out of school.

Another aspect of the issue that this dissertation wishes to address is the pre-packaging of curriculum and the impact that it has on authentic opportunities in school. When we import curriculum from other places, we disregard and discount the voices and experiences of the people in the room. When we predetermine the results before we meet our students, we do not give a chance for those in attendance to impact the work. And even further, the dialogue that Paulo Freire encouraged and emphasized is literally impossible when we step into a room as the all-knowing educator, even when we want to create an alternative to the traditional model:

> There are those who think about creating a "Piagetian curriculum" or "Piagetian teaching methods." But to my mind these phrases and the activities they represent are contradictions in terms. I see Piaget as the theorist of learning without curriculum and the theorist of the kind of learning that happens without deliberate teaching. To turn him into the theorist of a new curriculum is to stand him on his head. But "teaching without curriculum" does not mean spontaneous, free-form classrooms or simply "leaving the child alone." It means supporting children as they build their own intellectual structures with materials drawn from the surrounding culture. In this model, educational intervention means changing the culture, planting new constructive elements in it and eliminating noxious ones. This is a more ambitious undertaking than introducing a curriculum change, but one which is feasible under conditions now emerging. (Papert, 1980, pp. 31-32)

The grave misunderstanding that many people have regarding an unscripted classroom is that students are bouncing off the walls without purpose; this image works against the constructivist

who works in different ways from the traditionalist. It may be that we need a different model of the classroom space and the arrangement of rules and time and demonstrations of learning for the constructivist approach to take root and help students grow. Asking teachers to take the existing traditional structure and "do it Piaget style" would cause an unsolvable dissonance. That class can be unscripted but still structured needs to be proven to some, while others believe it in theory but lack the experience to make it come to fruition. When the textbooks and tests are not written by external sources, the work of the people in the room takes the prime position and must be seriously studied and used to develop their own units and assessments.

The work of school has many pitfalls because of its traditional and externally planned nature and its missteps in trying to "shrink wrap" a constructivist curriculum. Our efforts toward educating educators in how to study their own students have not yet grown to mainstream acceptance. Using culturally responsive pedagogies has moved students' experience closer to the center of the classroom narrative, and while these approaches are necessary and successful in many contexts, they are often used to augment or supplement a unit of study and do not necessarily transform the work of the class:

> The educator must be an anthropologist. The educator as anthropologist must work to understand which cultural materials are relevant to intellectual development. Then, he or she needs to understand which trends are taking place in the culture. Meaningful intervention must take the form of working with these trends. (Papert, 1980, p. 32)

There are many exciting and useful ways to bring students' narratives and experiences into the forefront. All the methods that cause a break from the past are typically met with resistance and make it difficult to reform the classroom and learning. Reliance on the past as a strategy and a reason lacks logic—convenience may lead to irrelevance and obsolescence.

We have created other traditions out of necessity that have gone on to become popular and expected conditions. Papert uses the typewriter key placement as a prime example of tradition outlasting purpose, since the pileup of metal type bars with frequently used letters led to the keyboard layout we know today—even though, I have personally not used a manual or electric typewriter since the early 1980s. The quick brown fox jumps over the lazy dog. I can type with my eyes closed and my students think I am a magician or an alien. This came from years of practice on an old system that I could memorize, though I could certainly memorize another one:

> QWERTY has stayed on despite the existence of other, more "rational" systems. On the other hand, if you talk to people about the QWERTY arrangement they will justify it by "objective" criteria. They will tell you that it "optimizes this" or it "minimizes that." Although these justifications have no rational foundation, they illustrate a process, a social process, of myth construction that allows us to build a justification for primitivity into any system. And I think that we are well on the road to doing exactly the same thing with the computer. We are in the process of digging ourselves into an anachronism by preserving practices that have no rational basis beyond their historical roots in an earlier period of technological and theoretical development. (Papert, 1980, p. 33)

Papert's observation makes sense when looking at the 100-year history of the teaching machine to the present use of the computer in classrooms: we have no fundamental shift in the output or outcomes, even though we have powerful processing power at our disposal. The flexibility of applying intellect to pose and solve problems has been pushed aside because it does not directly relate to the outcomes and standards in the predetermined curriculum. The test-on-Friday

curriculum using computers to type notes, send email, and display statistical data is our own QWERTY:

> There are many other ways in which the attributes of the subcultures involved with computers are being projected onto the world of education. For example, the idea of the computer as an instrument for drill and practice that appeals to teachers because it resembles traditional teaching methods also appeals to the engineers who design computer systems: Drill and practice applications are predictable, simple to describe, efficient in use of the machine's resources. So the best engineering talent goes into the development of computer systems that are biased to favor this kind of application. (Papert, 1980, p. 36)

This presents an interesting problem, for the very strengths of the programmers are then shifted to create programs that work counter to the potential aims of the computer's role. In considering the problems outlined in this chapter, previously delineated by the authors of the seminal works, there starts to emerge a pattern of an economic structure and a societal heritage that places great value on its repetition. The Freirean question is simply about who is served by these cycles, and both Dewey and Papert would point to different elements and groups. Turning this over in one's head could cause a disheartening and discouraging attitude—in other words, could the dreamers and the innovators ever topple the big money players in the system with a constructivist model that was encouraged and funded to succeed? There are many startup schools and charter schools and non-profit schools and private schools, and none of them have entered the marketplace with a business model and demonstrated results that shakes up the much bigger public schools. Furthermore, of these non-public schools, even fewer set out to try to be a place where experimentation happens in earnest. Sooner or later, mostly sooner, administrators and parents

prevent the teachers from living in their element of perpetual renewal with the students. And to watch from all of the various points within a school how the decisions are made to downplay collaboration and innovation, it is a wonder that dreamers emerge from the system at all—for example, I find it striking even to see the money spent on student desks, and that so many of them are the single unit chair attached to a table, the implication that learning happens alone.

A similar experience in the individual desk happens at the individual computer. The purchase of thousands of laptops and tablets by school districts indicates how each student alone must sit and produce artifacts and as a lone operator punch in answers at the terminal. It is almost as though we filled our schools with enough science laboratory equipment to run innumerable experiments where kids could solve real problems and discover unknowable truths, but instead we made sure that they could memorize the periodic table and fill out worksheets converting liters to ounces and made diagrams of atoms and molecules and occasionally turned on a Bunsen burner under a peanut to discuss calories. The effort to reinvent school falls far behind the effort to purchase tools; I cannot think of another industry where this is true:

> Most of what has been done up to now under the name of "educational technology" or "computers in education" is still at the stage of the linear mix of old instructional methods with new technologies. The topics I shall be discussing are some of the first probings toward a more organic interaction of fundamental educational principles and new methods for translating them into reality. We are at a point in the history of education when radical change is possible, and the possibility for that change is directly tied to the impact of the computer. Today what is offered in the education "market" is largely determined by what is acceptable to a sluggish and conservative system. But this

> is where the computer presence is in the process of creating an environment for change. (Papert, 1980, pp. 36-37)

Forty years later and there are many great apps and programs that help teachers remix content and shuffle up methodology to include more collaboration, though it remains in service of predetermined outcomes and standards that box in the voices and experiences of the students. There are plenty of free tools to download that are quite commonly used in classrooms around the globe, but again, what remains is a void of what to do with these tools save find an entertaining way to complete the standards. To remake the relationship to learning and knowledge, that is the potential of the computer. It is the ultimate tool! It sits waiting for us to figure it out. Perhaps the students will get there before the adults do.

The volume of devices showing up in kids' pockets and backpacks indicates that they are not only a major marketplace but also that their experience level with technology is guaranteed to be significantly higher than the teachers. If educators were to sit with a group of students and allow them to teach how they use social media, create content, share content, curate content, and build networks and relationships, an entire curriculum and methodology of study would be born from that exchange. Young people have already taken the newest tools and controlled their power and use; their influence on how new technology is used to create new economies is powerful and globally evident. Papert saw this potential early:

> Fortunately, there is a weak link in the vicious circle. Increasingly, the computers of the very near future will be the private property of individuals, and this will gradually return to the individual the power to determine patterns of education. Education will become more of a private act, and people with good ideas, different ideas, exciting ideas will no longer be faced with a dilemma where they either have to "sell" their ideas to a

> conservative bureaucracy or shelve them. They will be able to offer them in an open marketplace directly to consumers. There will be new opportunities for imagination and originality. There might be a renaissance of thinking about education. (Papert, 1980, p. 37)

Some big corporations have publicly shared that they are not particularly interested in new employees with college degrees as much as experience in vocational-oriented computer programming, graphic design, and hardware engineering. The winds are blowing in different directions—outside the school gates. Hope remains and this dissertation, in spite of its negative views of traditional methods, wants to breed hopefulness and stay hopeful. Only through work can hope transform from a vision to a model, so, please, dear reader, know that I write this in order to contribute to a great change that will bring about social justice equity for and innovations from our youth that we did not know possible. The first step in finding out where to go is to name where we are and where we have been. The critique of the didactic model persists only because what we have postulated as possibilities for replacement have been unable to penetrate the mainstream of society.

Perhaps Papert is correct that our language presents the barrier to entry into rethinking how we think about learning and school. Perhaps we do not yet have the proper language to discuss the ideas presented here without polarization. News outlets and research centers engage in conversation that is relevant and relatable to the general public, though it may not work in tandem with reform to persist in presenting ideas without consciously seeking new terminology to work against the predictable ebbs and flows of public opinion:

> This great divide is thoroughly built into our language, our worldview, our social organization, our education system, and, most recently, even our theories of

> neurophysiology. It is self-perpetuating: The more the culture is divided, the more each side builds separation into its new growth. I have already suggested that the computer may serve as a force to break down the line between the "two cultures." I know that the humanist may find it questionable that a "technology" could change his assumptions about what kind knowledge is relevant to his or her perspective of understanding people. And to the scientist dilution of rigor by the encroachment of "wishy-washy" humanistic thinking can be no less threatening. Yet the computer present might, I think plant seeds that could grow into a less dissociated cultural epistemology. (Papert, 1980, pp. 38-39)

The dichotomy can be limiting. Didactic versus constructivist, humanist versus scientist. These splits allow for the dilemma to exist as an entity and push its own agenda. The limiting agent is precisely the insistence that the dichotomy exists without resolution and that each of us must choose a side. Teacher versus student, individual versus society, man versus machine. An unrecognized change agent may be a new approach to learning, and the computer may be the catalyst. The hypothesis is simple: we may be able to alter our relationship to learning and knowledge when we augment the already powerful human mind with a programmable mind. The implications for schooling are huge because the traditional structure limits new ideas from emerging because we require students to demonstrate learning of predetermined knowledge and outcomes prior to meeting them and encouraging them to venture into the world of possible knowledge and outcomes. Further, the reliance on behaviorism and rote memorization in classroom computer usage relegates the machine to an auxiliary purpose and does not engage with its potential. Therefore, we have not yet fully tested the hypothesis that Papert wrote about in 1980. With new research studies involving experimental use of computers to augment human thinking, we can continue this work and see where it takes us and what it influences. Studies

have been performed to demonstrate that an alternative approach via computer programming can produce higher student test scores on traditional assessments than students who covered the material in a traditional manner (Harel & Papert, 1991). But what we have not yet done is to fully explore and study a constructivist, inquiry-based, student-driven computer and computing focus in an academic course.

At the heart of all three theorists' work, and mine, is the notion that we always retain a portion of our wonder as children explorers of the world. Through conscious engagement with that wonder and inquiry, schools have a chance to think with students about knowledge and learning in ways that can reactivate everyone's excitement for study and production of products or artifacts. The computer is only but a part of this approach and is not where learning ends; the computer is the strongest augmentation tool we currently have available to shift what we do when engaging in learning:

> The extent to which adults in our society have lost the child's positive stance toward learning varies from individual to individual. An unknown but certainly significant proportion of the population has almost completely given up on learning. These people seldom, if ever, engage in deliberate learning and themselves as neither competent at it nor likely to enjoy it. (Papert, 1980, p. 42)

The Internet has worked in our favor to leverage supply and demand for learning opportunities and certification for professional and career development. There is a growing population of people, young and old, using distance education as way to propel themselves into new ventures. This shows a comfort with the old model in a new delivery and is decentralizing schools, however the didactic model, rather than the constructive model, dominates this sector of education as well. While that should not be altogether surprising given the history of distance

education and traditional schooling, this does still point to a missed opportunity to transform learning while people are comfortably using computers in their individualized processes. This indicates that a move towards a new direction in learning with computers can still happen under the right conditions.

A school without artificial barriers would suit this experiment well. Time, age, grade level, subject areas, outcomes—these all work against the visionary promise of school. Training the teachers of tomorrow to support emerging voices, nurture intellectual and creative experiments, and place at the center the curricular narratives from the classroom's margins, that is the missing teacher preparation program. The theoretical does not have to remain theoretical:

> In a learning environment with the proper emotional and intellectual support, the "uncoordinated" can learn circus arts like juggling and those with "no head for figures" learn not only that they can do mathematics but that they can enjoy it as well. (Papert, 1980, p. 42)

John Dewey and Paulo Freire had the same concept for a learning environment as Seymour Papert. With or without computers or robotics or electronics, the three share a vision for what we can create when we encourage and appropriately structure unscripted interactions and experiences. We need not assume that students will only learn if provided with the most rigid and traditional experiences when we have not yet created an infrastructure to support an alternative model. Once we dispel the notion that students will "not be doing anything" unless told to do so, a new relationship between teachers and students will be forged; from this a new relationship among people and learning and collaboration and outcomes will also develop.

I recall very well my own son's kindergarten experience completing worksheets and packets copied from decades past. I never understood why anyone would give a child busy work,

let alone busy work with images and words that were not relevant to his vernacular. And up through his current freshman year in high school, he has received an endless supply of problems to solve, notes to copy, and forms to fill out all along the way. I happen to know that my son is brilliant, capable, and intelligent from multiple entry points—his schooling has been below average and far below my expectations. He tells me and his mom every night how useless his math class is and how much he hates it. And this is coming from a child who can build in Minecraft wildly complicated machinery and beautifully complex symmetrical structures in large scale—he knows math, he uses math, he feels math, but he hates the endless stream of disconnected concepts repeated through dozens of slightly variegated problems to solve:

> Imagine that children were forced to spend an hour a day drawing dance steps on squared paper and had to pass tests in these “dance facts” before they were allowed to dance physically. Would we not expect the world to be full of "dancophobes"? Would we say that those who made it to the dance floor and music had the greatest “aptitude for dance”? In my view, it is no more appropriate to draw conclusions about mathematical aptitude from children’s unwillingness to spend many hundreds of hours doing sums. (Papert, 1980, p. 43)

Sometimes my son will receive a C on a math test, even though he can conceive of many formulas and their purpose in his head or when he, instinctively, puts them to use in his own creations. I see every day what happens to my son’s engagement and interest levels in this class —they diminish, and the teacher becomes the enemy, the warden imprisoning his imagination. Toward what standard or graduation outcome should these kinds of experiences allegedly lead? They are all too common in the anecdotal evidence of students everywhere. Our greatest resource, our children, are suffering from an abuse and a neglect that we could clearly solve if

we were to look beyond "big data" and instead look at the children. Each one comes to school with experiences and ideas resting behind those eyes and our job is to help them make sense of the world they see and the world they want to create.

One of the first concepts we covered in my teacher preparation program in the 1990s was the affective domain and its strong impact on a student's trajectory in school. The emphasis in learning this made sense for it showed a weakness, a pitfall, a place where students could get lost in their self-talk and their sense of who they are as students. Essentially, students could self-sabotage and teachers needed to be taught how to prevent from contributing to this and how to address it. What was never discussed were the impacts that the school, the class, and the teacher all had in creating a student's experience; we were only to be mindful about speaking to kids without damaging their self-esteem, not critique the conditions of school that contributed to a student's negative self-talk:

> From kindergarten on, children are tested for verbal and quantitative aptitudes, conceived of as "real" and separable entities. The results of these tests enter into the social construction of each child as a bundle of aptitudes. Once Johnny and his teacher have a shared perception of Johnny as a person who is "good at" art and "poor at" math, this perception has a strong tendency to dig itself in. This much is widely accepted in contemporary educational psychology. (Papert, 1980, p. 45)

The safeguards protect the interests of the school while also doing something positive for the child. These analyses in the pages herein are to show the sore spots, or the rarely discussed tender points, of traditional school as an institution and what can be addressed in stages of reform. Oftentimes a common practice in a school is a well-worn path to cover a dilemma that has gone unsolved, and if the dilemma works against students' interests then I am compelled to

broach the topic. Children typically reveal their joys and dissatisfaction with trusted adults in free form conversation; asking them to look beyond how they discuss their attitude towards a subject matter in school and look into some of the shaping memories of that attitude would reveal the issues to address.

The center cannot hold, there are too many competing forces for the tradition to persist, and the crumbling parts, the cracks in the ceiling, the faults in the flooring—everything is being revealed. If there is one thing that this advanced Information Age has done well, it is the transparency of data; the storage capabilities and the search capabilities have increased beyond what we have been used to, thus creating legions of part-time journalists hunting down who paid whom and for what. Overpaid district employees are subject to scrutiny, as are the no-bid purchase orders and service contracts handed out to friends. It is getting tougher to steal from schools, and it may just be a matter of time before the textbook and testing corporations are exposed for their financial burden on the system. Until then, and even afterwards, educators must engage in professional training to rectify the decades of missed opportunities in engaging children at their fullest potential:

> The concept of mobilizing a child's multiple strengths to serve all domains of intellectual activity is an answer to the suggestion that differing aptitudes may reflect actual differences in brain development. It has become commonplace to talk as if there are separate brains, or separate "organs" in the brain, or mathematics and for language. According to this way of thinking, children split into the verbally and the mathematically apt depending on which brain organs are strongest. But the argument from anatomy to intellect reflects a set of epistemological assumptions. It assumes, for example, that there is only one route to mathematics and that if this route is "anatomically blocked," the child

> cannot get to the destination. Now, in fact, for most children in contemporary societies there may indeed be only one route into "advanced" mathematics, the route via school math. But even if further research in brain biology confirms that this route depends on anatomical brain organs that might be missing in some children, it would not follow that mathematics itself is dependent on these brain organs. Rather, it would follow that we should seek out other routes. Since this book is an argument that alternate routes do exist, it can be read as showing how the dependency of function on the brain is itself a social construct. (Papert, 1980, p. 46)

Too often children tell themselves that they are "better at" one way of thinking and perceiving the world than another way, whereas we know that life always happens full blast all subjects at once. School artificially separates reality into parts for expediency and efficiency during lesson delivery and assessment reconnaissance—but there is no other reason to do so, since it is possible to study everything one needs in pursuit of a larger all-encompassing goal. Common language among parents and educators indicates the acceptance of the false premise of a "math and science brain" and an "English and history brain" or even an "art brain"—we pass these words and concepts to the students, but they are pure fiction. In pursuit of new pathways for learning and new language to discuss it, this dissertation is. Papert's experiments and writings all endeavored to discover how students would react and what they would produce in an interconnected learning environment where studying computer programming language became the foundation for posing problems and solving problems. Without traditional barriers, what could students think about and create if we let them? How could their intellectual and creative discoveries be then followed and used as the multiple narratives of the classroom?

What work should be done in school is known before one attends, and that comfort that the elders may feel knowing that the youth will learn just what they learned may provide some social continuity—it also skips right over the youth and their culture and context. Further, it ignores and hampers new developments and ideas, it limits creativity and critical thinking. Plenty of adults alive today who passed through the gauntlet of school, and who were back then asked to perform automatic fact recall or number calculations, now ask their computers for the answers they seek. This is a cultural feature that could have easily been added to schools years ago:

> Before electronic calculators existed it was a practical social necessity that many people be "programmed" to perform such operations as long division quickly and accurately. But now that we can purchase calculators cheaply we should reconsider the need to expend several hundred hours of every child's life on learning such arithmetic functions. I do not mean to deny the intellectual value of some knowledge, indeed, of a lot of knowledge, about numbers. Far from it. But we can now select this knowledge on coherent, rational grounds. We can free ourselves from the tyranny of the superficial, pragmatic considerations that dictated past choices about what knowledge should be learned and at what age. (Papert, 1980, pp. 51-52)

Asking students to engage with concepts and theories as they pursue self-directed goals does not eliminate the need to perform calculations or think about specific pieces of data from any content area. It is the dissociation of content area data from reality that causes the disruption and, quite often, oppositional behavior from students due to the lack of meaning or joy in their learning process. Teachers control a large swath of children's lived experiences, and as a result of those first eighteen years of one's life, the composition of one's mind conforms mostly to a traditionalist world view.

When the classroom is a workshop or a laboratory or a production studio or a business incubator, the possibilities and the potential change. The attitudes shift. The ideas bubble over. The collaboration happens authentically. The pursuit of knowledge happens joyfully. There are no worksheets. There are no textbooks. There is only learning and creating. There is only sharing and performing. There is only problem posing and questions and answers and solving and more questions. There is only hope and perseverance. In Seymour Papert's vision, this is achievable when computers and computer programming are at the heart of how students form new relationships to knowledge, meaning-making, and logic:

> As mentioned earlier, one of the mainstays of the LOGO environment is the cluster of concepts related to "bugs" and "debugging." One does not expect anything to work at the first try. One does not judge by standards like "right—you get a good grade" and "wrong—you get a bad grade." Rather one asks the question: "How can I fix it?" and to fix it one has first to understand what happened in its own terms. (Papert, 1980, p. 101)

Assessments occur all day every day because there is no test on Friday. Friday is only another day to do work and grow and develop a project. All of the great knowledge that teachers as specialists can offer students, such as lectures on *Hamlet* or biochemistry or local architecture can still happen, and should happen, but in a different format and for a different purpose. The model where teachers talk and students listen, mixed in with some lessons and exercises to get the students engaging with material they did not choose to learn—and do not forget the culminating assessment because it is almost always coming at the end—that model is unnecessary and has not proven to effectively breed deep learning.

It is the student and the teacher who have been programmed by school to look at knowledge and learning as dichotomies of wrong and right. Perhaps Seymour Papert would say

today that we need to debug school. Perhaps Paulo Freire would say today that we need to pose school as a problem. Perhaps John Dewey would say today that we need to democratize authority and choice within school. Perhaps I would say today that we need to re-educate families about the promise of school:

> It is easy to empathize. The ethic of school has rubbed off too well. What we see as a good program with a small bug, the child sees as "wrong," "bad," "a mistake." School teaches that errors are bad; the last thing one wants to do is to pore over them, dwell on them, or think about them. The child is glad to take advantage of the computer's ability to erase it all without any trace for anyone to see. The debugging philosophy suggests an opposite attitude. Errors benefit us because they lead us to study what happened, to understand what went wrong, and, through understanding, to fix it. Experience with computer programming leads children more effectively than any other activity to "believe in" debugging. (Papert, 1980, p. 114)

Lately, educators and philosophers have invoked the power and the spirit of play as missing from the essential elements, attitudes, and behaviors in schools. I agree with that. Toying with ideas, tinkering with objects, messing with sequences, human perception and conception are deep, wide, and fruitful places to mine for something new. Our minds are our greatest tools. Our minds are so expansive and capable that we created additional minds, computers, to help us augment the work we do and how do it.

At best, in our current state, we are practicing some "soft skills" of collaboration, tolerance, and risk-taking in schools through structured projects, units, and lessons. That there is further work to be done in developing those skills rests heavily on the choices to mostly keep a traditional model of schooling. Teachers are asked to craft lessons that meet standards so they

tack on various elements to satisfy the external measurement. The mastery of the content and its accompanying demonstration assessments take precedence, thereby rendering an inauthentic character and quality to methods and pedagogies:

> In traditional schoolrooms, teachers do try to work collaboratively with children, but usually the material itself does not spontaneously generate research problems. Can an adult and a child genuinely collaborate on elementary school arithmetic? A very important feature of work with computers is that the teacher and the learner can be engaged in a real intellectual collaboration; together they can try to get the computer to do this or that and understand what it actually does. New situations that neither teacher nor learner has seen before come up frequently and so the teacher does not have to pretend not to know. (Papert, 1980, p. 115)

A pure constructivist school has teachers and students together in pursuit of a concept or project where both really do not know at times what is the best next move to make. It is in this limbo and free space where learning can happen in new uncharted ways. It is in this structured but unscripted workshop where knowledge can take shape in new innovative ways. We hold on to our history and heritage sometimes at the risk of losing the creation of a new tomorrow. Again, it is with the computer between and among humans that we can facilitate these ventures into new territories of thinking, learning, and knowing.

As one experiments and plays, it is the continued failure that leads to defining a success or a truth. Putting out a first draft makes it possible to write a fifth and a sixth. We grow through iteration and effort. Our ideas change as they travel from the nebulous space of the mind to something tangible; and they then change more with multiple versions on the way to something considered good enough or useful enough for sharing:

> Children do not follow a learning path that goes from one "true position" to another, more advanced "true position." Their natural learning paths include "false theories" that teach as much about theory building as true ones. But in school false theories are no longer tolerated. Our educational system rejects the "false theories" of children, thereby rejecting the way children really learn. And it also rejects discoveries that point to the importance of the false-theory learning path. Piaget has shown that children hold false theories as a necessary part of the process of learning to think. The unorthodox theories of young children are not deficiencies or cognitive gaps, they serve as ways of flexing cognitive muscles, of developing and working through the necessary skills needed for more orthodox theorizing. Educators distort Piaget's message by seeing his contribution as revealing that children hold false beliefs, which they, the educators, most overcome. This makes Piaget-in-the-schools a Piaget backward—backward because children are being force-fed "correct" theories before they are ready to invent them. And backward because Piaget's work puts into question the idea that the "correct" theory is superior as a learning strategy. (Papert, 1980, p. 132-133)

It would seem that we have continued in many ways, in particular with increased standardized testing in recent decades, to ignore the research that has been well-known and well-read. Certainly the teacher preparation programs introduced all of us to Piaget and Bruner, but were we too subjected to memory recall of their ideas as an assessment measure? Or perhaps we had to write some essays explaining how we might use their ideas in our classes? Either way, we did not have Piagetian or Brunerian experiences as teachers learning how to become teachers. The right answers were already lined up for us to master.

We are talking about a major overhaul of the system from top to bottom when we talk this way. For the teachers will be unable to provide a nurturing environment for students to explore learning unless they themselves have been in meaningful adult learning experiences designed to do the same. Having completed many years of schooling in my own life, I can attest to knowing the difference between walking through someone else's course and having a chance to explore it on my own and with my peers. As an experienced teacher, I have worked hard to create spaces for students to pursue their own inquiries. I am here to tell you that when the rest of the classrooms stay traditional, my constructivist work is hampered and hindered; the students just do not have the capacity to be bombarded with worksheets from most classes and still authentically engage in one or two:

> The teacher's genuine excitement about the product is communicated to children who know they are doing something consequential. And unlike in the arithmetic class, where they know that the sums they are doing are just exercises, here they can take their work seriously. If they have just produced a circle by commanding the Turtle to take a long series of short forward steps and small right turns, they are prepared to argue with a teacher that a circle is really a polygon. No one who has overheard such a discussion in fifth-grade LOGO classes walks away without being impressed by the idea that the truth or falsity of theory is secondary to what it contributes to learning. (Papert, 1980, p. 134)

Students talking excitedly about their projects breathes life into teachers' worlds; even those who teach didactically want their students to feel excitement and joy in their work. This common denominator could be used as a barometer for designing schools and classrooms. Learning as interrogation of knowledge, learning as innovation of concept, learning as invention of product—

we can make the future of schools more joyful and in turn, develop students who enjoy working on solving the real problems in their communities.

The paperwork bureaucracy fortress has two vulnerabilities: money and information, and they work at odds. The money is easier to obtain when the information about what truly goes on is scarce. Money high, information low. The radical core center of investigating and interrogating the history of the education establishment in this manner is to disrupt it. Presenting families with more information about what could be possible in schools is perhaps the only method for change. Advocating for their kids, families can interface with local school boards and talk about student inquiry and choice, high quality computer programming courses, action-oriented community problem solving, entrepreneurial incubators, student-centered projects, and the elimination of traditional methods that avoid engagement with students as people and thinkers. Textbook and testing corporation contracts would dwindle, and as a result, school boards could invest in the resources that students need each year, because those would grow and change, to take on their developing work:

> John Dewey expressed a nostalgia for earlier societies where the child becomes a hunter by real participation and by playful imitation. Learning in our schools today is not significantly participatory—and doing sums is not an imitation of an exciting, recognizable activity of adult life. But writing programs for computer graphics or music and flying and simulated spaceship do share very much with the real activities of adults, even with the kind of adult who could be a hero and a role model for an ambitious child. (Papert, 1980, p. 179)

Authentic design and an innovator's mindset: schools will need to change drastically to become truly participatory and they will need to be flexible enough to change during a calendar year, as

well as from year to year. Perpetual change requires open minds, continued training for all employees, and a reeducation of society as to the possible goals of the approach. With just one classroom allowed to experiment full blast as a pilot program, if the teachers and students do not have to attend any traditionally run courses at all, it may be possible to lift this off the ground and forge a new model that could be studied and documented. More educators need to see and read what is possible in school, not so they can import it or copy it, but so they can do their own authentic version of a Critical Techno Constructivist school to meet the needs of their students.

Seymour Papert left us with a viable model to put into motion. The time was right in 1980 and it is certainly right in 2019. The computer today is sorely underutilized in schools. Many technologists from forty years ago would be shocked at the advanced technical specifications of the machines in schools today that are used as digital paper and push-button terminals. More than ever before, the computer is truly an "object-to-think-with" because it has raw power previously unheard of—the power of the hallowed Holodeck from the fictional world of Star Trek is possible now, but instead of being put to new use, even in personal life, so much of this digital technology is rationed and parceled to be little more than an all-in-one expedient telephone, camera, notebook, entertainment center, personal shopper, and post office. And while that is amazing, those are all tasks that were done in other ways; the same formula has been applied to school where computers replace calculators, books, journals, magazines, pens, pencils, markers, and blank paper:

> And at the same time that this massive penetration of the technology is taking place, there is a social movement afoot with great relevance for the politics of education. Some people express this by extreme action, actually withdrawing their children from schools and choosing to educate them at home. For most, there is simply the gnawing sense that

> schools simply aren't doing the job anymore. I believe that these two trends can come together in a way that would be good for children, for parents, and for learning. This is through the construction of educationally powerful computational environments that will provide alternatives to traditional classrooms and traditional instruction. I do not present LOGO environments as my proposal for this. They are too primitive, too limited by the technology of the 1970s. The role I hope they fill is that of a model. By now the reader must anticipate that I shall say an object-to-think-with, that will contribute to the essentially social process of constructing the education of the future. (Papert, 1980, pp. 181-182)

Money, politics, school, one starts to wonder how they become so enmeshed but now it is too far gone to really know. Untangling the threads is not a viable option, however a pivot is possible. It can be small. But given how far behind we are in developing new schools, these experiments should have on board a full-time researcher to help document and publicize the data. Classroom experiments of this nature could occur globally; the only barrier to entry is the will of one person. The computer is the kingpin in this untethered universe of learning potential for it alone can be used in a manner dreamt up by its user, and the biggest dreamers are children, if we leave them enough space to be just that.

Reiterating the placement of Papert's book in this trio of seminal works, it is not only the chronological order of publication, but also that *Mindstorms* presents a galvanizing synthesis of Dewey's and Freire's ideas and places them in motion for educators, philosophers, families, and students to step forward and do something. Our important and revered technological, scientific, medical, intellectual, and creative advances all happened despite their conditions—what could we do if the conditions were favorable? How might we address the social justice, humanist, and

equity crises of our day with renewed vigor and purpose in schools? What problems will students pose as their most pressing issues if we step back to let them? What role will computers and computing play in this approach?

> The research challenge is clear. We need to advance the art of meshing computers with cultures so that they can serve to unite, hopefully without homogenizing, the fragmented subcultures that coexist counterproductively in contemporary society. For example, the gulf must be bridged between the technical-scientific and humanistic cultures. And I think that the key to constructing this bridge will be learning how to recast powerful ideas in computational form, ideas that are as important to the poet as to the engineer. In my vision the computer acts as a transitional object to mediate relationships that are ultimately between person and person. (Papert, 1980, p. 183)

It is in liberation that we will find out just how to live and think in new ways with the computer as the object-to-think-with. The computer will not solve any of our problems, but it will potentially allow us to find new ways to think about our problems and how we might solve them. The computer will also potentially allow us to find new relationships to knowledge and learning, as well as help us to find new ways to interconnect ideas. There is no single software program to use in the learning process, rather it will be that students will program their own software as part of their learning process. This will empower students to develop solutions and products and presentations that have deep ties to the problems they posed. With these powerful inquiry-based, critical inquiry experiences in a collaborative and dynamic classroom culture, students will have a chance to become the very best of what humanity has to offer to itself.

Summary

This chapter presents the heart of the dissertation in full narrative form. The ideas and explanations woven through the excerpts selected by their relevance to the identified codes attempt to make visible the weight and value of the themes emerging from the histories and literature in Chapter 2. As a reminder, the most frequently occurring code pairs in the seminal works are as follows: Banking Model and Institutional Change; Banking Model and Predetermined Outcomes; Banking Model and Social Impact; Constructivism and Institutional Change; and Engagement and Institutional Change. The overwhelming wave of change that these seminal works propose for our educational system can no longer be ignored. Buoyed by the histories and literature found in Chapter 2, this chapter aims to have made more digestible the kind of change necessary to return school to the students.

The synthesis and unification here in this document analysis narrative builds toward a new theoretical approach to make that change: Critical Techno Constructivism.

CHAPTER 5

CRITICAL TECHNO CONSTRUCTIVISM

This chapter will summarize the findings of the study and suggest multiple entry points to use the newly proposed learning theory for digital learning environments, Critical Techno Constructivism. Social justice, equity, and "righting the wrongs" are at the forefront of the author's mind and the naming of this theory. That students should be subjected to a model of education that strips them of their natural intellectual and creative value is itself a crisis.

Critical Techno Constructivism

Critical Techno Constructivism abides by the following principles:

- Social justice is a goal, not a topic.
- Predetermined outcomes limit creativity, intellectual growth, critical thinking, and problem-solving skills.
- Student inquiry must drive curricular choices and learning outcomes.
- Downloaded, purchased, or otherwise imported curricular materials and solutions are inadequate substitutes for developing original and relevant course materials.
- Computer programming is a mediating language between ideas and people.
- Guidance, coaching, and formative assessment replaces testing.
- Computers and electronics are objects-to-think-with, and should not merely be used as replacements of analog tools.
- School is a laboratory, a studio, and an incubator for students to develop ideas into public-ready products and artifacts, or mimic what professionals create.

Critical Techno Constructivism, my contribution towards a new learning theory for digital learning environments, builds on the work of John Dewey, Paulo Freire, and Seymour

Papert. Through intellectual alchemy, I am synthesizing their seminal works with my literature review, a history of distance learning, a history of the computer, and my own experiences as a classroom teacher for over twenty years.

Critical Techno Constructivism holds as a central belief that we doom progress and innovation once we insist on reaching an externally defined outcome fed by imported curricular material and strategy; and that at the center of student-driven, problem posing education we must place the computer as an object-to-think-with.

Critical Techno Constructivism asks that educators and students work together instead of at odds in pursuit of real work that has real impact on problems posed and questions asked by the students.

Critical Techno Constructivism operates on the principle that all digital tools must be mixed up with humans and their reality, and that no student should be asked to work *at* a computer, but rather that people and technology work with each other.

Further, Critical Techno Constructivism was created to undo school as we know it; therefore putting these ideas into action is a conscious effort by the people involved to seek new relationships to knowledge, to seek new innovations that impact their community, to seek new social structures to provide financial freedom, and to counter traditional methods that have been used, consciously or not, for dehumanization.

For future research, I would recommend that educators study the students who do not fit the traditional mold and track their progress through colleges and careers. Additionally, I recommend that more research be done on how to create and maintain schools as nurturing places for student engagement, since that is the central component of many pedagogies and theories vying for prominence in traditional schools. And finally, we ought to spend time also

researching how experimental use of computers can augment human thinking. Studies have been performed to demonstrate that an alternative approach via computer programming can produce higher student test scores on traditional assessments than students who covered the material in a traditional manner (Harel & Papert, 1990). But what we have not yet done is to fully explore and study a constructivist, inquiry-based, student-driven computer and computing focus in an academic course.

Issues

Notwithstanding the few times students are given choice and freedom to select some of what they study, the final analysis of their time in school weighs far more heavily on predetermined outcomes, forced curriculum, and a generalized voicelessness. That this happens whilst big testing and textbook corporations are pocketing billions of dollars from public coffers should be alarming. That the charter schools have inserted themselves as alternatives to public schools but use their own "big data" techniques to circus train students should be alarming. That K-12 private schools can charge upwards of $40,000 a year, publish brochures touting their 21st century approach, and still use traditional models and curriculum should be alarming.

I can be silent no longer. This dissertation stands as my public-facing document in opposition to how we "do school" and my suggestions for what to do differently. In what follows, I strive to provide a balance of practical and theoretical suggestions, since I abide by a fundamental principle that importing someone else's solution to one's own unique problem will not provide useful results.

Let's debug school. Let's pose school as a problem. Let's democratize choice within school. Let's create the impossible in school.

Naming

In the hunt for what words to use to succinctly describe the essence of my thoughts in this dissertation, I wanted to find a relevant phrase that built upon existing phrases known to educators. In fact, in that process I discovered the existence of "Radical Constructivism" after first considering it the title for my contributions to theory. That led me to consider "Critical Constructivism" as a possibility, but it lacked a reference to technology. From there, I felt that "Techno Constructivism" would need to be prominent, so in June 2018, I began searching for its frequency of use. I looked up six variations of the phrase in seven databases containing published documents about education and then updated this search in April 2019 to discover that only a few more instances had been published. The databases I searched are as follows: ERIC, ProQuest Dissertations and Theses Global, SAGE Research Methods, SAGE Journals, Education Full Text, Google Scholar, OneSearch+, and Springer. The phrasal variations I used are as follows: "technoconstructivist", "technoconstructivism", "techno-constructivist", "techno-constructivism", "techno constructivist", and "techno constructivism". (See Table 3.)

The significance of these findings resides in that foremost there are relatively few instances of "technoconstructivism" and its variants currently appearing in published works. Further, the inclusion of international repositories in Google Scholar's search gives a statistically significant boost in the results; this may show that educators and professors globally are giving more attention to the topic in their writings. In the global dissertation and thesis database, there are more instances than in the remaining databases. This may indicate a growing attention to this topic from graduate students. Part of my interest in choosing Critical Techno Constructivism as the final name of my contributions to the theoretical work herein is motivated by the relative absence of technoconstructivism in the literature, and my anti-traditionalist purpose I hope this

dissertation serves in unmasking the destructive forms that Education can have on the youth—that we have a duty to create more inclusive and purposeful classroom spaces, and that there is a for-profit venture happening inside the institution that can be thwarted with our concerted effort.

Critical and Techno Constructivist Mindset

Howsoever an educator chooses to approach work in the classroom, be it to fully embrace Critical Techno Constructivism or try a mixture of theories, pedagogies, and philosophies, I believe there are some fundamentals from my work here that can be of use to many. Embracing a mindset infused with Critical Theory and Techno Constructivist principles has many implications and ways to be operationalized. It is worth reiterating that my contributions here should not be prescriptive for that works counter to what I have found in my research.

Leaping into a Digital Learning Environments (DLE) often has a steep learning curve for teachers, more so than for most of their students. However, I would consider an educator's relative lack of comfort as a potential gold mine; students often experience a dissonance in the classroom that so often mushroom into larger problems under a traditional method. In this case, a teacher could have an opportunity to be forced into an expert learner role and "come along for the ride" with the students guiding and collaborating with each other and the teacher. With support from administration and colleagues, and certainly from the students, a teacher new to DLEs will have an instant Critical Techno Constructivist classroom project in the making.

And for the teacher who enters a DLE with experience and comfort, there may be a pull to recreate what worked in previous years. One ought to resist that urge for it will dominate students' thinking and result in diminished enthusiasm towards their own inquiry-based projects. As much as we may wish to downplay our significance, the teacher's psychological impact on students, simply by being the adult in the room, cannot be overstated—students will work to

please their teachers, even if we decentralize and democratize the classroom space. Further, the experienced DLE teacher might find ways to solve problems for students more efficiently than their own struggle, with the suggestion of apps, software, or hardware. An essential edict for this teacher will be to let everything emerge—do not interrupt—but work collaboratively in a manner such that students can find what they might as they look for it.

For both the novice and experienced teachers in a DLE, your role will shift rapidly as you modulate yourself from project to project. Each one will require a different slice of your guidance, encouragement, expertise, and focus. Your attention to these areas will best help students: cognitive flexibility, electronic civic engagement, computer science literacy, judgment of source material, collaboration, and complex problem solving. The DLE is where everyone can remix concepts and objects in search of new innovations to help better serve humanity. That is your gold standard for what to aim for as you work with students. This invigorating new classroom culture and space relies on creativity and multiple failure in pursuit of producing new ideas and prototypes to solve real problems pursued by students.

Digital Learning Environments (DLEs) can also be powerful creative places for students to create, share, and explore a variety of cultural expressions in a diversified and meaningful manner. Underrepresented students are most often the marginalized voices in our classrooms. A mindset of Critical Techno Constructivism asks of educators to create more places and pathways for students to express themselves, develop critical inquiries into their own assumptions and interests, challenge the assumptions of others, and deepen their connection to a lifetime of learning.

What follows on page 242 is my attempt to make a single table towards that end, for you, dear reader, to expeditiously familiarize yourself with the precepts of Critical Techno

Constructivism and to look for ways to apply the theory and create your own pathways and outcomes. What I offer will not be prescriptive, as that would contradict the central premise that predetermined outcomes limit the development of students' critical thinking, creativity, and problem solving skills. The concepts covered earlier in Tables 1 and 2 link directly to the tenets below in Table 6.

Constructivism and Constructionism provide major inspiration and guidance for building an instructional course around the personal inquiries of students that lead to compelling problems or questions. Students create meaning and interpretation through intimate, hands-on experiences with information. They discover solutions when engaged in active exploration. This directly counters the dilemma of predetermined outcomes and provides individualized pathways and relationships to learning and knowledge development. The freedom and individuality via this discovery learning method leads to dynamically created curricula and pedagogy. Critical Techno Constructivism has as its core this John Dewey-informed approach to school that bridges the cultures inside and outside of the home.

Essential to this new application of Dewey's ideas in this late phase of constructivism and technology comes the critical theory work championed by Paulo Freire, for it provides a framework and structure to assist dismantling the all-too-easily manufactured dysconscious racial and social injustices of the past. Critical Techno Constructivism exists also to inspire and work to change the educational institution and its well-formed bureaucracy so that students and their current needs are addressed and served without sacrificing quality. In this manner, the decisions before all educators must not only focus on what is best for students but also involve them in the making. A Dewey-Freire approach to school and education makes problem posing the central device by which students engage with the nexus of their community and their studies.

Serving as a staunch opponent to “banking education”, Critical Techno Constructivism lays the groundwork for a new school model that can empower students and teachers alike in pursuit of authenticity and purpose in their work. Crucial to the work done under the name of Critical Techno Constructivism will be the toppling of the testing and textbook companies that have a firm grip on curriculum and assessment creation and implementation in schools nationwide. Teachers and students cannot employ the tenets in this dissertation as long as the classroom has been outsourced for profit.

The computer in school must be a tool to think with and not an expedient form of paper or an assessment terminal, lest we render the computer to the junk heap of good ideas poorly implemented. An unprecedented amount of freedom and possibility sits latent in the computer; it need not be an electronic textbook when students can learn programming languages to create their own software applications in pursuit of solving their own problems within their own inquiries. Papert’s contributions to rethinking schools with computers are largely unrealized even after four decades of opportunities to do so. Computers and computing present infinite pathways for students to engage in formative demonstrations of their learning. They should be “making things” in school towards real problem solving, they should be highlighting their burgeoning knowledge and understanding as they “come into knowing”—no longer should we tolerate that students regurgitate what the teachers already know or what the textbooks and tests tell them they ought to know. A full revision of schools is possible and Critical Techno Constructivism will highlight the areas for critique, suggest new mindsets and pathways forward, and lead the surge—for the students of today and tomorrow, we cannot wait any longer.

Table 6

Tenets of Critical Techno Constructivism with Suggestions for Operationalizing the Theory.

Tenet	**Question**	**Action**
Personal Inquiry	Did the student develop the learning task?	Engage in open dialogue with students with the explicit purpose of developing together new assignments or topics of study. Work with students to define audience, purpose, resources, tools, and goals of the learning task. Think big with students about possible uses and aims of their work beyond the classroom and the confines of school. Encourage students to follow through and develop to its end what they pose as a problem to solve.
Compelling Problem or Question	Did the student arrive at an answer that led to more questions or problems?	Coach students as they work to keep a log of their progress, handwritten, typed, audio or video recorded, for the purpose of tracking ideas as they occur. Encourage students to spot potential new paths or questions to chase as they work. Develop with students some methodologies for addressing conflict and dissonance in their work and studies and possible applications.
Technology as Tool to Think With	Did the student use technology in the thinking process?	Choose technology wisely with students. Remember that analog tools may provide instant freedom in expression. Demonstrate how to think with the computer. Use machine learning, graphical statistics, programming language, and concordances or natural language processing. Make certain the computer remains an object-to-think-with, not a replacement of paper or a push-button terminal.
Formative Demonstration of Learning	Did the student demonstrate learning throughout the process?	Develop guidelines, rubrics, and expectations of outcomes with students. Adjust these as necessary throughout the process of their work, sometimes abandoning them when students find them restrictive. Consult with students about progress and engage in conversations less as an evaluator and more as an interested peer. Sparingly make suggestions so that students retain ownership.
Reflection as Learning	Did the student demonstrate a reflective approach in the formation of knowledge?	Explicitly teach the skills of mindfulness in short lessons. Engage wholeheartedly in the process of looking for student interest and joy in their work. Emphasize to students the importance of caring about their own interest levels. Engage in reflective questions that are genuine. Avoid leading statements about what you would do as this not-so-subtly shows teacher judgment.
Social and Cultural Critique	Did the student demonstrate a critical awareness of the larger established modes and forms of thought that shape thought?	If an understanding of larger social constructs does not yet show in their work, make a weighed decision to point them out. Building consciousness more authentically through self-realization is the most powerful, however, students will need coaching and guiding. Avoid moralizing or hijacking student work with your own politics, values, or experiences. Make mention of historical events, people, or concepts that students might consider for study on their own.
Sharing and Collaborating	Did the student actively seek out collaborators in the process of acquiring knowledge, testing theories, and creating a shareable artifact?	Demonstrate methods, procedures, and styles of communicating with people. Seek out experts and amateurs as guest speakers or consultants. Show the crossover of work done in school and out of school. Practice presentation skills. Create space and time in class to talk together about student progress. Explicitly teach and coach how to communicate respectfully with operationalized critique. Engage with students to develop multiple venues and audiences for sharing.

To reiterate, Critical Techno Constructivism has a central belief that we doom progress and innovation once we insist on reaching an externally defined outcome fed by imported curricular material and strategy; and that at the center of student-driven, problem posing education we must place the computer as an object-to-think-with.

TPACK

The ideas, habits of mind, and questions I have presented above fit in with the existing work of TPACK, a current and largely accepted framework for considering technology use in the classroom that merges Information and Communication Technologies (ICT) with Pedagogical and Content Knowledge (PCK). Written by Matthew Koehler and Punya Mishra, TPACK has had a positive impact on helping teachers to succinctly parse through their own individual application of computers in the classroom (Koehler, Mishra, & Cain, 2013). And herein lies the continued struggle many teachers face in this area of growth. There is no one way, one prescription, to present a teacher on how to use the vast array of options in the field of Educational Technology, for it grows far more quickly than a single teacher can keep current with, and that wave alone can dwarf one's interest in spending hours looking for possible technological approaches.

To prescribe particular computer applications or software programs would counter the beliefs set forth herein, but using computers as a constructive tool ought to lead teachers and students towards a solution that is meaningful. This pregnant statement implicates the board of education, the district administrators, and the school site leadership team: for teachers and students to engage in constructive work with computers, the timetable of learning must be reconfigured. All of the barriers that currently exist in the traditional model must be reviewed and reconsidered: time, age, grade level, subject matter, tests, outcomes, and graduation

standards. In other words, schools need to be reborn. Critical Techno Constructivism can certainly happen in small ways in the meantime, but some may find it more their speed to take on the entirety of the system before being frustrated by trying to work within the system.

It is important to acknowledge existing work that helps to draw the boundaries and parameters, and also to show the inspiration and predecessors of my thinking. All educators interested in pursuing further work with content, pedagogy, and technology must familiarize themselves with the TPACK framework. This approach consciously looks to find intersections and crossover of technology use in pursuit of content knowledge, and actively challenging educators to engage in pedagogies that push for the use of constructive collaboration:

> TPACK is an emergent form of knowledge that goes beyond all three "core" components (content, pedagogy, and technology). Technological pedagogical content knowledge is an understanding that emerges from interactions among content, pedagogy, and technology knowledge. Underlying truly meaningful and deeply skilled teaching with technology, TPACK is different from knowledge of all three concepts individually. Instead, TPACK is the basis of effective teaching with technology, requiring an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face; knowledge of students' prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge to develop new epistemologies or strengthen old ones. (Koehler et al., 2013)

The work of TPACK is brilliant and useful. My contribution here is to push TPACK even further to be more radical and public-facing as an opposition to traditional models of schooling. The

essence is there in what Koehler and Mishra have put forth; yet we could assist students in becoming more conscious, more aware, more actively involved in the crossover work on campus and off campus. Learning as a political act, learning as a radical act, these do not happen when the test-on-Friday curriculum is still front and center. Families will need to be equipped with the knowledge of the great philosophers in Education who have already told us just exactly what we ought to be doing instead.

What Is Next?

The birth of a movement, or the continuation of a movement, that is what is next. The co-construction of knowledge and attitudes towards knowledge must be recognized by educators as worthwhile endeavors. We must work to positively influence students to find their own individual theories and positions. We need not abandon everything we have prepared and studied for in our careers thus far, but we do need to reconfigure our time at school and how we spend it.

In contemporary times, the Constructivist approach applies not only to how teachers "run their classroom" but also how information is created, gathered, interpreted, and shared. The Internet is the biggest open classroom on the planet. We should embrace it and dive deep into experiments with information and knowledge creation, for these are the nexus points where learning naturally occurs.

The natural spiraling that Bruner discussed and that was again raised in the theoretical work of Connectivism gives us a framework to address how people "come to know" things in a variety of ways. Class will truly never end because thinking and learning will never end. An unstoppable exchange of information happens constantly in and out of public and private spheres, as well as in and out of individual and collaborative spaces. Our error is quite simply that we have allowed obtaining degrees and landing jobs as the goals for all of the "stuff to

learn" in school. Education begets education. A confident and engaging creative intellectual will no doubt perform well in a career.

The externally imposed outcomes for graduation and the rigid rules of college admissions translate into a ready-to-wear experience for most students. Whether or not students understand what they are asked to study is often of little concern. And another test is around the corner. The prescribed curriculum is so normal that it does not faze our sensibilities.

Certainly students could learn a thing or two, that is not in question, but just what is it that they are learning? Educators discuss multiplicity and diversity in the abstract as a good thing, but our teaching methods mostly do not help produce diverse and divergent thinkers. We continue to allow predetermined aims and outcomes to take precedence over the experience and ideation of the child.

Schools face a hiring problem. Not only do we have a shortage of educators willing to join the profession, we also have a shortage of educators willing to reimagine school. Teacher preparation programs must change. This is true for administration as well. Without any training in a different model, a traditionalist administrator evaluating a constructivist teacher would negatively critique the "abnormal" behavior in how "learning happens" in that classroom.

But what is the alternative? A hallway full of classrooms all teaching the same lesson in the same way to the same aged students on the same day? I had a Principal once tell me that in case I am ever out sick, that is exactly the classroom model she preferred because it would make her life easier. Shocking, but true.

Many times the Constructivist classroom is seen as a "free-for-all" for those untrained in what to look for when the classroom is de-centered. A teacher evaluator may come in and see that a teacher is not lecturing from the podium or forcing students to move "lockstep" through a

downloaded or Xeroxed worksheet of problems, and for these "crimes" would be considered as going too slowly or not meeting performance standards: one might wonder where exactly this evaluator gets her ideas for what happens in school and whether or not it is the teacher who is in school or the students. Nevertheless, these are real summaries of how schools operate—the fear that a teacher is non-performing has more to do with a misinformed perception of meeting the needs of all students. When the teacher is involved in the process of each student's pathway in the work, that teacher might be thought of as not teaching, and as strange as that sounds, it is true simply because teacher and administrative training courses do little to provide opportunities to practice anything but traditional methods.

Starving teachers of the opportunity to co-construct experiments with their students robs everyone. To stifle teacher creativity and autonomy can nearly ensure student misery: when the teacher is a lifeless robot, do not expect the students to accidentally find joy in their learning experience. We are suffering from a lack of imagination with how to run our schools, and most "solutions" are attempts to redirect or reinvent a traditional informational instructional model of teaching and learning—we stop short of reinventing school itself.

Comprised of an experience not of their choosing and methods not of their liking, students move through their days and hallways always vaguely wondering if there is something else to learning that could excite them. Students' relationship to knowledge and wisdom is threatened by the traditional school model for it makes ideas exist in an artificial space separate from their creation. Memorizing theorems and dates and rhetorical devices do little in comparison to using them or creating your own. For too many years, we speak idly of the creative forces necessary for true learning to take place when we allow our schools to exist in a falsely created parallel universe where studying is memorization and knowledge is a commodity.

We still do not topple the traditional structure of schooling with the same fervor that we put into political causes and social justice campaigns, even though this is a critical political and social justice issue!

In place of what currently exists, a new school system that knows itself as a system and its inherent limitations will be necessary to create. A school system based on humankind, humanity, and humane goals would have to reevaluate its obsession with planned curricula, grades, and tests. It is incumbent upon us to unmask the corporate and political takeover of Education. It is incumbent upon us to empower students and teachers to engage in authentic discovery and study. It is incumbent upon us to transform school in opposition to predetermined outcomes, planned curriculum, and standardized testing.

The fractured curriculum serves the specialist teacher and the accounting system more than it does the student. Freire contends that the fractured curriculum also further isolates people's minds and prevents them from engaging in the natural play of human imagination and conceptual strength. With authentic dialogue at the center of the work in school, it would be impossible to predetermine the curriculum and the outcomes.

A school must find itself. As enrollment and staffing changes from year to year, the school would then naturally change. Viewing a learning environment in this manner liberates us from the stranglehold of testing and textbook companies. The re-education of the public might need to start right at this point, for it has many far-reaching implications that impact a community. But again, posing school as a problem for a community to solve will allow for the local needs to be heard and addressed. Leadership is essential in the creation of this approach and guidance through it, though that leadership must be of a transformative, not transactional, nature.

At the heart of all three theorists' work, and mine, is a belief that we always retain a portion of our wonder as children explorers of the world. Through conscious engagement with that wonder and the natural inquiry that ensues, schools have a chance to think with students about knowledge and learning in ways that can reactivate everyone's excitement for study and production of products or artifacts. The computer is only but a part of this approach and is not where learning ends; the computer is the strongest augmentation tool we currently have available to shift what we do when engaging in learning.

The recent developments in drag-and-drop computer programming languages and easy-to-use robotics and computer engineering hardware kits have grown in accepted school usage. These new products and their familiarity in schools indicates a worthwhile effort to provide students with constructivist tools inside of a traditionalist system. These does not remake school, but do infuse it with some opportunities for student inquiry. The noteworthy focus on math and science shows the trends of the marketplace and how many view the role of computers and computing. However, for a lack of trying we have left out the Humanities branch in this recent uptick of classroom computer usage.

The final hurrah of this dissertation is to make the case for a classroom computer use that places all of the subject matters re-integrated into their untampered-with original form.

STEAMHAMLET

I am a product of my environment and my experiences. Surrounded by family members, young and old, some of whom were original thinkers and others rule-followers, I understood early the benefits and problems of both approaches. I was also an elementary school student when Apple Computers first joined the classroom. We programmed in BASIC and Apple LOGO our own original ideas. We also played through *Oregon Trail* and *Lemonade* and more.

My first feature-length program was created with two elementary school friends, and we did everything by ourselves during the unstructured times we could find. Before school, after school, lunch time, break time, finish-work-early time, we were coders. We decided to make a game in BASIC and call it “Star Wars” because we loved Luke and Darth and everything about that saga, and we wanted to create a game for it that went in different story directions and explored different themes and ideas. It took us many weeks just to create the only graphic in the game and we were extremely proud of our vector graphics starship. I am sure we rewrote the program thousands of times and saved it on that trusty five-and-a-quarter-inch floppy disk every time. That floppy disk is long gone and only vague memories of what we created remain—but it was one of the best times I ever had in school.

Another important reference point for me is when I was in Advanced Placement Calculus as a high school senior and I refused to do any homework—not because I hated homework, which I did, but because I did not see the need to complete it when I solved all of the test problems correctly. Furthermore, on the tests, I was somehow able to figure out the answers in my head and therefore chose not to show any work. My teacher marked all of my answers as correct but was failing me in the class for not showing my work and for not completing homework. I was offered an opportunity at the end of the first semester to bargain for a grade of “C” and drop the class in place of another English course. I took the deal and went on with my school life.

Looking back, I am shocked. Neither my teacher nor any administrators reached out to my parents to involve them in the situation, and even more amazing to think about is that nobody thought that perhaps I had some sort of strange gift for mathematics that was showing itself at this brief time in my life. After taking one more Calculus course in my first year in college,

where I earned an “A”, I stopped studying math and now look at those strange Calculus equations with no memory or idea of how to approach solving the problems.

All these years later, I dream about what my life would have been had I benefited from the kinds of learning environments possible with Critical Techno Constructivism. Nevertheless, I am product of my environment and my experiences.

One last experience guides the work that I do here. In the first few years of my teaching career, I was quick to notice student talents and strengths not honored by the curriculum or the classroom. In conversations with various groups of students, an idea to build the school’s first radio station was born. Poets, singer-songwriters, freestylers, storytellers, folk duos, journalists, beatmakers, comedians, experimentalists, turntablists—they wanted to make quality content that was completely within their control. They wanted to share their work and get feedback from audiences that they would find and create.

We found other people’s trash and made it our furniture and our recording equipment and our decorations. We broke everything and fixed it right back up. We took every computer and put it to use. If it was too old to handle recording software, we turned it into a slide viewer playing a continuous loop of pictures documenting our work. Our diverse student body tended to self-select groups based on affinities, but it was the radio station that became the thing they all had in common. We found a way to build our own beautiful ecosystem.

So, I want to create the tool that to co-create the kind of learning that I think is missing in school. The tool will be called STEAMHAMLET because it consciously puts back into one learning experience all of the subjects that school artificially separates. Further, it also includes the Humanities, which are too often missing from a focus on STEAM. The content areas are:

Science, Technology, Engineering, Art, Mathematics, History, Art, Music, Language, English, and Theater [STEAMHAMLET]. This integration has inquiry naturally embedded.

Art appears twice in STEAMHAMLET not by accident, but because art represents and communicates essential cultural and aesthetic values that humans consciously use to demonstrate their positionality and politics. Art is our most valuable form of irrationality where we can be emotional and expressive in pursuit of ideas.

STEAMHAMLET will be a mixed reality hologram projection tool that allows users to manipulate information in a collaborative environment. Pulling from existing databases, clearinghouses, and digital archives, all ideas and artifacts in recorded history will become movable objects projected by STEAMHAMLET in a shared space. No glasses necessary: Imagine students working collaboratively around a table where they can pinch, move, scale, mashup, replace, alter, add, and edit any informational object in an easily manipulated hologram projection. Limitless innovation with a vast storehouse of recorded data, that is STEAMHAMLET. Specialized or proprietary data can also be loaded into STEAMHAMLET for private editing and use.

Critical Techno Constructivism and STEAMHAMLET were inspired, no doubt, by many of the science fiction stories that I read and watched over the years. I was not the only one for whom the Holodeck has held great promise. Janet Murray's (2016) text *Hamlet on the Holodeck* presented a fascinating analysis of how narrative and textual studies have changed due to computers and the Internet:

> First introduced on *Star Trek: The Next Generation* in 1987, the holodeck consists of an empty black cube covered in white gridlines upon which a computer can project elaborate simulations by combining holography with magnetic "force fields" and energy-to-matter

> conversions. The result is an illusory world that can be stopped, started, or turned off at will but that looks and behaves like the actual world. The *Star Trek* holodeck is a universal fantasy machine, open to individual programming: a vision of the computer as a kind of storytelling genie in the lamp. (Murray, 2016, p. 17)

Taking from this vision of the hologram narrative, we can now produce in mixed reality, augmented reality, and extended reality a whole host of immersive imagery in real time. The computer technology capabilities have surpassed our current use in educational settings. What we do with computer technology in medicine and film can be put to use in the classroom. That we should have only in a fictional world of *Star Trek* the capability I wish to put in the classroom is astounding and also the next marketplace need.

Seymour Papert saw that the default nature of how schools and educators and families think of computers was what doomed its categorical use. Students will, students will, students will—the outcomes and standards are full of sentences about what the students will do but nowhere does it state what the administrators and the faculty will do. Why is this? What promises ought to be made to students about what will be done by the school in their favor? I would like to start right there.

A powerful new classroom space starts to emerge when we rethink the resources and activities with students' freedom at the center. A class where if you are not wrong you cannot go forward in your work, that is a wholly different model. The trauma of failing in front of your peers would simply not exist because the errors in computer programming are necessary to find useful solutions to build the desired product. Thinking with the computer is considered a radical act, though there will likely come a time in human history that looking back at 2019 will provide a good chuckle at our stubbornness in insisting on a traditional model when we have the tools

and philosophies to do otherwise. The analysis and discussion provided here in this dissertation will hopefully contribute to accelerating our progress towards new learning theories and schools and experiences for students.

Classroom experiments of this nature could occur globally; the only barrier to entry is the will of one person. The computer is the kingpin in this untethered universe of learning potential for it alone can be used in a manner dreamt up by its user, and the biggest dreamers are children, if we leave them enough space to be just that.

Conclusion

My vision for the future is less about using particular applications, clients, programs, and data sets, and more about my desire for the freedom that students and teachers together could have to choose and chart a path. Schools are hanging on for dear life to a traditional model of what Paulo Freire (1970) termed "banking education" and this is due mostly to how we, in the USA, are still tethered financially to the Educational Testing Service (ETS). What happens with technology in education or educational technology today is often still recognizable as that which happened since the 1980s –- once a week "pull out" computer lab time, individual "one and done" projects, or digitizing work that was previously completed with pencil and paper or typewriters. As of yet, we have not toppled the political money machine that shackles well-intentioned creative people in schools. If we did, and allowed for a shift in graduation outcomes and the manner in which we ask students to engage in work and be assessed, then we would help unleash innovation in ways that we could not predict but would positively change how we think and live.

I am a big systems thinker and wished to intentionally position my work here in this dissertation and at Loyola Marymount University as a necessary radical act towards improving

the intellectual, creative, and financial trajectory of the lives of students with whom we work. This brave new world of startups and venture capital should be made transparent and accessible to our students, but if we keep them trapped in an old factory model of learning material Monday through Thursday for a test on Friday, we will stifle their minds and deaden their senses—they are in the world, too, and they already see what is possible. Schools must react to the changes outside of the four walls.

What happens when we consciously counter the traditional narrative of school and schooling? What happens when students bring their own real-world situations to pose as problems for study? What happens when we make room for student control of the artifacts they produce? What happens when we use computers as objects-to-think-with? What happens when we learn computer programming languages to create software solutions of our own? What happens when we naturally and organically collaborate?

What happens when we remove from school the artificial barriers of age grouping, grade levels, time spent, content areas, content sequencing, and testing measurements?

Schools can change. Administrators can change. Teachers can change. Classrooms can change. The students are waiting.

APPENDIX A

Table 7
Number of Times Each Code Is Tagged in Dedoose on Excerpts from Seminal Works.

Codes derived from literature review	*Democracy and Education* by John Dewey	*Pedagogy of the Oppressed* by Paulo Freire	*Mindstorms* by Seymour Papert	Totals
Abstractions	5	5	4	14
Banking Model	23	14	15	52
Connectivism	1	0	3	4
Constructivism	22	9	17	48
Discovery Learning	2	5	15	22
Engagement	16	6	24	46
Freedom and Individuality	0	10	11	21
Institutional Change	18	7	26	51
Isolated Curricula	4	9	10	23
Observations on Life Itself	1	3	1	5
Oppression	0	19	3	22
Pedagogy	15	6	5	26
Predetermined Outcomes	13	5	20	38
Problem Posing Education	0	4	18	22
Shared Democracy	4	6	3	13
Social Impact	11	19	12	42
Theory	13	4	9	26
Totals	148	131	196	

APPENDIX B

Table 8
Types and Examples of Educational Software

Category	Features	Examples
Programming	Emphasizes logic with a foreign language, syntax, and diction	*LOGO Drawing Turtle* (1967) *C++* (1979) *Scratch* (2002)
Role-Playing Adventure	Emphasizes imagination and exploration with a set of packaged data	*Oregon Trail* (1982) *Odell Lake* (1986) *Mixed-Up Mother Goose* (1986) *Pajama Sam* (1996)
Drill and Practice, Tutorials	Emphasizes traditional rote learning and skill reinforcement through "gamification"	*MasterType* (1981) *Reader Rabbit* (1984) *Math Blaster* (1985) *Number Munchers* (1986) *Mario Teaches Typing* (1992)
Simulations	Emphasizes experience and reaction time through encounters with situations found in packaged data	*Lemonade Stand* (1979) *SimCity* (1989) *Civilization* (1991)
Problem Solving	Emphasizes logic skills and higher order thinking with situations found in packaged data	*Rocky's Boots* (1982) *Where in the World is Carmen Sandiego?* (1985) *Castle of Dr. Brain* (1991) *The Incredible Machine* (1992) *Museum Madness* (1994) *Logical Journey of the Zamboonis* (1996)
Brainstorming, Mind Mapping	Emphasizes drawing to help show connections among seemingly disparate ideas	*Inspiration* (1982) *Concept Draw Mindmap* (2001)

APPENDIX C

In the process of composing Chapter 4, many selected excerpts contained ideas that were similar in spirit and concept. Instead of deleting these excerpts, since they had been chosen through the honest process of the study, I elected to place them here in an appendix for reference. I sensed that my own annotations were trending towards redundancy and that the main themes, codes, and arguments of the seminal works had been fully addressed. So as to not bore both the author and the reader, and to preserve the authenticity of this study, this appendix will be a repository of important ideas excerpted from the seminal works that need not be annotated. To be clear, the annotations that I would have written for the following excerpts would have repeated annotations I had already created. For the purpose of the computer-aided analysis performed by the Dedoose software, I included all of the excerpts since together they serve as the main material studied in the document analysis.

John Dewey's *Democracy and Education*

"The way to enable a student to apprehend the instrumental value of arithmetic is not to lecture him upon the benefit it will be to him in some remote and uncertain future, but to let him discover that success in something he is interested in doing depends upon ability to use numbers." (Dewey, 1916, p. 249)

"In the multitude of educations education is forgotten. The obvious outcome is congestion of the course of study, over-pressure and distraction of pupils, and a narrow specialization fatal to the very idea of education. But these bad results usually lead to more of the same sort of things as a remedy. When it is perceived that after all the requirements of a full life experience are not met, the deficiency is not laid to the isolation and narrowness of the teaching of the existing subjects, and this recognition made the basis of reorganization of the system. No,

the lack is something to be made up for by the introduction of still another study, or, if necessary, another kind of school. And as a rule those who object to the resulting overcrowding and consequent superficiality and distraction, usually also have recourse to a merely quantitative criterion: the remedy is to cut off a great many studies as fads and frills, and return to the good old curriculum or the three Rs in elementary education and the equally good and equally old-fashioned curriculum of the classics and mathematics in higher education." (Dewey, 1916, pp. 255-256)

"This situation in education represents the divisions and separations which obtain in social life. The variety of interests which should mark any rich and balanced experience have been torn asunder and deposited in separate institutions with diverse and independent purpose and methods. Business is business, science is science, art is art, politics is politics, social intercourse is social intercourse, morals is morals, recreation is recreation, and so on. Each possesses a separate and independent province with its own peculiar aims and ways of proceeding. Each contributes to the others only externally and accidentally. All of them together make up the whole of life by just apposition and addition. What does one expect from business save that it should furnish money, to be used in turn for making more money and for support of self and family, for buying books and pictures, tickets to concerts which may afford culture, and for paying taxes, charitable gifts and others of social and ethical value? How unreasonable to expect that the pursuit of business should be itself a culture of the imagination, in breadth and refinement; that is should directly, and not through the money which it supplies, have social service for its animating principle and be conducted as an enterprise in behalf of social organization! The same thing is to be said, *mutatis mutandis,* of the pursuit of art or science or politics or religion. Each has become specialized not merely in its appliances and its demands

upon time, but in its aim and animating spirit. Unconsciously, our course of studies and our theories of the educational values of studies reflect this division of interests." (Dewey, 1916, pp. 256-257)

"Nevertheless the isolation of these studies from practical application, their reduction to purely symbolic devices, represents a survival of the idea of a liberal training divorced from utility. A thorough adoption of the idea of utility would have led to instruction which tied up the studies to situations in which they were directly needed and where they were rendered immediately and not remotely helpful. It would be hard to find a subject in the curriculum within which there are not found evil results of a compromise between the two opposed ideals." (Dewey, 1916, p. 267)

"It will generally be found that instruction which, in aiming at utilitarian results, sacrifices the development of imagination, the refining of taste and the deepening of intellectual insight—surely cultural values—also in the same degree renders what is learned limited in its use. Not that it makes it wholly unavailable but that its applicability is restricted to routine activities carried on under the supervision of others." (Dewey, 1916, p. 267)

"The more isolated the object, the more isolated the sensory quality, the more distinct the sense-impression as a unit of knowledge. The theory worked not only in the direction of this mechanical isolation, which tended to reduce instruction to a kind of physical gymnastic of the sense-organs (good like any gymnastic of bodily organs, but not more so), but also to the neglect of thinking. According to the theory there was no need of thinking in connection with sense-observation; in fact, in strict theory such thinking would be impossible till afterwards, for thinking consisted simply in combining and separating sensory units which had been received without any participation of judgment." (Dewey, 1916, p. 278)

"So far as schools still teach from textbooks and rely upon the principle of authority and acquisition rather than upon that of discovery and inquiry, their methods are Scholastic—minus the logical accuracy and system of Scholasticism at its best." (Dewey, 1916, p. 289)

"Through social intercourse, through sharing in the activities embodying beliefs, he gradually acquires a mind of his own. The conception of mind as a purely isolated possession of the self is at the very antipodes of the truth. The self *achieves* mind in the degree in which knowledge of things is incarnate in the life about him; the self is not a separate mind building up knowledge anew on its own account." (Dewey, 1916, p. 304)

"Freedom means essentially the part played by thinking—which is personal—in learning:—it means intellectual initiative, independence in observation, judicious invention, foresight of consequences, and ingenuity of adaptation to them." (Dewey, 1916, p. 311)

"In the normal process of becoming acquainted with subject matter already known to others, even young pupils react in unexpected ways. There is something fresh, something not capable of being fully anticipated by even the most experienced teacher, in the ways they go at the topic, and in the particular ways in which things strike them. Too often all this is brushed aside as irrelevant; pupils are deliberately held to rehearsing material in the exact form in which the older person conceives it. The result is that what is instinctively original in individuality, that which marks off one from another, goes unused and undirected. Teaching then ceases to be an educative process for the teacher. Teaching then ceases to be an educative technique. At most he learns simply to improve his existing technique; he does not get new points of view; he fails to experience any intellectual companionship. Hence both teaching and learning tend to become conventional and mechanical with all the nervous strain on both sides therein implied." (Dewey, 1916, pp. 312-313)

"The reconstruction of philosophy, of education, and of social ideals and methods thus go hand in hand. If there is especial need of educational reconstruction at the present time, if this need makes urgent a reconsideration of the basic ideas of traditional philosophic systems, it is because of the thoroughgoing change in social life accompanying the advance of science, the industrial revolution, and the development of democracy. Such practical changes cannot take place without demanding an education re-formation to meet them, and without leading men to ask what ideas and ideals are implicit in these social changes, and what revisions they require of the ideas and ideals which are inherited from older and unlike cultures." (Dewey, 1916, p. 341)

Paulo Freire's *Pedagogy of the Oppressed*

"One of the characteristics of oppressive cultural action which is almost never perceived by the dedicated but naïve professionals who are involved is the emphasis on a *focalized* view of problems rather than on seeing them as dimensions of a *totality*. In 'community development' projects the more a region or area is broken down into 'local communities,' without the study of these communities both as totalities in themselves and as parts of another totality (the area, region, and so forth)—which it its turn is part of a still larger totality (the nation, as part of the continental totality)—the more alienation is intensified. And the more alienated people are, the easier it is to divide them and keep them divided. These focalized forms of action, by intensifying the focalized way of life of the oppressed (especially in rural areas), hamper the oppressed from perceiving reality critically and keep them isolated from the problems of oppressed women and men in other areas." (Freire, 1970, pp. 141-142)

"Internalizing paternal authority through the rigid relationship structure emphasized by the school, these young people tend when they become professionals (because o the very fear of freedom instilled by these relationships) to repeat the rigid patterns in which they were

miseducated. This phenomenon, in addition to their class position, perhaps explains why so many professionals adhere to antidialogical action. Whatever the specialty that brings them into contact with the people, they are almost unshakably convinced that it is their mission to 'give' the latter their knowledge and techniques. They see themselves as 'promotors' of the people. Their programs of action (which might have been prescribed by any good theorist of oppressive action) include their own objectives, their own convictions, and their own preoccupations." (Freire, 1970, p. 155)

"Whereas in the antidialogical theory of action the dominators are compelled by necessity to divide the oppressed, the more easily to preserve the state of oppression, in the dialogical theory the leaders must dedicate themselves to an untiring effort for unity among the oppressed––and unity of the leaders with the oppressed—in order to achieve liberation." (Freire, 1970, p. 172)

"Organization is, rather, a highly educational process in which leaders and people together experience true authority and freedom, which they then seek to establish in society by transforming the reality which mediates them." (Freire, 1970, p. 179)

"Instead of following predetermined plans, leaders and people, mutually identified, together create the guidelines of their action. In this synthesis, leaders and people are somehow reborn in new knowledge and new action. Knowledge of the alienated culture leads to transforming action resulting in a culture which is being freed from alienation. The more sophisticated knowledge of the leaders is remade in the empirical knowledge of the people, while the latter is refined by the former." (Freire, 1970, p. 181)

Seymour Papert's *Mindstorms: Children, Computers and Powerful Ideas*

"Without the incentive or the materials to build powerful, concrete ways to think about problems involving systematicity, children are forced to approach such problems in a grouping, abstract fashion." (Papert, 1980, p. 22)

"In thousands of schools and in tens of thousands of private homes children are right now living through very different computer experiences. In most cases the computer is being used either as a versatile video game or as a 'teaching machine' programmed to put children through their paces in arithmetic or spelling." (Papert, 1980, pp. 28-29)

"In retrospect, we know that the road that led from nineteenth-century transportation was quite different. The invention of the automobile and the airplane did not come from a detailed study of how their predecessors, such as horse-drawn carriages, worked or did not work. Yet, this is the model for contemporary educational research. The standard paradigms for education research take the existing classroom or extracurricular culture as the primary object of study. There are many studies concerning the poor notions of math or science students acquire from today's schooling. There is even a very prevalent 'humanistic' argument that 'good' pedagogy should take these poor ways of thinking as its starting point. It is easy to sympathize with the humane intent." (Papert, 1980, p. 44)

"And as long as we insist on making children learn arithmetic by the standard route, we will continue to 'prove' by objective tests that these children really cannot 'do arithmetic.' But this is like proving that the deaf children cannot have language because they don't hear." (Papert, 1980, pp. 46-47)

"The computer-based Mathland I propose extends the kind of natural, Piagetian learning that accounts for children's learning a first language to learning mathematics. Piagetian learning

is typically deeply embedded in other activities. For example, the infant does not have a period set aside for 'learning talking.' This model of learning stands in opposition to dissociated learning, learning that takes place in relative separation from other kinds of activities, mental and physical. In our culture, the teaching of mathematics in schools is paradigmatic of dissociated learning. For most people, mathematics is taught and taken as medicine. In its dissociation of mathematics, our culture comes closest to caricaturing its own worst habits of epistemological alienation." (Papert, 1980, p. 48)

"For many years in school Jenny had been drilled in grammatical categories. She had never understood the differences between nouns and verbs and adverbs. But now it was apparent that her difficulty with grammar was not due to an inability to work with logical categories. It was something else. She had simply seen no purpose in the enterprise. She had not been able to make any sense of what grammar was about in the sense of what it might be *for*." (Papert, 1980, pp. 48-49)

"Children perceive the school's rhetoric about mathematics as double talk. In order to remedy the situation we must first acknowledge that the child's perception is fundamentally correct. The *kind of mathematics* foisted on children in schools is not meaningful, fun, or even very useful. This does not mean that an individual child cannot turn it into a valuable and enjoyable personal game. For some the game is scoring grades; for others it is outwitting the teacher and the system. For many, school math is enjoyable in its repetitiveness, precisely because it is so mindless and dissociated that it provides a shelter from having to think about what is going on in the classroom. But all this proves is the ingenuity of children. It is not a justification for school math to say that *despite* its intrinsic dullness, inventive children can find excitement and meaning in it." (Papert, 1980, pp. 50-51)

"I see 'school math' as a social construction, a kind of QWERTY. A set of historical accidents (which shall be discussed in a moment) determined the choice of certain mathematical topics as *the* mathematical baggage that citizens should carry. Like the QWERTY arrangement of typewriter keys, school math did make some sense in a certain historical context. But, like QWERTY, it has dug itself in so well that people take it for granted and invent rationalizations for it long after the demise of the historical conditions that made sense of it. Indeed, for most people in our culture it is inconceivable that school math could be very much different: This is the only mathematics they know." (Papert, 1980, p. 51)

"For example, in school math 'analytic geometry' has become synonymous with the representation of curves by equations. As a result every educated person vaguely remembers that *y = x2* is the equation of a parabola. And although most parents have very little idea of why anyone should know this, they become indignant when their children do not. They assume that there must be a profound and objective reason known to the those who better understand these things. Ironically, their mathophobia keeps most people from trying to examine those reasons more deeply and thus places them at the mercy of the self-appointed math specialists." (Papert, 1980, p. 52)

"'You learn stuff like that by making your mind a blank and saying it over and over until you know it.' Bill spent a considerable amount of time on 'learning' his tables. The results were poor and, in fact, the poor results themselves speak for the accuracy of Bill's reporting of his own mental processes of learning. He failed to learn because he forced himself out of any relationship to the material—or rather, he adopted the worst relationship, dissociation, as a strategy for learning." (Papert, 1980, p. 65)

"But if we can find an honest place for scientific thinking in activities that the child feels are important and personal, we shall open the doors to a more coherent, syntonic pattern of learning. In this chapter I show that this can be done and suggest that relating science to physical skills can do much more for learning science that providing what educators like to call a 'motivation.' It can potentially place children in a position of feeling some identification with scientists through knowing that scientists use formal descriptive languages and knowing that they too can use such languages as tools for learning physical skills—juggling for example. The idea is to give children a way of thinking of themselves as 'doing science' when they are doing something pleasurable with their bodies. If children could see Descartes's invention of coordinate geometry as something not totally alien to their own experiences of daily life, this could not only make Descartes more meaningful but, at the same time, help the children come to see themselves as more meaningful." (Papert, 1980, pp. 96-97)

"The student must first learn how to work with equations before using them to model a Newtonian world. The simplest way in which our computer microworld might help is by putting students in a simulated world where they have direct access to Newtonian motion. This can be done when they are young. It need not wait for their mastery of equations. Quite the contrary: Instead of making students wait for equations, it can motivate and facilitate their acquisition of equational skills by providing and intuitively well understood context for their use." (Papert, 1980, p. 124)

"This use of the computer to create opportunities for the exercise of qualitative thinking is very different from the use of computers that has become standard in high school physics courses. There it is used to reinforce the quantitative side of physics by allowing more complex calculations. Thus it shares some of the paradox we have already noted in the use of new

technologies to reinforce educational methods whose very existence is a reflection of the limitations of the pre-computer period. As previously mentioned, the need for drill and practice in arithmetic is a symptom of the absence of conditions for the syntonic learning of mathematics. The proper use of computers is to supply such conditions. When computers are used to cure the immediate symptom of poor scores in arithmetic, they reinforce habits of dissociated learning. And these habits which extend into many areas of life are a much more serious problem than weakness in arithmetic." (Papert, 1980, p. 139)

"The purpose in working on the problem is not to 'get the right answer,' but to look sensitively for conflict between different ways of thinking about the problem: for example, between two intuitive ways of thinking or between an intuitive and a formal analysis. When you recognize conflicts, the next step is to work through them until you feel more comfortable." (Papert, 1980, pp. 145-146)

"I want you to go away from this book with a new sense of a child's value as a thinker, even as an 'epistemologist' with a notion of the power of powerful ideas. But I also realize that these images might seem abstract and even irritating to some of you, perhaps especially those of you who teach children." (Papert, 1980, pp. 150-151)

REFERENCES

21st Century Skills, (2016). In *The glossary of education reform.* Retrieved from http://edglossary.org/21st-century-skills

Ackermann, E., (1991). From decontextualized to situated knowledge: Revisiting Piaget's water-level experiment. In I. Harel & S. Papert (Eds.), *Constructionism Part 4: Cybernetics and Constructionism* (pp. 367-379). Norwood, New Jersey: Ablex Publishing Corporation.

Ackermann, E. (2001). Piaget's constructivism, Papert's constructionism: What's the difference. *Future of Learning Group Publication*, *5*(3), 438.

Aldahdouh, A. (2018). Jumping from one resource to another: How do students navigate learning networks? *International Journal of Educational Technology in Higher Education, 15.* doi: 10.1186/s41239-018-0126-x

Analog, (2006). In *TechTerms*. Retrieved from https://techterms.com/definition/analog

Anderson, B., & Simpson, M. (2012). History and heritage in distance education. *Journal of Open, Flexible and Distance Learning*, 16(2), 1-10.

Anderson, T., & Dron, J. (2012). Learning technology through three generations of technology enhanced distance education pedagogy. *European Journal of Open, Distance and E-Learning*, (2).

Araque, J. C., Maiden, R.P., Bravo, N., Estrada, I., Evans, R., Hubchik, K., Kirby, K., . . . Reddy, M. (2013). Computer usage and access in low-income urban communities. *Computers in Human Behavior*, *29*(4), 1393–1401, ISSN 0747-5632.

Attewell, P. (2001). The first and second digital divides. *Sociology of Education*, *74*(3), 252–59.

Augmented Reality, (2016). In *TechTerms*. Retrieved from https://techterms.com/definition/augmented_reality

Blended Learning, (2013). In *The glossary of education reform*. Retrieved from http://edglossary.org/blended-learning

Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal*, *9*(2), 27-40.

Bower, B. L., & Hardy, K. P. (2004). From correspondence to cyberspace: changes and challenges in distance education. *New Directions for Community Colleges*, (128), 5-12.

Boyd, D. (2016). What would Paulo Freire think of Blackboard: Critical pedagogy in an age of online learning. *The International Journal of Critical Pedagogy*, *7*(1).

Bruner, J. S. (1961). *The process of education*. Cambridge, MA: Harvard University Press.

Bruner, J. S., Goodnow, J. J., & Austin, G. A. (1956). *A study of thinking*. Oxford, England: John Wiley and Sons.

Casas, M. (2002). The use of Skinnerian teaching machines and programmed instruction in the United States, 1960-1970.

Chou, S. & Liu, C. (2005). Learning effectiveness in web-based technology mediated virtual learning environment. 3a- 3a. doi: 10.1109/HICSS.2005.385

Collis, B., & Muir, W. (1984). Computers in education: An overview. *Software Engineering/Education Cooperative Project*. Victoria, Canada: University of Victoria.

Computer, (2006). In *Tech terms*. Retrieved from https://techterms.com/definition/computer

Constructionism, 2005. In *Learning theories*. Retrieved from https://learning-theories.com/educational-robotics-and-constructionism.html

Critical Theory, (2009). In *Encyclopedia Britannica*. Retrieved from https://www.britannica.com/topic/critical-theory

Dalgarno, B., & Lee, M. (2010). What are the learning affordances of 3-D virtual environments? *British Journal of Educational Technology*, *41*(1).

Dedoose Version 8.0.35, web application for managing, analyzing, and presenting qualitative and mixed method research data (2018). Los Angeles, CA: SocioCultural Research Consultants, LLC. www.dedoose.com.

Dewey, J. (1916). *Democracy and education*. Carbondale, IL: Southern Illinois University Press.

Digital, (2006). In *TechTerms.* Retrieved from https://techterms.com/definition/digital

Educational Technology in the 21st Century: Joint hearing before the Committee on Science and the Committee on Economic and Educational Opportunities. House of Representatives, 104th Cong., 1 (1995).

Eglash, R., Gilbert, J. E., Taylor, V., & Geier, S. R. (2013). Culturally responsive computing in urban, after-school contexts: Two approaches. *Urban Education*, *48*(5), 629–656.

Extended Reality, (2019). In *Qualcomm*. Retrieved from https://www.qualcomm.com/news/onq/2017/05/31/extended-reality-convergence

Feenberg, A. (2002) *Transforming technology*: *A critical theory revisited*. Second Edition. Oxford, England: Oxford University Press.

Feurzeig, W., & Papert, S. A. (2011). Programming languages as a conceptual framework for teaching mathematics. *Interactive Learning Environments*, *19*(5), 487–501.

Freire, P. (1970). *Pedagogy of the oppressed*. New York: Bloomsbury.

Gavelek, J. R., & Raphael, T. E. (1996). Changing talk about text: New roles for teachers and students. *Language Arts*, *73*(3), 182-92.

Gilbertson, A., (2014, August 27). The LA school iPad scandal: What you need to know. National Public Radio. Retrieved from http://npr.org

Glaser, R., & Lumsdaine, A. A., (1960). *Teaching machines and programmed learning: a, source book*. Washington, DC: National Education Association.

Hardware, (2006). In *TechTerms.* Retrieved from https://techterms.com/definition/hardware

Harel, I., & Papert, S. (1990). Software design as a learning environment. *Interactive Learning Environments*, *1*(1), 1–32.

Harré, R. (1984). *Personal being: A theory for individual psychology*. Cambridge, MA: Harvard University Press.

Information Communication Technologies*,* (2006). In *TechTerms*. Retrieved from https://techterms.com/definition/ict

Koehler, M., Mishra, P., & Cain, W. (2013). What is technological pedagogical content knowledge (TPACK)? *The Journal of Education*, 193(3), 13-19. *JSTOR*

Kafai, Y. & Burke, Q. (2015). *Connected gaming: What making video games can teach us about learning about literacy*. Cambridge, Massachusetts: MIT Press.

Kellner, D., & Kim, G. (2010). YouTube, critical pedagogy, and media activism. *Review of Education, Pedagogy & Cultural Studies*, *32*(1), 3–36. doi: 10.1080/10714410903482658

King, H. (2016). Microsoft is bringing Minecraft into the classroom. *CNN*. Retrieved from https://money.cnn.com/2016/01/19/technology/microsoft-minecraft-education/index.html

Levin, B. B., & Schrum, L. (2013). Using systems thinking to leverage technology for school improvement: Lessons learned from award-winning secondary schools/districts. *Journal of Research on Technology in Education*, *46*(1), 29–51. doi: 10.1080/15391523.2013.10782612

LMS*,* (2018). In *TechTarget*. Retrieved from https://searchcio.techtarget.com/definition/learning-management-system

McKnight, K., O'Malley, K., Ruzic, R., Horsley, M. K., Franey, J. J., & Bassett, K. (2016). Teaching in a digital age: How educators use technology to improve student learning. *Journal of Research on Technology in Education*, *48*(3), 194–211. doi: 10.1080/15391523.2016.1175856

Micheuz, P. (2009). E-maturity and school development: When the tail wants to wag the dog. In *IFIP World Conference on Computers in Education* (pp. 129-137). Springer, Berlin, Heidelberg.

Mixed Reality, (2019). In *Techopedia*. Retrieved from https://www.techopedia.com/definition/32501/mixed-reality

MOOC, (2019). In *Techopedia*. Retrieved from https://www.techopedia.com/definition/29260/massive-open-online-course-mooc

Murray, J. (2016). *Hamlet on the holodeck*. Cambridge, Massachusetts: The MIT Press.

National Center for Education Statistics (2017). Children's access to and use of the Internet. *The Condition of Education*. https://nces.ed.gov/.

One-to-One, (2013). In *The glossary of education reform*. Retrieved from http://edglossary.org/one-to-one

Papert, S. (1972). Teaching children thinking*. *Programmed Learning and Educational Technology*, *9*(5), 245-255.

Papert, S. (1980). *Mindstorms: Children, computers, and powerful ideas*. New York, New York: Basic Books, Inc.

Papert, S. (1993). *The children's machine: Rethinking school in the age of the computer*. New York, New York: Basic Books Press.

Pedagogy, (2018). In *Dictionary*. Retrieved from https://www.dictionary.com/browse/pedagogy

Piaget, J. (1928). *The children's conception of the world.* London: Routledge and Kegan Paul.

Piaget, J. (1959). *Judgment and reasoning in the child*. Paterson, New Jersey: Littlefield, Adams, & Co.

Pressey, S. L., (1926). A simple apparatus which gives test and scores—and teachers. *School and Society*, *23*.

Programming Language, (2011). In *TechTerms*. Retrieved from https://techterms.com/definition/programming_language

Sandbox, (2018). In *Techopedia*. Retrieved from https://www.techopedia.com/definition/3952/sandbox-gaming

Siemens, G. (2005). Connectivism: A learning theory for the digital age. *International Journal of Instructional Technology and Distance Learning, 2*(1), 3–10. Retrieved from http://www.itdl.org/Journal/Jan_05/article01.htm

Siemens, G. (2006). *Knowing knowledge*. Retrieved from https://archive.org/details/KnowingKnowledge

Skinner, B. F., (1958). Teaching machines. *Science, 128*.

Stager, G., (1988). *Freire and Papert*. [Video file]. Retrieved from https://vimeo.com

Steiner, E. (1988). *Methodology of theory building.* Sydney, Australia: Educology Research Associates.

Theory, (2018). In *Dictionary*. Retrieved from https://www.dictionary.com/browse/theory

Troutner, J. (1991). The historical evolution of educational software. *Tippecanoe School Corporation.*

United States. National Commission on Excellence in Education. (1983). *A nation at risk: the imperative for educational reform: A report to the nation and the Secretary of Education, United States Department of Education*. Washington, D.C.: The Commission: [Supt. of Docs., U.S. G.P.O. distributor].

Virtual Reality, (2006). In *TechTerms*. Retrieved from https://techterms.com/definition/virtualreality

von Glasersfeld, E., (1990). An exposition of constructivism: Why some like it radical. In R. B. Davis, C. A. Maher, & N. Noddings (Eds.), *Monographs of the journal for research in mathematics education, #4*. Reston, VA: National Council of Teachers of Mathematics.

von Glasersfeld, E. (1995). *Radical constructivism: A way of knowing and learning*. London, England: Routledge.

Vygotsky, L. (1978). Interaction between learning and development. *Readings on the development of children*, *23*(3), 34-41.

Vygotsky, L. (1993). *The collected works of L. S. Vygotsky, Vol. 2: Fundamentals of defectology* (R. Reiber and A. Carlton, Eds.). New York: Plenum.

Wann, J. & Mon-Williams, M. (1996). “What does virtual reality NEED?: Human factors issues in the design of three-dimensional computer environments.” *International Journal of Human-Computer Studies*, 44(6): 829-847.

Wenglinsky, H., (2005). *Using technology wisely: The keys to success in schools*. New York: Teachers College Press.

WWW, (2006). In *TechTerms*. Retrieved from https://techterms.com/definition/www

Yoo, C. (2015). Moore's law, Metcalfe's law, and the theory of optimal interoperability. *Faculty Scholarship at Penn Law.* 1651. Retrieved from https://scholarship.law.upenn.edu/faculty_scholarship/1651