
by

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A thesis submitted in conformity with the requirements for the degree of Doctor of Philosophy, Department of Curriculum, Teaching and Learning, Ontario Institute for Studies in Education at the University of Toronto

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Teaching practices supported by networked digital technologies that activate the kind of learning environments advocated by the learning sciences require significant changes in pedagogical practices (Fullan & Langworthy, 2014, Fullan, 2012; Friesen & Lock, 2010; Dede, 2010; Scardamalia, 2010, 2006, 2004; Koehler & Mishra, 2008; Sawyer, 2008). Using technology to support a constructivist approach to K-12 education, this thesis looks at factors that impede and facilitate that stance. Some studies describe the challenge of creating these types of learning environments as related to teachers’ abilities and desires to develop new ways of knowing, which in turn drive the process of change and improvement. Other studies indicate change and improvement is more likely driven by collaborative action among teachers, and it is action that leads to new understandings. This study seeks to determine how such change happen by asking K-12 teachers what influences their tendencies to adopt more constructivist practices in technology-rich environments.

Concepts and assumptions inherent in the popularized term “21st Century Learning” are deconstructed and reconstructed. Employing a qualitative constructivist grounded theory design, the findings indicate that teachers believe the use of technology in classrooms will only be successful when it is effectively used as a tool to support sound pedagogical practices, and the tools used are connected to authentic teaching and learning. The findings demonstrate that an
understanding of how knowledge is constructed accelerates teachers’ transitions to constructivist practices in technology-rich environments. The findings also suggest that shifting teacher practice is most effective when teachers are empowered to collaboratively and collectively shape change and improvement initiatives. A clear sense of how the educational community can support teachers in change and improvement initiatives that engage students in deeper and more authentic learning emerges.

*Key Words:* learning sciences, pedagogy, change and improvement, knowledge-building, technology, learning in the 21st Century, 21st century learning, learning environment
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Introduction

We live in a time of profound change. The world is increasingly interdependent, connected, wired and flat (Friedman, 2007). Our global community has experienced a rapid evolution from a traditional, industrial base dependent on factories and physical labour to a new knowledge economy where critical thinking, creativity, innovation, collaboration and adaptability are taking central stage (Wagner, 2008; Winner, Goldstein & Vincent-Lancrin, 2013; Drucker, 1995; Scardamalia, 2000; Bereiter, 2002, Gardner, 2008; Pink, 2005; Canadian Council of Learning, 2010; Partnership for 21st Century Skills, 2007). As education is recognized as one of the critical drivers of social and economic change (World Economic Forum, 2014; UNESCO, 1997), and improving educational attainment is a priority for every nation, how are education systems being shaped to become more responsive to these new realities?

Whole System Reform: The Local Context, Ontario, Canada

Over the past decade, countries around the world have been part of a global reform movement focused on improving the quality of teaching and learning. Schleicher (2010) confirms that reform models of the past decade implemented in most OECD countries, including in the jurisdiction of Ontario, have been whole-system models. He identifies the most prevalent strategies employed include a combination of equalizing opportunity, diversifying education, developing school leadership and improving school quality.

In the last ten years, the educational community in Ontario has been deeply focused on three priority goals: improving student achievement and well-being, reducing gaps in student
achievement, and increasing public confidence in publicly funded education (Ontario Ministry of Education, 2013). To achieve these goals, a whole-system reform model, called the Ontario Education Strategy, was introduced (Ontario Ministry of Education, 2003). The model ensured that reform was focused on improving student learning, the proposed changes had measurable effects, and that all parts of the system contributed to reform success (Fullan, 2010). Strategies to support reform included providing coherence and consistency to instructional practice in classrooms, and strengthening teacher and leadership capacity through networks of learning. Full day play-based learning programs for Kindergarten-aged children and a wider range of programming options for secondary students were introduced. The protective, supportive factors that make schools safe, accepting and inclusive, and a greater awareness of, and focus on students with mental health issues were brought to the fore of learning.

As part of the Educational Partnership Table, educational stakeholders had opportunities to provide input into large-scale reform decisions as well as the design of the implementation of those decisions so that reform measures could be adapted to local cultural and political contexts. Collective efforts on the implementation of the plan resulted in inspirational improvements in student achievement as measured by international and provincial standards (OECD, 2013, 2009; EQAO, 2013). In terms of benchmarking, the Organization of Economic Cooperation and Development’s (OECD) 2013 and 2009 Program for International Assessment (PISA) results, which measure student’s capacity to apply knowledge and skills in key subject areas (Pellegrino & Hilton, 2013), demonstrated Ontario was in the top third among 65 countries and educational jurisdictions surveyed in the world in reading, mathematics and science test scores. E.Q.A.O. assessment scores in reading, writing, and mathematics for elementary-aged students have been trending upwards, although recently a small decline in the area of mathematics has been
High school graduation rates have risen from 68% in 2004 to 83% in 2013 (Ontario Ministry of Education, 2013). Ontario’s education system has made remarkable gains over the past decade, and has become globally recognized and respected for its excellence.

**Moving Forward to Deepen Learning**

Yet there is still much work to be done to support student success as we move further into the 21st century. Gaps remain in achievement among socio-economic and racial demographics. These gaps are specifically evident with respect to Aboriginal students, and students in care of social services agencies who are underserved in a myriad of ways in comparison to their peers (EQAO, 2013; Canadian Council of Learning, 2010; MetLife Survey, 2013). Adolescent and secondary school student engagement is low (Dunleavy & Milton, 2009; Ferguson, Tilleczek, Boydell, Rummens, Cote & Roth-Edney, 2005). In Canada, the Canadian Education Association conducted a survey of public school students across the country and found the majority of students in senior grades reported to be intellectually unengaged in their learning in the classroom (Dunleavy & Willms, 2011). The OECD 2013 PISA results demonstrate that although Ontario students continue to perform above the average in every category, and Ontario reading and science achievement remained similar to what it was on the 2009 PISA assessment, Ontario students’ math achievement is declining (OECD, 2013). Changes in labour market trends and globalization are leaving a skills-gap for the future that is resulting in significant economic and social consequences. The Conference Board of Canada (2013) estimates “the skill gaps and mismatches are costing Ontario $24.3B annually in foregone GDP and $3.7B in provincial tax revenues” (p. 2). This is especially apparent in sectors such as manufacturing; health care; professional, scientific and technical services; and financial industries which account for 40% of Ontario’s employment (Stuckey & Munro, 2013).
The rationale for transforming learning at the school and classroom level, so that it is more relevant and engaging for 21st century students, has been well documented (Berry, 2011; Christensen, Horn & Johnson, 2008; Sahlberg, 2011). By Grade 9, over 50% of Canadian high school students report questioning the relevance of what they are learning, as well as report being the least engaged in their learning (Dunleavy & Willms, 2011). Advances that postmodern society is experiencing require the cultivation of a different set of skills than those required in the industrial era. Darling-Hammond (2010) confirms that the skills needed for the 21st century global economy cannot be learned in traditional education systems which have been in place since the early 1900s. Robinson (2006) eloquently describes how the existing industrial model suppresses creativity in yet another generation of young people. The digitalized world that students are growing up in today is much different from the world in which their parents and teachers were raised (Dede; 2010; Prensky, 2010). Students are immersed in an exciting multimedia environment where technologies have changed how they interact with information, how they live, work and socialize, how they construct their identities, and how they participate in civil society. Jukes (2006) explains that “Digital Learners’ attention spans aren’t short for games or music, or anything else that actually interests them. They just have short attention spans for old ways of learning” (p. 26).

The growing disengagement of learners from traditional teaching models, methodologies, and practices has been well researched. Although there are inspiring models of educational innovation that have arisen around the world in response to new realities, is the process of teaching and learning changing consistently in all our classrooms? For the most part, schools and classrooms have not successfully realized the large-scale reinvention many other sectors have in the past 50 years, including schools who may have attempted to do so but failed for predictable
reasons (Gardner; 2008; Pink, 2005; Shattuck, 2007, Cuban; 2003, 2008). Most schools are still rooted in a factory model based on structural logic derived from the industrial world designed for conformity and standardization (Sahlberg, 2011). Many students are still being taught within a conventional school model where the classroom is the primary place of learning, the school day is the prime educational time, most tasks are paper and pen or pencil driven, the teacher is the primary source of information, the curriculum is constructed of distinct subject areas, physical spaces represent these traditional disciplines, and there is an expectation students proceed in linear age-appropriate placements for some 15 years (Grose, 2013). If the familiar traditional teaching methodologies and industrial models predominant in most schools today remain as they have for the past century, and classroom teachers and education systems cannot adapt to our postmodern technology-rich globalized environments, there remains a risk student engagement and drop-out rates could be further compromised. This will not be because students can’t learn, but because they don’t want to learn within existing traditional school structures that place them as passive receivers of knowledge in a world where they have agency as active consumers of their own learning.

Transforming teaching and learning in the classroom requires that students’ needs are addressed and students are prepared for the kinds of learning and work of postmodern society. Ontario’s realities demand an evolved education plan. The plan must build upon the past decade’s success by strategically balancing what are already understood as best practices for continuous improvement, with new practices focused on learning theory and innovation so that what and how students are learning is engaging, relevant, forward-focused and measurable, and so that curriculum, instruction, assessment, and learning environments are modernized.
Is “21st Century Learning” the Answer to Transforming Teaching and Learning?

Over the past number of years, the term “21st Century Learning” has become synonymous with educational change and promising pedagogical transformation. What exactly is this buzzword “21st Century Learning” that has become so intricately interwoven into the discourse of today’s educational circles? A Google search of the term “21st Century Learning” results in over 35 million hits. Articles, social media sites, books, scholarly journals, research reports and blogs written by practitioners, students, academics, think tanks, parents, industry, and knowledge intermediaries spur robust debate. Proponents of “21st Century Learning” see necessary shifts in knowledge required for living, learning, and future success. Some see the rationale for the shift as too heavily weighted on economic advancement. Others suggest there should be more focus on content, and cultural, civic and environmental sustainability. Critics see the paradigm as a rebranding of old ideas.

In exploring the concepts and assumptions inherent in this culturally popularized term, the definitions; the origins and rationales of the beliefs; the interpretations of the drivers for change; and the types of singular and multi-faceted strategies suggested to support teachers in their efforts to transform learning, appear to be as diverse and varied as the literature itself.

Kereluik, Mishra, Fahnoe and Terry (2013) lament:

“It is unclear what precisely phrases such as 21st century knowledge, 21st century skills, and 21st century learning mean. In some sense, “21st century learning” becomes an empty signifier (Barthes, 1977), a term that we all think we understand yet are hard pressed to clearly define” (p. 127).

Chapter 2 of this thesis provides an in-depth review of the academic literature regarding the constructs within the culturally popularized concept “21st Century Learning.” A brief
overview of the nature of “21st Century Learning,” including frameworks and strategies captured in the literature suggested to advance learning, helps to set the context for the rationale for this study.

**Frameworks for 21st Century Learning:** Globalization, skills deemed essential for 21st century success, declining student engagement, and networked digital technologies have inspired the development of a number of frameworks and approaches to assist in transforming teaching and learning. These include, but are not limited to: Organization of Economic Cooperation and Development (2005); International Society for Technology in Education (2007); Canadian Council of Learning (2010); Assessment and Teaching of 21st Century Skills (2012); Educational Testing Services (2007); Metiri Group (2003); Partnership for 21st Century Skills (2007); American Association of Colleges and Universities (2007); Recommendation of the European Parliament and of the Council of the European Union on Key Competencies for Lifelong Learning (2006); Centre for Public Education (Jerald, 2009); Zhao (2009); Gardner (2008); and Pink (2005). Analyzed by many, the frameworks and approaches to change are generally alike (Pellegrino & Hilton, 2013; Kereluik, Mishra, Fahnoe & Terry, 2013; Mishra & Kereluik, 2011; Last, 2012; Dede: 2010). They include common calls for changes to the curriculum, or what is taught; changes to the pedagogy of teaching, or how teaching is acted upon; changes to the structure of schooling; changes to the governance of schools; and an increased role of technology in teaching and learning. The framework’s conceptualizations help to identify new ways of learning in the 21st Century. Yet academic literature suggests there are limitations. Scardamalia and Bereiter (2006), prominent researchers in the learning sciences, remind us that the act of acquiring knowledge and skills is not a separate process, but rather, deeply interdependent. Dede
(2010) cautions us to think critically about the core 21st century skills in these proposed frameworks:

“We cannot reasonably predict the capabilities people will routinely use in 2095 any more than a comparable group of scholars in 1907 could accurately forecast the competencies central to the workplace, citizenship and self-actualization in 1995. What we are really attempting to discuss is the core capabilities people will need in the first part of the 21st century-say fifteen to thirty years hence-to qualify for an attractive, prosperous job and lifestyle” (p. 3).

Pellegrino and Hilton (2013) stress that to support educational transformation, further research is needed to clearly define 21st century competencies, to design reliable assessments of those defined competencies and to establish a causal relationship between 21st century competencies and student and adult outcomes.

As the concept of “21st Century Learning” is so loosely and widely defined, for the purpose of this study, a working definition is required. I define “21st Century Learning” as a student-centred approach to deepening learning, enabled by technological tools, that results in healthy, active citizenship in global society. This approach to learning varies significantly from traditional models of instruction. It requires a balance between effective evidence-based practices already widely understood as drivers to improve student achievement, and new learner-centric pedagogies, structures and practices supported by technology that deepen learning, increase engagement and make learning relevant and authentic. Teaching practices supported by networked digital technologies that activate the kind of learning environments advocated by the learning sciences require significant changes in pedagogical practices (Fullan & Langworthy, 2014; Fullan, 2012; Friesen & Lock, 2010; Dede, 2010; Sawyer, 2008; Scardamalia & Bereiter, 2010, 2006, 2004; Koehler & Mishra, 2008). However, the use of technology in classrooms will
only be successful when it is effectively used as a tool to support sound pedagogical practices and the tools used are connected to authentic teaching and learning. This study looks at the factors that impede and facilitate that stance.

**Strategies for Deeper Learning:** 21\textsuperscript{st} Century Learning strategies endeavor to deepen learning. Suggestions in academic literature regarding how teaching may be transformed so that emergent, context-sensitive, learner-centric environments where students take agency for and better understand the process of their learning are varied. Commenting on Bereiter’s (2002) analysis of Popper’s three worlds, Hattie (2009) suggests “there needs to be a major shift, therefore, from an over reliance on surface information (the first world) and a misplaced assumption that the goal of education is deep understanding or development of thinking skills (the second world), towards a balance of surface and deep learning leading to students more successfully constructing defensible theories of knowing and reality (the third world)” (p. 28). Scardamalia and Bereiter (2010, 2006, 2003) argue that rather than the small tasks and activities common in most classrooms today, students need to co-construct, create and pursue significant understandings of foundational disciplined based concepts, and then improve those ideas in face-to-face and online knowledge-building communities where they not only increase their own personal knowledge, but advance the community’s collective cognitive growth. Zhao (2009) contends “what is needed is more local autonomy, more flexibility, more choice, less testing, less content, and less standardization” (p. 60). Fullan (2012) states that progress regarding transforming learning is not being realized because “pedagogy, or the fostering of actual teaching, is neglected” (p. 36) and that a wide-scale adoption of a more learner-centric model supported by technology and resulting in new roles for learners may be the key.
Strategies for Reform: Four common strategies in academic literature arise to assist in the spread and scale of a culture of learning so that educational practices and outcomes for every child can be improved, and so that there is enhanced student voice and shared power for learning. First, transforming educational practices requires a significant shift in pedagogy that results in a focus on learning (Dede, 2010; Fullan, 2012). Second, transformational principles reflect a constructivist epistemology that can be used as the frame for designing for learning (Laurillard, 2012; Small, 2009; Fosnot, 2005) in K-12 schools (Jonassen, 1999; Boettcher, 2007; Quinton, 2010). Third, technology plays a role in supporting an interdisciplinary approach to instruction, assessment and knowledge building, and an engaging learning environment. (Puentedura, 2009; Mishra & Koehler, 2006; Benton-Borghi, 2013; Porras-Hernandez & Salinas-Amescua; 2013; Prensky, 2010; Shattuck; 2007). Lastly, to realize authentic transformation requires a shift in decision making regarding school improvement and innovation from centralized, or system-level controls, to the school level, where school communities and teachers become the locus for educational transformation (Hargreaves & Shirley, 2009). Described as the fourth way, they argue “Fourth Way learning is learning for life” (p 85). Hargreaves (2013) proposes the evidence-based strategies identified by Scheicher (2010) that have been part of whole-system reform models in the past decade, can be infused with the “4 I’s” he identifies as improvement, inspiration, innovation, and inclusion, to drive large-scale educational change required for new education systems reflective of the 21st century.

Teacher Voice in Transforming Learning: Less common in the literature are the perspectives of teachers regarding their experiences transforming learning in technology-rich environments. How might teachers suggest continuing to improve student outcomes assessed by traditional measures while challenging traditional pedagogy so teaching methodologies are more
responsive to the needs of 21st century learners, and learning itself ultimately becomes more authentic, engaging, and complex (City, Elmore, Fairman & Teitel, 2009)? What do teachers believe must be addressed to optimize new forms of learning and educational structures, with the goal to modernize education? Last (2012) confirms there are gaps in academic articles regarding how to transform learning. He indicates that research is needed to illustrate “seeing the teacher standpoint; scaffolding the learning; and how and when to teach the technology” (p. 3376).

**How Do We Move Forward?:** Society today is at a point where critical decisions must be made to better serve students. Over the past decade, the educational community in Ontario has focused on strategies that deepen student learning. Yet shifting teacher pedagogy is no easy task. Constructivist principles and practices often face intense political opposition. Technology is constantly changing. There is no body of evidence that proves individual schools make better decisions than centralized systems in this, or in any other area. If changes to teaching practices and educational structures are to be meaningful and sustained, and if transformation is to be realized at scale, three key issues must be addressed. Research focused on teacher’s perspectives and experiences transforming learning in technology-rich environments must be undertaken to strengthen the alignment between those determining the parameters of reform models, and teachers responsible for implementing reform strategies and tactics in classrooms and schools. Empirical evidence to determine the specific strategies most effective in improving outcomes for students in the 21st century must be amassed. Lastly, as Dede (2010) reminds us, there is a significant need for metrics to evaluate proposed reforms.

**The Purpose of the Study**
This study seeks to add to academic literature by illuminating teacher’s perspectives regarding the nature of transforming learning. Three research questions are the foundation for the study.

- What factors influence teachers’ tendencies to adopt more constructivist practices in technology rich environments?
- What factors impede using technology to support a constructivist approach to teaching?
- What factors facilitate that stance?

As critical decisions must be made to improve student outcomes in today’s networked knowledge-building communities so that all students are better served, teacher knowledge is imperative to determine how to approach change and improvement.

The roots of this study are grounded in my personal and professional experiences working in the education sector for 24 years. Although supported through policy implementation, from my experiences serving as a classroom teacher, school-based and system leader, I believe the locus of change lies within our teachers. I have been consistently inspired by the desire of teachers to learn from research and data. I have been constantly impressed by the dedication of teachers as they optimistically embrace disciplined processes that lead to adapting practices that result in improvement. These types of authentic changes occur most successfully when teachers are empowered as an integral part of the change process, when they propose changes and understand the rationale for changes being proposed, when they are motivated to change, and when the necessary conditions to support change are in place.

I recognize that it is not enough to just plan and implement change alongside teachers. Many of the best changes in teaching occur as a result of listening to the hopes, desires and needs of students. In my years as a classroom teacher, I can fondly recall many times I was deeply
humbled by the creative ideas and the brilliance of the students I served. Ensuring students are partners in learning and change processes results in authentic learning and change. Securing accountability requires monitoring practices, processes and providing targeted feedback to impact practice (Freedman & Di Cecco, 2013; Freedman, 2007). I am grateful to my colleagues in educational leadership for generously sharing their insights and expertise regarding how to support conditions for effective teaching and learning in the 21st century, and how to integrate heightened accountability expectations with critical attributes such as motivation, passion, curiosity, and humanity as part of an engaging, forward-thinking, evidence-based improvement strategy.

It is urgent planned change brings about the desired improvements in student achievement, well-being and engagement in learning the educational community strives to achieve. Hattie (2011, 2009) suggests that differences among and between classrooms in one school are greater than differences among and between schools. Lack of coherence in practice impacts student achievement, especially for students facing social and economic barriers to learning. To decrease the variability that exists, educators are responsible for increasing the effectiveness of all classrooms. To do so, educators must be driven by a clear sense of how we can make a measurable impact on learning outcomes.

What are the factors that accelerate teachers’ tendencies to adopt student-centred learning practices in technology-rich environments? The Wallace Foundation’s research (Leithwood, Louis, Wahlstrom, Anderson, Mascall & Michlin, 2009) confirms that teachers, followed by school-based leaders, are the most important school-based factor in impacting student achievement. Teachers play the critical role in implementing new approaches to learning. It is they who determine how to shift their pedagogical stance; what strategies to use to personalize
instruction and assessment; how to motivate students in new ways; and how to integrate technology into the learning process. Teachers do so all while collecting evidence to assess whether they, and the new practices they are implementing, have an impact on improving student learning. As such, the development of renewed large-scale education plans that result in authentic cultures of learning relies heavily on teacher’s capacity, perspective, motivation, and commitment as transformative leaders and agents of change. Fullan (2011) emphasizes the critical role teacher’s play as partners in whole-system reform when he discusses the right drivers that need to be in place to realize change.

Considering the reported shortfall of studies addressing practitioners’ standpoints regarding transforming learning in the 21st century, a research process was undertaken to determine what factors influence teachers as they transition from familiar traditional teaching methodologies to more constructivist approaches in technology-rich environments. For the purposes of this study, technology-rich environments are defined as those where connectivity is available to expand learning beyond the four walls of the classroom, and technological tools are available so that students are able to demonstrate their knowledge, anytime and anywhere, through any preferred learning modality. The study began with a comprehensive review of the literature in the field regarding the concepts inherent in the term 21st Century Learning and the role of technology in learning. Empirical data regarding teachers’ experience as they transform teaching methodologies in technology-rich environments were then collected and analyzed to support a theory building process. The study concludes with the construction of a theory that identifies the factors that influence change to teacher practice. The findings of the study contribute to the pedagogical and policy discourse illuminating transforming teaching and learning in the 21st century. To improve student outcomes and educational practices, nine
suggestions that may assist teachers, schools and systems in their change and improvement efforts are advanced.

There has been much academic literature written about rational theories of learning that acknowledges rethinking prior knowledge results in making new choices and acting on new understandings (Mezirow, 1991, 1995, 2000). Those earlier understandings have now been overturned, and newer more promising theories of learning have emerged. These new theories of learning reveal that transformational change is not a mere surface-level adoption of new approaches to teaching and learning, but a deeply cognitive process that reflects a habit of mind and results in the development of new ways of knowing (Connelly & Clandinin, 2006, 2000, 1995, 1994). This more authentic understanding of transformation requires the fusing together of multiple ways of knowing derived from personal professional experiences to synthesize new knowledge, which in turn drives the process of change.

The nature of teacher knowledge, referred to as personal professional knowledge, is critical to the process of transformational change as teacher’s perspectives, expressed in their own terms, represent the reality of their experiences. Chan (2012) states that according to Connelly and Clandinin (1995), “teacher knowledge is related to teachers’ personal history and expressed in teachers’ present classroom practices and future actions” (p. 117). To support the meaning making process, Clandinin and Connelly suggest narrative, or reflective journaling, as a key tool to create space for critical thinking that leads to the construction of knowledge. Phillion (2005) supports this assertion by stating “a narrative approach to teacher education is based on the idea that we make meaning through reflection. Reflection leads to understanding, which leads to action, in the case of teachers, reflection and understanding can be transformed into renewed and revitalized practice” (p. 6). This study supports the idea of transformational change
as a highly cognitive process driven by teacher personal professional knowledge (Clandinin and Connelly, 2006, 2000, 1995, 1994; Phillion, 2005). However, the findings of the study indicate transformational change is more likely driven by collaborative action among teachers, and it is that action that leads to new understandings.

Pedagogues such as Dewey, Piaget, Vgotsky, Papert, Freyney, Freire, Bereiter and Scardemalia provide valuable insights into how learning occurs through physical, emotional, and cognitive experiences and how tools and technologies may support knowledge development. Their perspectives and theories have profoundly influenced the theory of learning called constructivism. Constructivism is a set of psychological theories that share common assumptions about the nature of learning and the construction of knowledge. These theories, an epistemological alternative to objectivist theories, suggest that meaning is actively constructed in the mind through social interaction with the world, and that learning is informed by experience and the contexts of that experience. Making sense of that meaning occurs by adjusting and creating internal knowledge structures to accommodate understandings of reality.

There are multiple interpretations, multiple perspectives and multiple varieties of constructivism. Constructivism, social constructivism, constructionism, and knowledge building are all theories that posit knowledge is actively constructed by learners in interaction with their world. Yet these theories are often used interchangeably in varied discipline contexts to mean the same thing, thereby leading to some degree of confusion. Constructivism, the genetic epistemology of Jean Piaget (1952, 1957, 1962) suggests that learning is actively constructed in the mind of the individual through linking pre-existing knowledge to existing mental schemas. Social constructivism, the epistemology of Lev Vygotsky (1934, 1978), suggests that meaning is not solely constructed by innate factors but that knowledge is socially mediated through
communication, language, and interaction with others. Constructionism, the epistemology of Papert (1980, 1993) supports the constructivist viewpoint that the learner is an active builder of knowledge. However, constructionism emphasizes the construction of external artifacts shared by learners and more specifically, the ways in which computer technology supports those mental constructions (Orey, 2010). Knowledge building, the epistemology of Scardamalia and Bereiter (2006, 2003, 2002), suggests that the process of creating cognitive artifacts occurs as a result of the synthesis of ideas through group discussion. Sometimes referred to as deep constructivism, new ideas are generated to advance an understanding of what is known about a specific topic.

As the latter part of this study’s design is a collective inquiry in which participants collaboratively constructed a theory that resulted in a more complex understanding of what influences teacher transformation, the latter part of the design can be viewed through the lens of deep constructivism, or knowledge building. However, as the full intent of the study is to determine what influences teachers in their transition to adopt more constructivist practices, and this involved continually socially mediating knowledge through interaction with both self and others, this study is actually based on the perspective of social constructivism.
Chapter Two: Literature Review

General Myths Regarding “21st Century Learning”

With so much being written about 21st Century Learning, it is challenging for teachers to discern between academic literature, opinion and rhetorical articles, new instructional strategies touted by colleagues, relabeled teaching approaches, and seductive practices popularized by mainstream social media. To deconstruct the concept of 21st Century Learning as it is reflected in the current academic literature, the next part of the paper frames this review by exploring 10 of the concept’s general myths.

Myth #1: Society has a shared understanding of the purpose of formal education and the outcomes hoped to be achieved through 21st century learning.

Ongoing discussion focused on the 21st century learning agenda will no doubt flame the well-documented debate that has raged on for centuries regarding the purpose of education. Why do we educate? Progressives like Sergiovanni (1996) argued the purpose of education is to ensure every individual becomes an active, civil participant in a caring and democratic society. This perspective is supported by learning theorists such as Dewey (1916), and popularized by mainstream authors such as Robinson (2006), Schwahn and McGarvey (2012). The Organization of Economic Cooperation and Development (OECD) and educational researchers such as City, Elmore, Fiarman, and Teitel (2009), and Marzano, Waters and McNulty (2005), position the purpose of education to ensure every graduate reaches high standards that enable individual prosperity and sustain a nation’s economic viability and well-being within the global community. This perspective is popularized by mainstream authors such as Zhao (2009) and Wagner (2008). There are many other viewpoints grounded in firm ontological belief that fall in between because of different understandings of the nature of reality due to the variance in the
social, cultural and political contexts of people’s lived experiences. As such, dialogue continues unproductively to remain focused on what is taught and how it is taught--identified as the “educational means” (Stack, Grosjean, Mazawi & Smith, 2006), rather than starting from a wider shared societal understanding of the purpose of education--identified as the “educational ends” (Stack et al., 2006).

The outcomes, or “educational ends,” society hopes to achieve through 21st century learning are also widely varied. Objectivists argue that in a system where success is measured by standardized tests which drive teaching and support standards-based centralization and uniformity, transforming learning and education systems could put the climate of order, efficiency, academic rigor, and accountability at risk. This could result in reducing high standards and excellence as assessed by large-scale assessment measures. Some of these concerns arise as a result of the desire to retain what one believes a good education to be in order to civilize the young, based on valued knowledge and cultural traditions. Critical theorists that argue these concerns are rooted in a desire to maintain existing power structures and dominant cultural norms within education and society. From a critical pedagogical lens, described by Giroux (2008) as “attempts to understand how power works through the production, distribution and consumption of knowledge within particular institutional contexts” (Vander Valk, 2008, p. 206), the desired outcome of transforming learning and educational systems is to achieve equity for students and families marginalized from the mainstream, dominant society. This can be achieved by eliminating explicit and implicit power structures within schools that impact students (Kincheloe, 2008). Critical theorists ultimately want to ensure transforming learning results in teaching becoming an act of social justice. The “de-schooling” theory, an alternative theory popularized by Illich (1971), questions the importance of physical locations of schools as central
to learning, socialization and the delivery of educational services. A heightened focus on personalized learning, technological innovation, and an alternative approach to leveraging community resources to support learning all come into play within Illich’s transformational theory. De-schooling theorists anticipate 21st century learning may result in more innovative and organic models of learning.

**Myth #2: Technology alone will transform 21st century learning.**

There is no denying that the recent explosion of technological innovation has dramatically changed the way people live, work, and learn. Technology has, and continues to disrupt age-old ways of doing things, and has rendered some previous skills and organizational models irrelevant (Manyika, Chui, Bughin, Dobbs, Bisson & Marrs, 2013). There are a growing number of reports identifying technology as the driver for the transformation of 21st century learning. Many of these reports shared with educators to demonstrate how technology has transformed learning and improved student outcomes are beautifully presented and often financially supported by high-tech companies. Hattie (2011) cautions that almost anything increases student achievement, however, the issue is identifying what is most effective. As most of these reports do not provide the longitudinal, or experimental, rigor needed to be valid and reliable, and do not generally demonstrate any causal relationship between the use of technology and its impact on transforming learning or student outcomes, these types of reports must be regarded with great caution (E.Q.A.O., 2009).

Can technology alone really transform 21st century learning? Global initiatives like the One Laptop Per Child (OLPC), inspired by MIT Media Lab founder Nicholas Negroponte, were started with the belief technology would transform learning and improve student outcomes. The OLPC program recently implemented in Peru, with the hope of fighting poverty by improving
student learning, provided 800,000 students in public schools with laptops costing the government $200 million dollars. However, when this initiative was recently assessed over a 15 month period, it was determined a failure (Santiago, 2010; Severin & Capata, 2011). The program’s lack of professional learning for teachers, the limitation of required infrastructure, and the inability to leverage partnerships with the community to support the program were cited as the primary reasons. Although the reports indicated access to computers increased students’ abstract reasoning, verbal fluency, and information processing skills by approximately six months, the study found no increase in math or language skills, no improvement in classroom instruction, no improvement in reading habits, and no ability to redesign the existing schooling model from a teacher centric structure to a learner centric model. Reports concluded there was little solid evidence regarding the effectiveness of the program (Haikin, 2012).

Locally developed initiatives such as The Khan Academy, which provides over 5,000 free online lessons for K-12 students, and the growing use of Massive Open Online Courses (MOOCs), which allow large numbers of learners to take higher education courses on mobile devices, are often regarded by educators and industry as models for how technology can transform learning. Yet are these models transformative?

Upon closer examination, one may more rightfully conclude that what The Khan Academy really provides is greater accessibility to traditional teaching in a digital medium. An in-depth analysis of MOOCs uncovers cautionary findings. Offered by large providers such as Coursera, Udacity, edX, FutureLearn, and the People’s University to a market of learners who want to learn but are not seeking credit, MOOCs propose to transmit high quality content while removing barriers for many people who in the past were prohibited from pursuing higher education or interest-based learning due to the cost and location of traditional educational
institutions. While MOOCs have been championed as a transformative learning model that can overcome barriers of geography, race, gender, class, and income that traditionally disadvantage some learners, the evidence does not support the claim. In a recent survey of more than 34,000 MOOC users in more than 200 countries on the online education service Coursera, Ezekiel (2013) found that most students taking courses on MOOCs were not only already well-educated, but were predominantly young males seeking to advance their careers. Through technology, and specifically mobile technology, these “just in time” learning models have accelerated access to learning primarily for English speaking learners. They have also inspired encouraging dialogue regarding the viability and scalability of online learning. Yet in these cases, one can conclude that technology serves to access for some learners, but not necessarily to transform.

Quinton (2010) states “Unless technology is intentionally incorporated with reformed educational practices that acknowledge the primacy of the learner rather than the centrality of the lecturer/teacher, then its use will be limited” (p. 343). New York’s School of One and Arizona’s Carpe Diem School system, which use technology to support online and blended learning, are educational models that demonstrate Quinton’s assertion. The predominant reason for these schools’ success is that technology was used within an already transformed educational model where pedagogy has driven the effective use of technology. Fullan and Donnelly (2013) confirm these redesigned educational models are good examples of how transforming learning may work well.

Cuban (2008) reports technology has not yet made any fundamental difference to how schools work, nor has technology made a noticeable difference on what or how much students learn. What is absolutely clear in the academic research is that it is effective teaching and instruction that directly affects student achievement and that the quality of a school system rests
on the quality of its teachers (Mourshed, Chijioke & Barber, 2010). This is reaffirmed by Hattie (2011) who rank-orders the factors that have the greatest effect size in improving learning and reveals that it is teachers and teacher practice that makes the value-added difference. Therefore, it is critical that educators resist the temptation to view technology as the primary driver for forward thinking solutions in education. Technology is not a panacea for transforming 21st century learning. Networked digital technologies are important to learning in the 21st century, but do not alone ensure the type of learning supported by research in the learning sciences. This understanding is affirmed by Dillon, Wang and Tearle’s (2007) who assert “As technology is used increasingly to ‘deliver’ education, it is important to keep in focus human needs and not let technology drive the process” (p. 157).

**Myth #3: The digital divide in society is closing.**

One reason schools are continuing to adopt a wide range of technology is to bridge the digital divide related to access to technology (Van Dijk & Hacker, 2000). Large racial and socioeconomic differences in access to hardware and connectivity continued through the first decade of the new millennium (PEW, 2008, 2009, 2010). Yet times are changing. The Economist (2011) revealed there were more than 5 billion people worldwide with mobile phone subscriptions. McKinsey and Company (2013) suggests there will be an additional estimated 2-5 billion people gaining access to the Internet by 2025. A PEW Research Center survey (Madden, Lenhart, Duggan, Cortesi & Gasser, 2013) found 78% of youth in the United States now have a cell phone, 47% have a smartphone, 23% have a tablet computer, 95% use the Internet, and 93% have a computer or have access to a computer at home. Project Tomorrow’s 2012 Speak Up Survey, which gives more than 364,240 American K-12 students voice in technological issues, reported percentages of youth access to technology are even higher.
Teachers today “are working with students whose entire lives have been immersed in 21st century media culture” (schools.spsd.sk.ca). Many are digital learners at ease and expectant of real time feedback available through smart phones, tablets, laptops, and gaming devices. Many spend hours a day on a variety of devices simultaneously gaming, listening to music, and surfing the Web. Lewin (2010) reports that in the United States 8 to 18 year olds spend more than seven and a half hours a day on their devices, compared with less than six and a half hours five years ago (2005) when the same study was last conducted. This research does not factor in the time spent texting or on cell phones. With this included, average use would increase by approximately half an hour per day.

Critics suggest these types of wide-sweeping claims are unsubstantiated by empirical evidence (Sanchez, Salinas, Contreras & Meyer, 2012; Li & Ranieri, 2010). Although most students today come to school with great interest in technology, and understand how to use many of these tools, does this mean they are actually media literate? Can students transition from using their everyday tools for gaming and communication to successfully function in a collaborative online environment where they research, analyze, synthesize, critique, and construct new knowledge? Research indicates students are not necessarily able to effectively use digital tools in learning (Li & Ranieri, 2010; de Castell, Boschman & Jenson, 2009; Kennedy, Judd, Churchward & Gray, 2008). Research also indicates the traditional digital divide, based on access, has shifted to a divide based on the ability and skills needed to use technology efficiently and effectively (ETS 2007). Kozma (2010) reports this new digital divide is actually growing. Student views support this new understanding of the current digital divide. Project Tomorrow’s 2012 Speak Up survey reported that while ten years ago students indicated the obstacle to technology use at school was mainly a result of access to school-provided technology that was
too slow, too old or unavailable, today the obstacle to technology use at school is as a result of lack of permission to use personal devices and social media accounts, restrictive school filters, and firewalls and teachers who consciously limit technology use in the classroom.

Information literacy and technological skills have been identified as important to learning in the 21st century (Pellegrino & Hilton, 2013; Manyika et al., 2013; Mishra & Kereluik, 2011). Ongoing issues with sexting and inappropriate posts indicate there is much work to be done in assisting students to better understand the responsibilities of digital citizenship. According to Laurillard (2012), the role of the teacher is not “simply mediating the knowledge already articulated, but is more deeply involved in scaffolding the way students think and how they develop the new kinds of skills they will need for the digital literacies” (p. 4).

**Myth #4: 21st Century skills, sometimes referred to as the “4 C’s,” are new to learning.**

Critical thinking and problem-solving, collaboration, communication, and creativity, widely known as the 4 Cs, are the higher-order thinking, cognitive and social skills deemed prerequisite for success in our ever-changing global environment (Organization of Economic Cooperation and Development, 2005; International Society for Technology in Education, 2007; Gardner, 2008; Pink, 2005; Canadian Council of Learning, 2010; Partnership for 21st Century Skills, 2007; Metiri Group, 2003; Centre for Public Education, Jerald, 2009; Assessment of Teaching of 21st Century Skills, 2012; Educational Testing Services, 2007; American Association of Colleges and Universities, 2007; Recommendation of the European Parliament and of the Council of the European Union on Key Competencies for Lifelong Learning, 2006; Zhao, 2009; Winner, Goldstein & Vincent-Lancrin, 2013). The 4 C’s encourage 21st century learners to think in new ways, to ponder “what if” and “why” questions and to take the time to find deep answers to those questions that make them curious (Robinson, 2006). Yet although essential to
citizenship, and academic and social success in the 21st century, the 4 C skills are not new to learning!

Syntheses of the differing frameworks and diverse approaches offered in the literature regarding 21st century skills identify 3 broad categories of knowledge required to succeed in the 21st Century (Kereluik, Mishra, Fahnoe & Terry, 2013; Mishra & Kereluik, 2011). Mishra and Kereluik (2011) identify the three categories as: foundational knowledge, which includes core content knowledge, information literacy and cross-disciplinary knowledge/synthesis; metaknowledge, which includes problem-solving and critical thinking, communication/collaboration and creativity and innovation; and humanistic knowledge, which includes life/job skills, cultural competence and ethical/emotional awareness. Mishra and Kereluik (2011) argue:

“Cognitive skills such as critical thinking, problem-solving, job and life-skills, and synthesis have a long empirical history closely connected to academic achievement. These skills rather than being novel to the 21st century and necessary for success in the 21st century are skills that are required for successful learning and achievement at any time, including but not limited to the 21st century” (p. 12).

Of the key common skills cited, Mishra and Kereluik (2011) identify only two as new and “uniquely pressing to the 21st century” (p. 12). The first is the information literacy that is “needed at all levels of interaction with digital media” (p. 13). The second is the cultural competence and the awareness required to work and learn collaboratively, respectfully and productively within diverse groups of people.

Pellegrino & Hilton (2013) also confirm most proposed 21st Century Skills are not new to learning. Their research “views the various sets of terms associated with 21st century learning skills label as reflecting important dimensions of human competence that have been valuable for
many centuries, rather than skills that are suddenly, new, unique and valuable today” (p. 2).
Pellegrino and Hilton (2013) caution there is limited available empirical evidence linking 21st
century competencies to desirable adult outcomes, and that further research is needed to
organize, align and define the constructs. They identify three broad domains of competence
within the various terms for 21st century skills: the cognitive domain, which includes cognitive
processes and strategies, knowledge and creativity; the interpersonal domain, which includes
teamwork and collaboration, and leadership; and the intrapersonal domain, which includes
intellectual openness, work ethic and conscientiousness, and positive core self-evaluation. Their
findings indicate the difference with respect to these skills today is twofold. First, unlike
individual success in education and the workplace of the past, society today may see mastery
across multiple skills and knowledge as essential for all students. Second, due to digital
technologies and the speed at which communication and information exchange has now been
accelerated, new competencies to process multiple forms of information across multiple formats
and contexts are required. Manyika, Chui, Bughin, Dobbs, Bisson and Marrs (2013) confirm
Mishra and Kereluik (2011) and Pellegrino and Hilton’s (2013) findings regarding the need for
new 21st century information literacy skills by asserting “It is not surprising that new
technologies make certain forms of human labour unnecessary or economically competitive and
create demand for new skills. The extent to which today’s emerging technologies could affect the
nature of work is striking” (p. 4).

How might these findings impact transforming learning for today’s K-12 students?
Although a wide array of media existed prior to the 21st century, what is new to learning today is
the ability to be connected anytime, anywhere. Mishra and Kereluik (2011) agree “The
informational impact of the Internet and digital media is unprecedented” (p. 13). Today’s
technology has expanded the potential for learning in both time and space. With collaborative technologies that support distributed learning now common place, it is information literacy, which includes digital collaboration, and the process of collective knowledge-building using digital media, that has significantly changed what is seen as fundamental knowledge.

The development of the age-old 4 C skills can be supported in today’s technology-rich context through a wide array of modalities that result in a more dynamic and fluid participatory learning culture. While students develop the 4 C skills, and their own new 4 C learning roles as critical thinkers and problem solvers, collaborators, communicators and creators, they may hold more than one role simultaneously depending on where they are in the continuous learning cycle. By being connected beyond the classroom and into the global community, students benefit from opportunities to acquire and develop their own expertise and take on the role of facilitator and guide when they lead and share that expertise (Scardamalia & Bereiter, 2003; Beck & Kosnik, 2006). This student-centric environment encourages students to reflect upon their learning and set their own goals to move forward in their individual learning journey. This understanding is supported by recent thinkers such as Jonassen (1999), and Scardamalia and Bereiter (2010, 2006, 2003) and is described by Beck and Kosnik (2006), as Principle 2 and 3 in their proposed implications for teaching. Technological advances also afford a more dynamic interaction among peoples and countries around the world. This global interaction requires teachers to cultivate emotional awareness, cultural competence, and the leadership skills to support meaningful interactions and relationships with others as students learn, play and explore the world of work (Kereluik, Mishra, Fahnoe & Terry, 2013).
Myth #5: Students today, chained to industrial models of education and exposed to traditional teaching methodologies in classrooms devoid of technology, are learning nothing of relevance to their future.

Although this type of environment is not representative of an optimal learning environment reflective of the attributes of learning in the 21st century, students have been taught using traditional methodologies, in traditional schooling structures, and in environments devoid of technology as it is known today for many, many centuries. Interpersonal connections have always been central to good schooling. A wide variety of program offerings have been available to serve the varied curricular and co-curricular interests of students. Most children have grown to become productive and well-adjusted citizens, and to achieve personal and professional success.

Education is at a juncture where important decisions must be made to better serve students in the 21st century. While pedagogies framed upon constructivist learning theories are gaining appeal, and technology can be used to support a constructivist approach to education, quantitative research demonstrates that they are not as efficient or effective as the more traditional directed approaches (Hattie, 2009). This is particularly evident when comparing traditional teaching methods and traditional measures of learning with new teaching methods and traditional measures of learning.

Myth #6: Constructivist teaching practices are the only teaching methodologies applicable to 21st century learning.

Although the underlying premise of 21st century learning is framed around constructivist teaching practices supported in technology-rich environments, it is imperative to explicitly state constructivist practices are not the only methodology applicable to learning in the 21st century. There is great value to applying a wide range of methods to pedagogy and instructional practice.
Vrasidas (2000) argues “different approaches to instructional design and curriculum development should be seen as a set of tools from which educators can choose the most appropriate for a given purpose” (p. 13) and supports the notion that “different situations require different practices” (p. 13). Ultimately, the understanding that knowledge is constructed establishes a framework for constructivist teaching and therefore an additional set of teaching methodologies than the objectivist ones most pervasive in schooling structures today.

**Myth #7: Constructivism supports a pedagogy that has no structure, where knowledge and skills are not taught and students run amok within a chaotic, free-for-all learning environment.**

This myth is common and far reaching. In discussing constructivist approaches in mathematics, Battista (1999) bemoans:

"Unfortunately, most educators (including many teachers, educational administrators, and professors of education) and almost all non-educators (including mathematicians, scientists and writers for the popular press) have no substantive understanding of the research-based constructivist theory that I have alluded to above. Many of them conceive of constructivism as a pedagogical stance that entails a type of non-rigorous, intellectual anarchy that lets students pursue whatever interests them and invent and use any mathematical methods they wish, whether these methods are correct or not" (p. 429).

**Understanding Constructivism:** What may be at the root of this myth is what is central to a deep understanding of constructivist epistemology. Constructivism, a theory of learning rooted in the work of Dewey (1916) and Vygotsky (1934), suggests learning is a socially mediated, context-dependent, and culturally constructed process. Learners actively construct knowledge in developmentally appropriate ways by using existing or past knowledge, and by
interacting with, and interpreting their learning environment. The construction of knowledge is supported by a wide array of tools and artifacts such as language, experience, culture, peers, mentors, and others. These tools help to promote metacognition, enhance communication, provide access to multiple perspectives and real world examples, and model and guide the learning process. The learning process, optimal within a learner’s Zone of Proximal Development (Vygotsky, 1978), is supported by accessing prior knowledge (Piaget, 1962), interaction through scaffolding and distributes cognition (Hutchins, 1990) through authentic activity (Brown, Collins & Duguid, 1989) and discovery or inquiry (Bruner, 1973) within socially dynamic Communities of Practice (Lave & Wenger, 1990). Russell (1999), heavily influenced by Dewey and Vygotsky, explains:

“In summary, the cognitive and social development of the learner proceeds as an unfolding of potential through the reciprocal influences of the learner and the social environment. Through guided ‘intervention’, higher mental functions that are part of the social and cultural heritage of the learner will shift from the socially regulated to the self-regulated” (p.4).

Constructivist teaching is highly communicative, emergent and dynamic. It emphasizes building context-sensitive understanding within a learning environment co-designed between teachers and students thereby transforming traditional roles in the learning process. Levin (1999) posits:

“The constructivist approach to learning--which conceptualized learning as a complex, interactive, changing, active and situated process that allows learners to individually construct their knowledge in a unique and meaningful way while confronting challenges and dilemmas, fears and excitement--not only applies to students but to teachers as well” (p. 299).
Interdisciplinary knowledge and skill development is imperative because students’ passions and interests are constantly changing and growing. Unlike objectivist methodologies that do not often leave much room for capitalizing on student voice, constructivist teaching requires teachers to understand the strengths, attributes and interests of their students. Students play a key role in determining the goals of learning, and the role of the teacher shifts from a transmitter of knowledge to a supportive and active facilitator who guides the learning process by providing scaffolding, modeling, and coaching. Papert (1980) asserted decades ago that “the role of the teacher is to create the conditions for invention rather than ready-made knowledge.” Boettcher (2007) more recently described this transformation of the role of teachers as “Directors of the Learning Experience” (p. 54).

**Structures to Support Learning:** Constructivist practices require structure to be successful. Garrison and Arbaugh (2007) state that care must be taken to encourage positive social interaction and to provide structure and support early in the learning process, particularly in the case of online learning. Vrasidas (2000) confirms “Constructivist approaches rely heavily on learners to manage their learning tasks and engage in interaction with their peers and content. In order for learners to manage their learning, structure is crucial for providing the guidelines and skills necessary to succeed in distance education courses” (p.13).

The literature clearly indicated there is still much work to be done regarding the nature of virtual pedagogy and how to best support the essential characteristics of constructivist online and immersive 3D virtual learning environments. It is imperative the structural design elements are well understood. The types of structures required specifically for online constructivist learning environments have been identified as “situatedness, commonality, interdependency and infrastructure” (Hung & Chen, 2001, p. 7). Dillon, Wang and Tearle (2007) state “virtual
education should be conceptualized so that it is better aligned culturally and linguistically with the needs of global learners and, by extension, that educational multimedia such as VLEs should be responsive to these needs” (p. 54). Teachers must be aware that as these environments evolve, there will be a need to address how the environments are being used as tools for learning, how new identities and new forms of identity are being created, and how implicit and explicit assumptions embedded in technology may be affecting student learning (Vander Valk, 2008).

Myth #8: Technology in schools is being used effectively.

Many schools and districts are investing heavily in hardware, software and professional learning with the belief technology will be used effectively in classrooms. Baines (2013) reports that American K-12 schools spent over 10 billion dollars on technology in 2012 and they plan to spend over 10 billion dollars on technology again in 2013. Despite these investments, the level of technological integration into classrooms and learning remains low (Ertmer, 2005; Gulbahar, 2007; Cuban, 2003). Teacher knowledge, lack of resources, negative attitudes and beliefs and unsuccessful experiences have all been identified as key barriers to effective technological integration (Mishra & Koehler, 2006; Puentedura, 2013; Liu, 2011; Ertmer, 2005; Cuban, 2003). When technology does penetrate the classroom, there is a risk that new tools will be used solely to extend existing practices rather than make meaningful improvements to teaching and learning (Puentedura, 2013, 2009). Scardamalia (2002) found that when schools “incorporate network communication into their educational activities most of these uses, however, make no fundamental change in the structure of classroom discourse or in the allocation of cognitive responsibility” (p. 5). This suggests the deeper question of whether or not technology is used as an authentic learning tool or simply as a means for the traditional delivery of content is a critical one. Are schools using technology for new or broader educational purposes or are they using
technology to boost the efficiency of the delivery of a standardized education within an existing factory model?

Even in an age of increasing technological innovation and artificial intelligence, and even with the TPACK framework describing the interaction between technology, pedagogy and content and the “complex, multifaceted and situated nature of teacher knowledge” (Koehler & Mishra, 2008), challenges still remain regarding just exactly how to best operationalize the framework in order to successfully integrate technology into teaching and learning. The use of technology in classrooms will only be successful when it is effectively used as a tool to support sound pedagogical practices, and the tools used are connected to authentic teaching and learning. Koehler and Mishra (2008) explain that “Instead of applying technological tools to every content area uniformly, teachers should come to understand that the various affordances and constraints of technology differ by curricular subject-matter, content or pedagogical approach” (p.22). When technology is intentionally and seamlessly integrated into learning, it can provide opportunities to change the learning culture. This can be done by making learning more student-centred, supporting richer resources for student inquiry, and providing timely and meaningful feedback for students as they take agency in their learning (Hattie, 2009).

Beyond the importance of the authenticity of the application of technology along constructivist educational principles, and despite new ICT standards, policies and increased accessibility to technological devices, a deeper examination of what may be hindering teacher’s use of educational technology in the classroom suggests a more prominent issue in play. As technology and technological tools used to support learning are relatively young, there has not yet been accrued a substantive, longitudinal body of academic research on technology use in the classroom that answers the question of whether the use of technology in a given educational
context actually adds value to the learning experience (Benton-Borghi, 2013; Tondeur, Hermans, van Braak & Valcke, 2008). A recent survey conducted by the Bill and Melinda Gates Foundation (2012) to explore existing barriers that prevent or deter teachers’ use of technology in classrooms reports:

“Teachers are concerned about the true benefits of technology for their students. Despite recognition of the importance of technology in education, many teachers report skepticism about the actual benefits of using technology in the classroom because there is little, widely accepted proof that technology tools provide real value for student learning” (p. 2).

Miranda and Russell (2011) propose that “the strongest predictor of reported teacher-directed student use might be the teachers’ belief about the instructional benefits of technology, followed by teachers’ experience with technology and teachers’ perceived pressure to use technology” (p. 371). Benton-Borghi (2013) confirm that teachers who believe technology is of benefit to teaching and learning “are more likely to integrate technology (Ertmer, 2005; Ertmer & Ottenbriet-Leftwich, 2010), implement constructivist teaching, and have strong academic backgrounds (Becker, 2000) because “[u]nless a teacher [teacher educator] holds a positive attitude for technology, it is not likely that he or she will use it in teaching” (Zhao & Frank, 2003, p. 809)” (p. 248). Until the gaps in a research-based understanding of what makes for effective learning with technology are clearly articulated and explicitly linked to effective pedagogical practice, teachers will continue to question whether educational technology actually adds value to the learning process and how technology can be appropriately integrated into teaching practice to transform learning.

**Myth #9: Teachers need to be experts in technology to use it in their classroom.**
The Web-based Commission (Kerrey & Isakson, 2000) found two-thirds of all teachers surveyed felt under-prepared to use technology in teaching. These findings held even when teachers used computers to plan lessons, and create activities. Lack of professional development is the most cited reason for the lack of implementation of new technology (Birch, 2008). Although teachers may feel the need to be able to expertly model the use of technology in their classrooms, this is not a prerequisite to integrating technology into learning. In fact, with the speed of the evolution of technology and current and emerging innovative Web 2.0 tools, it would be impossible.

The literature is inconclusive with respect to whether a teacher’s personal use of technology is directly correlated with their use of technology in the classroom. Some studies indicate that teachers who comfortably use technology at home do not necessarily bring that technology into the classroom to transfer or apply it in their teaching (Kumar & Vigil, 2011; Russell, O’Dwyer, Bebell & Tao, 2007; Kajder, 2005; Tonduer, Hermans, van Braak & Valcke, 2008). Other studies found that teachers who personally use ICT are more likely to use it in the classroom (Action Canada, 2013). This same study also reported that the use of technology in the classroom was a predictor of teaching 21st century learning competencies, teacher age was not a significant determinant of technology uptake, and teacher expertise was a significant determinant of technology uptake (Boudreault, Haga, Paylor, Sabourin, Thomas & van der Linden, 2013).

Research clearly demonstrates professional learning is essential to technological uptake in the classroom (Benton-Borghi, 2013; Mouza & Karchmer-Klein, 2013; Kushrr Benson & Ward, 2013; Niess, 2013; Angeli & Valanides, 2013; Porras-Hernandez & Salinas-Amescua, 2013). Teachers can learn alongside colleagues and students with powerful job-embedded professional learning designs that promote cultures of inquiry and support collaborative projects
in the classroom. Blended designs such as demonstration or exploration classrooms that provide real world learning, technology mentors (including the students!), journal reflections, team teaching, micro-modules that include self-paced webinars with simulation and interactivity, and collaborative online communities of practice can provide teachers with rich opportunities to learn together, and share ideas and resources.

**Myth #10: Teachers have a collective desire and the capacity to embrace constructivism and constructivist principles to support 21st century learning.**

Many teachers’ experiences have been in highly prescriptive, traditional environments. As such, teachers may find traditional teaching practices more familiar than a constructivist approach to teaching, and may be challenged to respond to the socio-cultural needs of students, to capitalize on the cognitive models students use for learning, and to access “just-in-tine” pedagogical strategies to guide the learning process. Even if teachers indicate they are willing to embrace constructivist pedagogy, are they effectively able to do so? The literature reveals five key factors that influence the knowing-doing gap (Pfeffer & Sutton, 2000).

**Teacher Conceptions of Teaching and Learning:** Teacher belief systems, which are the product of personal experience and cultural context, are a strong factor in their tendency to adopt constructivist practices (Levin & Nevo, 2009). Levitt (2002) reports that beliefs and behavior work collaboratively, Elmore (2002) states that changes in beliefs usually accompany changes in behavior and Fullan (2011) indicates that beliefs have a powerful effect on teacher’s classroom practices and their value systems. Levin and Nevo (2009) assert that “Given that the strength of a belief is indicated by the person’s subjective probability that he or she will live up to the behavior associated with the belief, it is important to investigate teachers’ beliefs in the context of classroom experiences” (p. 440). In discussing teacher change, Ertmer and Ottenbreit-
Leftwich (2010) conclude that “the underlying message here is that teachers’ knowledge and beliefs appear to interact with the existing culture to create action” (p. 267). As teachers epistemological beliefs guide their instructional and curricular decision making, and their desire to adopt new pedagogies, opportunities to challenge and realign beliefs are critical if constructivist practices are to be adopted (Brand & Moore, 2011).

Teachers may be resistant to changing their practices and unable to embrace constructivist approaches to teaching as they threaten their sense of control in the classroom. Scardamalia (2002) suggests that teachers "need to maintain a position of authority and [are] in disbelief in the capacity of students to shoulder such responsibility. This condition not only favors a centralized management structure; it also severely constrains the kind of discourse that can go on. As analysts of classroom discourse have observed, classroom exchanges are usually both initiated and terminated by the teacher" (p. 4). Windschitl (2002) argues in an extensive study of constructivist-in-practice dilemmas, that it is difficult for teachers to allow students to co-construct knowledge with them because either teachers do not wish to relinquish their existing power roles in the classroom (and hence prefer a more teacher-centric environment) or feel intimidated allowing the new exploration of practices in the classroom. Challenging preconceived conceptions of effective teacher practice was evidenced in the multi-year study of the impact of the Rice Model of Teacher Professional Development (Diaconu, Radigan, Suskavcevic & Nichol; 2012) and by Brand and Moore (2011) who report that teachers’ prior experiences as learners pose challenges as they consider the demands of inquiry-based settings.

**Teacher Understanding of Constructivist Teaching:** Teacher’s lack of in-depth understanding of constructivist principles and practices is commonly cited in the literature as a factor that influences whether or not constructivist teaching is adopted. Although the vast
majority of empirical studies reviewed for this paper reveal teachers who do not understand the underlying epistemological assumptions of constructivist practice cannot translate its principles into practice, there are studies confirming that teacher’s conceptions of teaching and learning changed after being introduced to constructivist practices. Levin and Nevo (2009) reference this in the way teachers describe learning at the beginning of their study as “a formal process of knowledge accumulation” or “a process in which teachers transmit concepts and values to their students” or “a process in which the student receives information and internalizes it” (p. 451). Near the end of the study, after having been exposed to constructivist practices and having had the opportunity to reflect upon their past and present experiences and consider new practices, the teacher’s schema no longer solely represented the knowledge transmission model. Levin and Nevo (2009) report teachers later describing teaching as being like “an orchestra conductor; a challenger; a learner; an activator” (p. 453) and learning, as an indirect process, as “opening your mind to see things in different ways; a thinking process, a personal meaning making process that develops the intellect; a process that starts with curiosity and motivation and ends up with questioning a diversity of issues; a learning movement with an insight movement” (p. 451). The study uses metaphorical voice to describe a fulsome transformation with respect to teacher’s understandings of constructivist principles and practices.

There is ample literature regarding an insufficient understanding of constructivist pedagogy associated with technology (Liu, 2011). Although some studies report constructivist beliefs are positively correlated with the use of technology in the classroom (Tondeur, Hermans, van Braak & Valcke, 2008; Brown, 2003), these are not indicative of the majority of empirical studies included in the literature review. Liu’s study (2011), which examines the pedagogical beliefs associated with teaching activities and the effects of those beliefs and activities on
technology use, is much more indicative of common academic findings. Liu (2011) found most Taiwanese teachers held constructivist beliefs, but do not integrate constructivist teaching with technology because of an insufficient understanding of constructivist pedagogy associated with technological use. As reported in Liu’s study (2011):

“Some studies identified lack of resources, unsuccessful experiences and negative attitudes and beliefs as accounting for insufficient technological integration (Cuban, 2003; Ertmer, 2005, Park and Son, 2009), however, even when teachers have sufficient successful experiences with technology, teachers do not necessarily integrated technology into instruction (C.-H. Chen, 2008; Ertmer, 1999; Palak & Wallace, 2009) or are unwilling to integrate technology into teaching activities (Tondeur et al., 2008). Ertmer (1999) categorizes barriers hindering technology integration as external and internal barriers. External barriers, such as a lack of equipment, training and support can be overcome by adequate funding and training and via governmental policies. Internal barriers related to teacher beliefs are key variables (Palak & Walls, 2009; Park & Ertmer, 2007)” (p. 1).

Liu (2011) reported that teachers primarily used technology to design instructional materials and deliver lectures. This finding is consistent with Lawless and Pellegrino’s study (2007) that demonstrates teachers used technology for lesson preparation, word processing, PowerPoint, and to access the Internet and deliver lessons.

With the emergence of new technologies to support learning, Mishra and Koehler (2006) suggest that teachers would be more apt to change practices if they better understood that it is the intersection of technology, pedagogy and content that has the most impact on learning. Building on Shulman’s (1986) work on pedagogical content knowledge (PCK), Mishra and Koehler (2006) extended the concept to include technology knowledge and developed a framework
relating Content, Pedagogical and Technological Knowledge (TPACK). The TPACK framework, which helps to explain the intricate interplay between teacher knowledge and technology integration in the learning process, proposes that quality teaching and learning only occurs when there is a relationship between technological, pedagogical and content knowledge. This relationship among the three knowledge bases is represented in Figure 1.

The TPACK framework, designed to guide teachers in their efforts to integrate information and communication technology (ICT) into their teaching and learning, also consists of overlapping areas that represent combined knowledge bases. Benton-Borghi (2013) defines these seven components as:

- **TK**: Refers to the knowledge of technology
- **CK**: Refers to the knowledge about the subject matter that the teacher will teach
- **PK**: Refers to the knowledge of methodology and the process of teaching, from classroom management to instructional decision making
• PCK: Refers to the knowledge of the process of teaching based on the specific content being taught
• TCK: Refers to the knowledge of how to use technology to represent specific content
• TPK: Refers to the knowledge of the use of technology in teaching based on the specific methodology used by the teacher
• TPACK: Refers to the synthesis of teacher knowledge of all elements (content, pedagogy and technology) required to integrate technology in their teaching (p. 251).

Mishra and Koehler (2008) believe that teachers who demonstrate best practices with technology are “creative, flexible and adapt ways in which they navigate the constraints, affordances and interactions within the TPACK framework” (p. 20) and that authentically integrating technology requires teachers to relate technologies with creative pedagogical practices to teach content and skills in a learner-centric approach (www.tpack.org).

Since the TPACK theoretical framework was introduced to the educational community, some theoretical issues have arisen regarding the nature of the integrative model. Angeli and Valanides (2005, 2009) offer an alternative model called the ICT-TPCK conceptual framework which is based on content knowledge, pedagogical knowledge and knowledge of learners, knowledge of educational context and ICT knowledge. Although both models have Shuman’s (1986) PCK as their theoretical base, each has a different epistemological stance. The TPACK model reflects a more integrative perspective of the knowledge needed to effectively integrate technology into teaching and learning while the ICT-TPCK model aspires to a more transformative process using competencies teachers need to have to know how to teach with technology. Porras-Hernandez and Salinas-Amescua (2013) posit the TPACK framework is limited because it defines the contexts in which teachers work and students learn too narrowly.
As constructivist teaching requires a learner-centric environment driven by student preferences, prior knowledge, motivation, and cultural, social and economic conditions are critical. Porras-Hernandez and Salinas-Amescua (2013) suggest “TPACK recognizes the relationship between the teacher’s technology integration decisions and context; however, the notion of the context requires further theoretical development to understand its complexity, expand its several dimensions, and make the teacher’s own subjective variables visible as part of the TPACK model” (p. 224). The literature suggests there is still much work to be done regarding the situated nature of learning and constructivist pedagogy associated with technological use.

**Cultural, Political and Social Contexts:** Sociocultural, political, and social contexts and their implications of implementing constructivist practices into teaching arose in the literature as a factor influencing the theory to practice gap. From a sociocultural context, some countries around the world saw textbooks as the primary source of knowledge, and there was parental pressure to ensure students covered all course content through the provincial or national curriculum in order to achieve well on end of course or state level examinations (Liu, 2011; Lee, 2009; Li, 2007). From a political and social context, empirical research identified that the use of constructivist pedagogies was challenging in an era of accountability where traditional approaches to teaching were encouraged, and improving student outcomes were not seen in the broader context of learning but rather were synonymous with academic achievement and knowledge (Brand & Moore, 2011).

**Social Constructivism:** Moving constructivist theory to practice was more successful when the epistemology of constructivism was viewed through the lens of social constructivism. Social constructivism, a theory of knowledge attributed to Dewey, Piaget and Vygotsky, suggests learners make meaning by transferring knowledge, building deeper understandings and
negotiating with the ideas of others. According to Beck and Kosnik (2006) social constructivism is “an approach that encourages all members of a learning community to present their ideas strongly, while remaining open to the ideas of others” (p. 8); it is “dependent on attitudes, emotions, values and actions” (p. 13), and it is centred upon three concepts: integration, inquiry and community.” (p. 24). Brand and Moore (2011) argue transitioning constructivist theory to practice through the lens of social constructivism supports the transformation process by more readily confronting prior experience, constraints and conceptions, adapting conceptions and related strategies, and encouraging teachers to share reports of inquiry practices. These findings are corroborated by Laurillard (2012) who confirms that the availability of interactive, communicative and user-controlled technologies in education fit well with the requirement for social constructivist, active learning.

**From 21st Century Learning to Learning in the 21st Century: Building a Framework from the Review of the Literature**

A synthesis of the academic literature regarding 21st Century Learning demonstrates three key findings. First, in order to transform education so that students are better prepared for the kinds of learning and work needed in our postmodern society and teaching methodologies are more engaging, relevant and responsive to the needs of 21st century learners, it would be beneficial for future conversations to focus on issues of learning theory and pedagogy rather than purely on technology. Second, although constructivism and its principles are described fairly consistently throughout the literature, constructivist practices are difficult to implement because constructivist principles both replace well-understood approaches to learning with an unfamiliar epistemology that challenges teachers’ existing beliefs about pedagogical priorities, as well as fail to provide a clear link between learning theory and practical instructional design. This is
compounded when the implementation process fails to make clear how instructional design can best be supported with emergent technological tools. Third, transitioning constructivist theory to practice is more successful when the epistemology of constructivism is viewed through the lens of social constructivism.

In examining the concept’s common myths, I have come to the conclusion the cultural term 21st Century Learning has become a significant barrier to supporting teachers in their efforts to transform learning in technology-rich environments. To strengthen society’s collective capacity for bold, forward thinking action that genuinely changes learning will require a well facilitated public conversation regarding what 21st Century Learning actually means, and what society hopes to achieve by transforming learning. When this dialogue occurs, all voices must be present at the table; students as key clients, parents (especially those who feel marginalized), community, business, researchers and educational partners. Society can only attempt to achieve a shared understanding and actualize a vision of 21st Century Learning when the discourse and debate is open to and inclusive of all members of society.

Until this happens, the concept of 21st Century Learning remains vague and elusive. As we advance further into the 21st century and build upon past success, this term so frequently utilized in today’s educational discourse to describe promising educational change must be more clearly defined so that it is more apt to support pedagogical transformation. To start effective academic discourse, I believe that changing the term 21st Century Learning to Learning in the 21st Century is a critical first step. Although at first glance this may appear to be solely a simple change in word order, it is not. It is most intentional. Using the term “Learning in the 21st Century” provides significant advantages to the development of a thoughtful and viable conceptual framework to support a focus on improvement because it explicitly positions the
interplay between learning theory, pedagogy, learners and learning environments at the forefront of the discourse, and enables teachers to examine context-sensitive tools and artifacts used to support constructive teaching and learning within the social, cultural and political context of “real” time.

Identifying what influences teachers in their transition from familiar teaching methodologies to new roles more reflective of constructivist pedagogy within technologically-rich learning environments requires determining how teachers become conscious of the ways in which they define their epistemology and build their pedagogical stance. Teacher’s concept of role, and their approach to teaching and learning are key. Also important are the attributes a teacher perceives as critical to supporting an effective learning environment, and the explicit and implicit expectations they have of students’ agency for learning.

By better understanding the interrelatedness between teacher’s constructions of teaching and learning, constructivist principles and practices, socially mediated knowledge and technological integration, teachers will be more likely to intentionally construct the conditions for optimum learning in the 21st century that result in improved student outcomes, increased engagement, new roles for learners, and learning that is deep and authentic. Of critical importance to these outcomes is the need to clarify new roles of learners including students, teachers and those staff who support the learning environment, and to provide precision and specificity of 21st century learning goals and the learning activities that address those goals.
Figure 2: Learning in the 21st Century Conceptual Framework (Grose, 2014)

The conceptual framework provides an understanding of a learning model that effectively balances constructivist principles and practices with evidence-based practices already understood as drivers to improve student achievement and student outcomes. The conceptual framework invites additional possibilities. It may encourage the exploration of constructivism and constructivist principles that endeavour to explore shifts in culture through personal and online communication over time. It may spur researchers to identify a set of clear constructs defined with precise language. It may add to the existing frameworks in literature that may inspire researchers to develop a whole new epistemology. Brown, Collins and Duguid (1989) state “Much common educational practice is the victim of an inadequate epistemology. A new epistemology might hold the key to a dramatic improvement in learning and a completely new perspective on education” (p.41). Finally, providing educators a simple yet powerful conceptual framework, where factors that impede and facilitate teacher change can be examined and
discussed, will assist in knowledge exchange, and strengthen the link between research, policy and practice. (Cooper, Levin & Campbell, 2009).
Chapter Three: Methodology and Design

Introduction

This study employs a constructivist grounded theory design. Grounded theory is a qualitative methodology design that uses a systematic process of inductive data collection to examine the common experiences of individuals and to construct a theory (Charmaz, 2009, 2006, 2000; Glaser & Strauss, 1967; Strauss & Corbin, 1998, 1994, 1990). The resulting theory is “grounded” in the data collected from participants in a study based on their lived experiences (Fassinger, 2005). Grounded theory research consists of three types of designs, all of which originate from the seminal work of Glaser and Strauss (1967). One design is a systematic design (Strauss & Corbin, 1998) which uses predetermined categories to make explicit connections. Another is an emergent design (Glaser, 1992) which explores social processes without pre-set categories. The third is a constructivist approach (Charmaz, 2000) which focuses on subjective meanings by participants, makes explicit the values and beliefs of the researcher, and results in suggestive or tentative conclusions (Creswell, 2012). All three designs “seek to inductively distil issues of importance for specific groups of people, creating meaning about those issues through analysis and the modelling of theory” (Mills, Bonner & Francis, 2006, p. 8).

As the research question in this study seeks to develop a sound theory that suggests what influences teachers as they transition from familiar traditional teaching methodologies to more constructivist approaches in technology-rich environments, a constructivist grounded theory design was best suited. A constructivist grounded theory approach is founded on the belief that data and theories are neither discovered nor emergent but are interactively co-constructed by the participants and the researcher to understand the meaning of experiences (Charmaz, 2009). Simply stated, themes and theories are co-constructed from data collected, shared and discussed.
The process of co-construction, which supports the understanding that “the feelings of individuals as they experience a phenomenon or process” (Creswell, 2012, p. 430) are based on the realities of their own individual practices, complexities and contexts, is described by Mills et al. (2006) as “epistemologically subjective” and “ontologically relativist” (p. 6). These interpretative renderings of a reality are explained by Charmaz (2000) who states “Data do not provide a window on reality. Rather, the ‘discovered’ reality arises from the interactive process and its temporal, cultural and structural contexts” (p. 524).

**Reflexive Research Practices**

A constructivist grounded theory approach is situated within the qualitative research paradigm. As themes and theories emerge through data using an interpretive meaning making process, participants are provided voice and control in the research process thereby disrupting the researcher’s own understandings and ways of knowing. This more emergent and spontaneous response to the flow of shared experiences reveals rich insights into the meaning of shared experiences (van Manen, 1990) and enables a search for deeper meaning.

A constructivist grounded theory approach requires the researcher takes on a reflexive stance towards the data to elicit multiple meanings by “searching for and questioning tacit meanings about values, beliefs and ideologies” (Mills et al. 2006, p. 7; Charmaz, 2009). It also requires the researcher to transition from the role of producing and interpreting data, to immersing themselves in the construction of data through coding processes and theoretical memos. This interactive process includes a “layered analysis” that deepens the scope of the study and balances the participants and the researcher’s shared contribution to the making of meaning and the construction of a grounded theory model (Charmaz, 2009, 2001).
The design explicitly acknowledges the interpretive role of the researcher and the researcher’s biases and perspectives. The flexible and creative nature of constructivist grounded theory was the best design for the study because it is congruent with my own beliefs of the nature of reality and the nature of knowledge. The design reflects my belief that knowledge is actively developed through a socially-mediated, context dependent and culturally constructed process that honours individuals’ experiences and that group interactions provide a diversity of perspectives that extends learning. This design openly acknowledges the subjective, interactive relationship between myself, as the researcher, and the participants in the study as we worked together to share and extend understandings and create new knowledge through an inquiry-driven research process. Finally, the approach to data analysis in the constructivist grounded theory design ensured the data collected from the participants’ explanatory narratives is embedded into and drives the process of constructing a strong theoretical foundation in response to the research question.

**Participant Selection**

Grounded theory privileges the purposeful selection of individuals. The participant selection for this study was intentionally taken from a group of teachers who had volunteered through word of mouth to collaborate in an action research project in the summer of 2012. The purpose of the action research project was to provide an opportunity for teachers to collaboratively explore the dynamics of implementing learner-centric instructional methodologies in technology-rich environments.

The participants are 6 teachers in Ontario. As a group, they have a broad range of teaching experience. The participant selection includes a beginning teacher with 5 years of experience and a seasoned veteran with 29 years of experience. The selection’s cumulative
service to teaching totals 118 years. This group of 6 teachers has taught across the province of Ontario in small rural school districts, mid-sized districts, large urban districts, and outside of the educational sector. All attended pre-service education programs in Ontario. They have collectively taught all ages of learners; primary-aged children (Kindergarten to Grade 3), Junior and Intermediate students (Grades 4-8), secondary aged students (Grades 9-12) and adult learners. All have taught English Language Learners and children with special needs. Over their careers, they have willingly and openly shared and evolved their practice through observation, feedback and input from colleagues. All have held school-based Positions of Responsibility (POR) to support colleagues in their efforts to address change and improvement. The teachers are highly regarded by their colleagues for their understanding of a constructivist epistemological stance, their successful application of constructivist teaching practices, and their rich expertise and knowledge of technology-enhanced learning. Four have coached and mentored teachers in centrally-assigned instructional leadership roles at the district, or the provincial level. Four have taught Additional Qualification Courses (AQs) such as Computers in the Classroom, Reading, Teaching and Learning with Technology, Media Literacy and Library. Two are currently school administrators; one a seasoned principal and the other a newly promoted vice-principal.

<table>
<thead>
<tr>
<th>Name</th>
<th>Gender</th>
<th>Age</th>
<th>Years of Experience</th>
<th>Areas of Teaching Experience (K-12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kien</td>
<td>Male</td>
<td>49</td>
<td>24</td>
<td>Grades 2, 2/3, 3, 3/4, 4, 4/5, 5, 6, 7, 8; Grade 8 Science; Grades 6, 7 and 8 Computers</td>
</tr>
<tr>
<td>Jack</td>
<td>Male</td>
<td>45</td>
<td>17</td>
<td>Grades 6, 8; Primary and Junior English as a Second Language (ESL); Grades K-8 Technology; Grades K-8 Teacher Librarian</td>
</tr>
<tr>
<td>Camille</td>
<td>Female</td>
<td>44</td>
<td>19</td>
<td>Grades 1, 2, 6, 7, 8; Grades 4 and 5 Core French; Grades 7-8 Instrumental Music; Grades 1-6 Computers; Grades 1-8 Teacher Librarian; Behavioural Adjustment (Grades 9-12)</td>
</tr>
<tr>
<td>Name</td>
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</tr>
<tr>
<td>Anya</td>
<td>Female</td>
<td>51</td>
<td>29</td>
<td>Business Studies (Grades 9-12); Computer Studies and Engineering (Grades 10-11); Guidance Counselor (Grades 9-12); GLC (e-learning)</td>
</tr>
<tr>
<td>Dylan</td>
<td>Male</td>
<td>35</td>
<td>5</td>
<td>Kindergarten; Grades K-3 Media Literacy; Grades K-6 Teacher Librarian</td>
</tr>
<tr>
<td>Jean</td>
<td>Female</td>
<td>49</td>
<td>24</td>
<td>Grades 3/4, 5/6, 6, 7/8, 8; Grades K-6 Physical Education; Behavioural Adjustment. Grades K-3 Remedial; Grades 4-6 Remedial; Primary English as a Second Language (ESL)</td>
</tr>
</tbody>
</table>

Figure 3: An Overview of the Participant Selection

To determine what influences teacher transformation, the cross-section of teachers was purposefully chosen to elicit rich and varied understandings of personal and practical knowledge regarding learning theory, learners, pedagogy, technology, youth culture, professional learning designs and change management. The cross-section of teachers was also purposefully chosen to determine whether overarching holistic themes, or themes unique to teaching specific ages of students or types of learners, may arise. Lastly, they were chosen because each participant has had experience mentoring and coaching other teachers at the school or district level, or beyond, in their efforts to transform practices. I believed the personal and professional experiences of this diverse group of teachers would yield data useful in generating a theory regarding what influences teachers in their transition from familiar teaching methodologies to more constructivist approaches in technology-rich environments. I also believed the collective participant selection was likely to elicit deep knowledge of the issues that impede and facilitate transformation amongst thousands of teachers.

In every research study, openly disclosing any pre-existing relationship between the researcher and the participants, as well any actual or perceived power differential is imperative. I
collaborated with the six participants in the action-research project focused on implementing project-based learning instructional design supported by a wide array of technological tools in the Summer of 2012. At that point in time, I served as a Coordinating Superintendent in a large urban school district in Ontario. Although 4 of the 6 participants in the study worked in the same district as I did, none of the 4 reported to me. However, to rigorously mitigate any perceived power differential in this pre-existing relationship, two strategies were put in place. First, to assume my role as a researcher, I took an unpaid Leave of Absence to conduct the research for the study as a doctoral candidate. Second, in my full-time role as researcher, through the interview process I constantly and consciously paid careful attention to what could be perceived as my power and authority to advance the purpose of the study. In the case of this study, this meant my reflexive role may have leaned more towards listening and asking probing questions than actively contributing to the making of meaning that deepened the scope of the study.

**Measures**

Data for this study were collected in two stages. The first stage involved conducting individual interviews with each of the 6 participants. During the interviews, physical and online artifacts, materials, and documents the participants chose to share to demonstrate or explain their experiences were examined. In accordance with the theoretical sampling procedure, as new concepts emerged from the data collected in the initial interviews, new interview prompts and probes were adapted for later interviews. This strategy afforded the opportunity to augment underdeveloped categories and to ensure additional data were collected based on the identification of missing data or new information brought forward by the participants. As explained by Strauss and Corbin (2008) “concepts are derived from data during analysis and questions about those concepts drive the next round of data collection” (p. 144).
Upon the completion of the individual interviews, online focus group interviews were conducted with all 6 participants through an online discussion board using a Google Doc. Selected topics that emerged from the individual data were discussed. Using group prompts and probes, new knowledge was collectively constructed amongst the participants. One final face-to-face focus group interview was conducted to review the co-constructed data and to make changes to the data as required.

Data Collection and Analysis

Constructivist grounded theory design requires a flexible and responsive approach to data collection and data analysis. As the process of data collection and data analysis occur simultaneously, the two processes will be discussed together.

Prior to the collection of data, a meeting was held with each participant to explain the purpose of the study and to invite the participants into the study. The teachers were assured by a letter from the researcher that their participation was voluntary. Confidentiality assurances were outlined in the letter and teacher consent to participate was acknowledged through participant signature on the consent form. In addition, a separate pilot group of three teachers was assembled to ascertain whether the initial choice of question prompts and probes were comprehensible and supported a natural flow for response completion. Response arising from the participants in the pilot group indicated the question prompts and probes were understood. However, the pilot group questioned the rationale for face to face interviews when technologies could be used as an effective tool to construct knowledge for the study.

Stage One: The first set of data were collected through individual interviews with each of the 6 participants from July to September 2013. The need to negotiate methodology arose immediately. As foreshadowed by the pilot group, not all participants wanted to participate in
face-to-face interviews. Some did not believe this method to be the most effective, efficient or comfortable mode of data collection. Some questioned why technological tools were not being modeled in a study on teaching and learning in the 21st century, when technology as a tool to support teaching and learning was being investigated. Common responses arising from the participants follow:

“Do we have to meet together? I want to answer the questions on a Google Doc where I have more time to think, respond and then go back in and refine my answers” (Jack), “time is way too limited face-to-face. I need time to provide rich responses. And I am teaching summer school so my schedule is nuts. I need to have the flexibility to do this when I am free” (Anya), and “face-to-face? Too much pressure! I already read the questions and I need to answer them on my own time and in my own way!” (Camille).

As a result of the participants’ feedback, it was determined they would have the opportunity to respond to the questions in their choice of a face to face, online or blended format. Two participants requested face to face interviews, stating they preferred this method of data collection because “it allows me to be part of the social dynamics of the interview” (Jean) and “I prefer the flow of real conversation” (Kien). These interviews were transcribed verbatim. Four candidates chose to respond to the individual questions using an electronic document or online in a Google Doc. Online interviews afforded the benefit of built-in transcription.

The individual interview prompts and follow-up probes used in Stage One of the data collection were chosen to begin to understand the interrelatedness between components of the conceptual framework that emerged from the literature review in this study. These components included teacher’s constructions of teaching and learning, constructivist principles and practices,
socially mediated knowledge and technological integration. The prompts and probes, shared with the participants prior to the interviews, were:

- Tell me about your approach to teaching. Was there a particular incident or a series of incidents that occurred that changed your approach? Please share a story from your experience or share your story using your teaching timeline.
- Do you have terms you use to describe your own teaching philosophy and pedagogical approach to teaching? Can you tell me about these and what they mean for you?
- What do you understand by the term constructivism? What do you understand constructivist teaching to involve? How is it different from non-constructivist teaching?
- Would you consider your approach to teaching to be constructivist? Why or why not? Can you give some examples?
- What happened when you began to adopt more constructivist practices? How did you feel?
- What instructional strategies did you use to adopt a more constructivist approach to teaching? What did they look like in your classroom?
- How have you come to understand children's learning? What were important components of change in your understanding of learning and teaching?
- Do connectivity and technology support learning? Did technology play a role in your transition to a more constructivist approach to understanding learning? If so, how? If not, why not?
- What professional learning designs supported your journey towards transformative teaching? How did you begin to develop your personal professional knowledge regarding constructivism?
• What enabled and what inhibited your efforts to transform teaching and learning?

• Please complete these sentences:
  a) I used to think learning was ………………….
  
b) I now believe learning is ………….

• Should you wish, please share an artifact that represents what you used to think learning was and one that represents what you believe learning is now.

• Can you create a personal knowledge web with constructivism as its centre?

To realize change in teacher practice requires deep examination of how teachers may become conscious of the ways in which they define their epistemology and build their pedagogical stance. How might teachers address these issues? How might teacher’s concept of role, and their approach to teaching and learning impact their pedagogical stance? What characteristics do teachers believe are critical to effective learning environments? Where does technology fit in learning and the learning process? What are their implicit and explicit expectations of students’ agency for learning? Is clarification for the new roles of learners and precision and specificity of 21st century learning goals, and the learning activities that address those goals, needed?

Response to the individual interview prompts and follow-up probes during the two face-to-face interviews was organic and free-flowing. Initially planned for a 90 minute block of time, the face-to-face interviews took much longer. The questions provoked rich response that required an approximate 3 hour block of time in July, as well as repeated interviews, email correspondence and phone calls through August and September 2013 as the two participants chose to augment their initial responses with new thoughts and information. The four participants who responded electronically to the interview prompts and follow-up probes addressed the
questions in a more structured manner. They too augmented initial responses with new perspectives and understandings via email, phone conversation as well as adding to their electronic documents throughout the three month period.

During the individual interviews, all 6 participants were eager to share their thoughts and perspectives. Their stories were vivid and inspirational. It was evident their change and improvement efforts were focused on a desire to better serve the needs of today’s students. Two common areas of challenge arose among the participants during the individual interviews. The first revolved around the question regarding the creation of a knowledge web with constructivism at its centre. All 6 participants expressed discomfort in being asked to complete this task. They revealed that they did not consider themselves constructivists and that the word constructivism did not appeal to their preferred language of practice. As a result, all but one participant chose not to create the knowledge web. The one participant who did, modified the knowledge web to place students at its centre and supports for learning outside the centre. This participant defined one of those supports as the relevant and applied curriculum, and explained that that is where he felt the construction goes on.

All 6 participants confirmed their teaching practices had changed so that students now have more agency for their learning, and that technology is a tool used to support authentic teaching and learning. However, I noted a high level of frustration among all 6 participants regarding the degree of that change. While improvements were evident, the participant’s experiences suggest that their teaching practices do not look that fundamentally different due to challenges of reliable connectivity, and the constraints of the traditional structures and practices embedded in schools today. The participants appeared irritated that these structures impede the
development of an educational model that supports flexible learning designs unbound by time, place and space.

Three specific steps of data analysis were implemented during the study’s constructivist grounded theory design process. The first step of data analysis involved open coding, where “units of meaning” (Fassinger, 2005, p. 160) were assigned to incidents, actions and events derived from field notes, observations, physical and online artifacts, and the transcribed notes capturing the words the participants used to describe their experiences in the response to the interview questions. Data collected were sorted and re-sorted using a constant comparison analysis to recognize patterns and themes that emerged. Broad categories and subcategories were identified by segmenting information that brought meaning, order and structure to the data to categorize it in meaningful ways. The broad themes identified were: teacher’s conceptions of teaching and learning, personal and professional knowledge and its impact on changing practice, and technology as a tool to support learning. Theories within the data that appeared to assist in the shaping of ideas and the exploration of broader hunches were captured through the creation of a series of written memos. These memos were a helpful tool for my own ongoing reflective dialogue regarding the components of a potential emerging theory. The creation of written memos continued through all stages of the data analysis.

The second step of data analysis involved axial coding where the data was assembled in new ways. By drawing rough coding paradigms, the interrelationships between the categories of conditions that influence the core phenomena, specific strategies taken in response to the core phenomena, the contextual and intervening conditions that influence the strategies and the consequences, or outcomes from using the strategies, were considered (Creswell, 2012, p. 426). Categories were spread out according to clusters. Careful attention was paid to word repetitions
and key words in context of phrases and sentences. Axial coding categories emerged as themes relating to knowledge and understanding, the nature of learning, the learning environment and its impact on changing practice, classroom and school learning conditions, and how and when technologies may be used to support learning. Through this analytical process, these themes connected the categories and highlighted potential theories about what teachers experience and what influences teachers as they transition from familiar traditional teaching methodologies to more constructivist approaches in technology-rich environments.

The third step of data analysis involved theoretical coding, where concepts are merged into theoretical categories using a constant comparison procedure that lead to saturation. The analysis generated and connected categories by comparing incidents in the data, incidents to categories, and categories to categories, so that the categories were grounded in the data (Creswell, 2012). Once the analysis was completed and saturation had been reached, three core categories emerged: motivation for changing teacher practice and the factors that influence that change, identifying what the transformation means to changes in teaching and learning, and the conditions required to support change in teacher practice. These categories were discussed in the proceeding group interviews.

Stage Two: Charmaz’ (2006) constructivist grounded theory approach emphasizes that discovered reality arises from understanding the meaning of experiences shared in an interactive approach. A second set of data were collected through a collaborative online focus group interview conducted with all 6 participants from September to December 2013. My role as researcher was to facilitate, guide and moderate the discussion and the construction of knowledge and new understandings that occurred.
The data collected were selected from questions arising from the themes that arose from the individual interviews conducted with each of the six participants. The prompts and probes were:

- In the individual interviews, you discussed popular and academic writers and research that influenced your understanding of a constructivist orientation in a technology rich environment. The following were collected: Seymour Papert, John Hattie, Heidi Hayes-Jacobs, Robert Marzano, Wil Richardson, Anne Davies. Are there any writers or research reports you wish to add?

- In the individual interviews, everyone talked about the conditions and supports that need to be in place to support the learning environment for student in the 21st century. The conditions shared in the individual interviews are synthesized below. Can we collaboratively determine if these are indeed the conditions and supports, and then determine what these may mean to the learning environment?

- Should there be MOOCs for K-12? What are the advantages and disadvantages?

- If you had the opportunity to provide advice to those crafting a plan for large-scale reform to bring schooling out of its current industrial state, what specific strategies, models and structures would you recommend for consideration? What new ways of thinking should be considered for K-12? Elementary? Secondary? What about K-20? What should not change?

- What would a typical day or week in the life of a secondary student in a 21st C school look like?
• If you had the opportunity to give the Minister of Education one piece of advice, or one strategy to transform learning that would be immediately implemented in Ontario, what would it be?

To encourage knowledge building among the 6 participants, three of the six online focus group prompts and probes were supported by data collected from the individual interviews or initial conclusions synthesized from the data. In the first case, the names of the writers and researchers the participants identified as influencing their understanding of a constructivist stance in a technology-rich environment were shared, and the participants were asked to add to the list as they saw fit. In the second case, a synthesis of the characteristics the participants identified as critical to an effective 21st century learning environment was provided. In the third case, a very rough draft of the participant’s ideas regarding a typical day in the life of a secondary student in a 21st century school was provided. These three prompts and probes were selected to be supported by data from the individual interviews because response from the participants in the individual interviews was the most consensual. The remaining 3 sets of prompts and probes were left unsupported. These included the question about MOOCs, advice for informing large-scale reform plans, and the identification of one particular strategy to move the change and improvement agenda forward in Ontario. These three prompts and probes were left unsupported due to the high degree of variance in participant response during the individual interviews.

Introducing the online discussion board required no need to negotiate methodology. Within 24 hours of sending the link to the participants, robust conversation began. In the first week, much of the conversation occurred between two female participants. In the next two weeks, the other 4 participants jumped in. Over Stage Two of the data collection, the participants
accessed the discussion board between 8 and 21 times. The earliest comments were posted at 5:37am and the latest comments were posted at 11:37p.m. Participants used the discussion board in a number of different ways; to read only; to pose questions; to probe for deeper understanding regarding other’s ideas; to extend other ideas, and to express contrary opinions.

Comments were posted in a variety of ways. Participants chose to write directly on the Google Doc, to write along the side of the commentary using the tracked changes tool, or to do both. Participants initialized their comments, identified their comments with highlighting in a self-selected colour, or kept comments anonymous. It appeared some participants used all three approaches to collaboratively build knowledge and to respond to each other. Over the data collection period, a total of 148 comments were made. These 148 comments were embedded in a total of 16 pages of commentary.

Learning is Adaptive and Responsive:

- Learning is a constantly evolving or recursive process that includes reflection, questioning, collaboration, investigation, learning, application, reviewing, creating, and innovating.
- Learning reflects the diverse social realities of students.
- Learning is culturally responsive and asks critical questions of current issues, the curriculum, teacher, and others.
- Learning promotes an understanding of a full range of equity issues, approached from multiple perspectives in a developmentally appropriate context, using current events and students lives.
- Cueing systems, anchor charts, exemplars, learning goals, targets, success criteria, student work samples, descriptive feedback, and other cueing and reinforcing strategies to scaffold student learning are evident.
- Not sure if this should go with the statement above... learning is reinforced through an online presence where students can reveal when needed the samples, success criteria, exemplars, (pictures of what's on the walls of the classroom).
- Rigor, pace, choice in learning tasks and entry points to learning are adjusted.
- Learning includes purposeful student collaboration and online communication.
- Student voice is activated through opportunities for critical thinking and leadership. "Knowledgeable others" are part of the learning team to maintain focus and expand the learning.
Figure 4: Screenshot of the process of online knowledge construction among the study’s participants

The culture of the online environment was positive, open and collaborative. There was humour evident in some comments posted. Leadership for knowledge building was distributed fairly evenly among the participants. However, the question that asked participants to describe a typical day in the life of a secondary student was clearly led by the participant with the most secondary school experience. When the participants were collaboratively constructing knowledge of which they had significant personal professional experience, such as in the fundamental characteristics of the learning environment and the day in the life of a secondary student in a 21st century school, they added short suggestions to the document, identified new ideas with highlighting and the pace of the co-construction was slow and deliberate, in some cases taking weeks. When the participants were discussing broader ideas they may have been less familiar with, such as whether MOOCs are an applicable learning design for K-12 students, they were more apt to post longer comments with supporting evidence and arguments, in a conversational manner, in shorter periods of time. Over the three months, the comments, ideas and suggestions posted were either affirmed by the group, or collaboratively discussed, debated, refined or dismissed.

Online discussion group response was not without controversy. Three particular questions evoked a significant variance in response. The participants could not agree whether MOOCs are an applicable learning design for elementary and secondary students. Although consensus was reached regarding the 8 fundamental characteristics of the learning environment and the respective “look-fors” that describe the learning environment, 3 of 6 of the participants were adamant that due to the age-old structures of the existing schooling model, it was unrealistic to
expect that the flow of learning could be determined by the learning collaborative. Lastly, opinion was divided regarding whether EQAO testing should remain as it has the past decade for Grade 3, 6, 9 and 10, or whether it would be more advantageous to test smaller cohorts longitudinally and follow up regarding casual factors where there is tremendous or little growth within a cohort.

The data analysis procedure resulted in refining, developing, constructing and clarifying the meanings of the categories for the theory (Creswell, 2012, p. 433). This collaborative, interactive and layered analytical process deepened the scope of the study and resulted in the shared construction of the final grounded theory model amongst the 6 participants and myself as the researcher (Charmaz, 2009, 2001). The final grounded theory model is reported in the findings of the study, and is represented by a diagram and a series of propositions.

**Personal Reflections on the Research Design**

This study contributes to the ongoing academic literature in the area of the learning sciences and the nature of learning in the 21st century. The study adds to the growing body of literature focused on educational change and improvement. To gather empirical data reflective of teacher’s standpoints, the design of the study included the purposeful selection of participants who were highly respected for their knowledge of constructivist epistemology and the application of that knowledge to teaching and learning in technology rich environments. Even with this purposeful selection of participants, the study selection was small, and therefore the interpretations of the study may not be generalizable beyond this particular case.

There are a number of methodological challenges inherent in a constructivist grounded theory approach. First, a constructivist grounded theory approach usually demands considerable time for the transcription of verbatim accounts of interviews. This challenge was overcome in the
design of the study with the utilization of a wide array of technologies, such as e-mail, Skype, FaceTime, wikis and threaded Google Docs, which easily captured synchronous and asynchronous researcher-participant and participant-participant dialogue. Second, the constructivist grounded theory approach demands a high degree of tolerance for ambiguity and uncertainty during the analytical process required to construct the final theory. This challenge was evident in this study as the themes and findings did not take full shape until the second phase of the data collection which involved participatory co-constructed knowledge building. Third, there is always the possibility of researcher bias within this design because the researcher has a unique, reflexive role that can be influenced by subjective interpretation. This bias can limit the validity of the emergent grounded theory. These two challenges were overcome by explicitly committing to a patient, listening stance from the beginning of the study, which was fruitful as it resulted in deepening the scope and validity of the study. Lastly, there can arise challenges in conducting this type of research distinct from a researcher’s area of expertise and familiarity as unfamiliar contexts can pose restrictions on the researcher’s role to interact reflexively with the participants. As the participants and researcher in this study are educators all familiar with the context of teaching and learning, this particular design challenge was the least applicable.

Despite the smaller number of participants and the design’s methodological challenges, the study’s findings offer important insights into the on-going discussion of the nature of learning in the 21st century, what teachers experience as they transform teaching practices, what supports teachers identify as instrumental to successfully teaching and learning in technology-rich environments and how they perceive new roles of learners in the 21st century. The findings may also provide other researchers with empirical data to build upon in subsequent research.
Chapter Four: Findings

The findings of the study are reported in two sections. The first section offers a series of personal portraits describing some of the experiences and perspectives of each of the six participants as they assumed more constructivist teaching approaches in technology-rich environments. The second section reveals the patterns of overlap in the totality of the data collected from the six participants. The data, which demonstrates six key findings embedded within three broad categories, is infused into a grounded theory.

Section One: Participant Portraits

The following illustrative narratives reinforce two key findings in the literature reviewed for the study. First, teacher conceptions of teaching and learning are factors that influence the adoption of new teaching practices (Diaconu et. al, 2012; Brand & Moore, 2011; Scardamalia, 2002; Windschitl, 2002). Second, teacher belief systems, which are the product of personal experience and cultural context, are a strong factor in a teacher’s tendency to adopt constructivist practices (Fullan, 2011; Ertmer & Ottenbreit-Leftwich, 2010; Levin & Nevo, 2009; Elmore, 2002; Levitt, 2002).

Kien’s description of his formative schooling reflected a typical industrial-aged classroom with “straight rows of desks, chalk’n’talk, and learning that was directed by teachers.” His first career was as a Social Worker with Big Brothers in eastern Ontario. During his interactions with schools, he was surprised about how little teachers actually knew of their student’s personal lives. “One day one of the boys was telling me he got in trouble because his mother had not signed a note the teacher sent home. The boy was so upset, he cried. He didn’t understand why the teacher was so angry. What the teacher didn’t know was that the boy’s
mother couldn’t read.” These types of early experiences, which amplify the importance of strong relationships to support the process of learning, motivated Kien to pursue a career in teaching.

Kien described his early years of teaching as “joyful with total freedom. I team-taught in a student-centred, open concept school with lots of laughter, story-telling, and a wide variety of exploratory learning centres. Although I was having fun, and the kids were enjoying themselves, at the end of the day I really had no idea what I was doing, and had no idea if the kids were learning.” In his 7th year of teaching, Ontario introduced EQAO assessments. Kien spent part of the summer marking the assessments. After the first day of marking, he realized “I hadn’t encouraged any critical thinking in my own teaching of Math. I had just asked kids to memorize math facts and spit out answers. I was focused on product and no process. Seeing the EQAO process was a window into thinking that changed the entire way I taught math.”

Kien identified the experience of marking EQAO assessments as the moment his transformational journey began. “I needed to know more about learning. Yet the more I learned about learning, the more complex it seemed to be. I began to question who actually owned this learning? And that changed everything. I realized that I may not know all the learning needs of my students, but what I do know is that it is our job as teachers to create the conditions to support learning. This means using an attributes-based approach that starts with identifying the strengths of students, creating shared responsibility and ownership for the learning environment, and ensuring a wide variety of tools that afford learning are available to students within that environment so they can construct and personalize their learning. This included the use of computers. I saw kids reluctant to write on paper suddenly write a whole story, and those afraid to draw begin to create pictures. Back then, using tools like hypercard and hyperstudio, students
began to create their own understandings, and to apply that learning in thousands of ways I couldn’t have dreamed of.”

Kien summed up his transformation by saying “I had no understanding of the nature of learning when I first started teaching. But as time went on, my understanding emerged. The learner, whether it is my students, my colleagues or myself, must be central to the learning process. I became a better teacher in terms of using triangulated data to drive my teaching practices, refining my work, being more purposeful, and being more differentiated. The students became actively engaged in driving their own learning. I became more aware of my students, especially those ‘kids in the middle’ who were quietly not learning, by being more attentive, and knowing if and when they needed help. My understanding of learning changed, the role of my students changed, and my role as a teacher changed.” In a recent visit with his former students, Kien was struck by the fact they told him that what they remembered most about their time together was “what the classroom felt like, and that they had voice and choice in their learning.”

Kien continued his educational career as a district-wide I.C.T consultant serving K-12 teachers, and as the Coordinator of the K-12 Beginning Teachers Program at both the district and the provincial level. In these larger contexts, he continues to apply his understanding of the nature of learning to adult learning models. No longer directly serving students, and having lost what he terms his “street cred,” Kien supports the conditions for learning while encouraging teachers to construct their own “learning or mentoring webs” that personalize and support their professional growth.

Jack attended “typically traditional top-down elementary and secondary schools devoid of any technology as we know it today.” He began his career as a Grade 6 teacher in a large urban school district in southern Ontario. As a new teacher, he explained his approach to
teaching was focused on two key beliefs. “One was to ensure I was always available and approachable to all my students, because if I was going to be a great teacher, my students had to believe that I was someone who genuinely cared for their well-being. The second was to ensure my program would be challenging to all students, regardless of their ability.”

Unlike the participants in the study whose transformational journeys began at a later point in their career, Jack was jolted into thinking more deeply about his approach to teaching his first month as a rookie teacher. “Within a few weeks of teaching my first class, I was informed I was surplus to my school. The students and parents were told the next day. The following Monday morning, I pulled into the school parking lot to receive my new teaching assignment from my principal, and noticed blue flyers peppered everywhere. The flyers were stuck on the school building, on poles and on sign posts. I didn’t read them because I was being transferred somewhere else the next day, and my heart was broken. When I went into the school, another teacher told me the flyers were created by my students and their families in an effort to keep me at their school. I was overwhelmed. To make a long story short, I actually ended up not having to leave because a more senior teacher on staff received a promotion to a central assignment. When I asked my class why they went to such great lengths to have their voices heard, I mean they were only in Grade 6, what they told me was they knew I cared about them, I tried to make learning different, and they wanted me to stay. I realized right then and there, on my 16th day on the job, that the impact a teacher has is far greater that just possessing knowledge or information. There was something about how I did learning that was working. I didn’t know what it was but I was determined to find out. This experience, although early in my career, profoundly changed how I would come to understand what I believed to be effective teaching and learning.”
As his transformational journey began, Jack maintained what he referred to as a “caring and personal” approach to teaching. However, he began to seek out a more “flexible and dynamic” pedagogical stance to learning. “The instructor and instruction should never be something, or someone, that stands still. Considering the rapid advancement in information displacement, one must be able to have students adapt and adopt a similar learning model. One never truly knows all that they need to know and change is the only constant.” Jack came to understand “the nature of learning to be far more social than I understood it to be when I first started teaching. Learning is not something that happens in one spot, but anytime and everywhere. This means learning must be encouraged to happen wherever the need and opportunity arises.” Jack became an avid supporter of technology in the learning process. “Technology allows students to demonstrate their knowledge, anytime and anywhere, through any preferred learning modality.”

Jack grew into an approach to teaching that “provided the ability to build upon an understanding of something through a creative or guided inquiry.” This changed Jack’s understanding of his role of a teacher. “This type of learning involves teachers to be more facilitators of gaining insight as opposed to direct transformers. Teachers talk less and teach more through the creation of tasks or projects. This differed from my original approach to teaching because the teaching involved not simply providing the knowledge in a packaged format for consumption, but allowing students to build upon what they understand, and to construct their own understanding in the timelines that suit them and in their preferred learning style. I as a teacher do not enable learning, learning is enabled by everyone.”

Jack continued his educational career as a district-wide I.C.T consultant serving K-12 teachers, and then took a Leave of Absence from teaching to serve as a K-20 Development
Executive in the education channel of a high-tech company. He currently works and learns alongside teachers and school leaders across North America in their efforts to support innovative technology-enabled learning.

Camille, inspired by an aunt who was a teacher, did not pursue teaching until “I had explored the possibilities of law school, graduate school, and took roles as a K-12 English instructor in Greece, and an adult ESL instructor at night and summer school.” After determining “teaching just felt right,” Camille enrolled in a pre-service education program. Reflecting upon her early teaching methodologies, Camille explained that “due to a practicum placement in the faculty with a gifted teacher who did open-ended inquiry with lots of choice and a variety of levels and activities, a series of professional development sessions on cooperative learning strategies, and the mentorship of the school’s enrichment teacher, I was exposed to a personalized approach to teaching right from the beginning of my career. I really didn’t know any other way to teach.”

As Camille’s career unfolded, she assumed the position of teacher-librarian in a large inner-city elementary school. “At that point, I still believed learning was what student’s needed to know that the Ministry laid out in curriculum documents. Partnering with other teachers to integrate technology and big ideas across the curriculum into teaching began to challenge my thinking about learning.” Camille leaned in, eyes shining brightly, and said “and then I became a Mom. My whole understanding of learning grew dendrites every which way. Having children is like participating in lifelong job-embedded professional learning regarding the nature of knowledge”!

“Watching the world of learning my daughters lived in was transformational. When they were young, they made sense of things by making connections to what they saw and did in their
lives. They made these connections differently; my older daughter through words and looking things up, and my younger daughter through video and images. I watched as they built their knowledge through these mediums by tapping into what they already knew, interacting with their environment, and then taking new ideas, examining them, and applying them to their lives. Their learning was a very social process. A communicative process. A metacognitive process. Their natural curiosity motivated them to pursue a topic and in the end, they expressed their learning differently. My daughters showed me it was no longer about me, what I wanted them to learn, or me controlling their learning. My children taught me how we all build our own knowledge through connections, and that our own contexts and experiences, things that make sense to us, influence the knowledge we create, and the process of our learning.”

Camille’s new understandings motivated new approaches to her teaching practice. She began to “further release the responsibility of learning from myself as a teacher to my students so that they became empowered to become advocates for themselves as learners. When learning is emergent and dynamic, students have choice in their learning process. It takes learning out of the textbook and gives them the opportunity to see how what they are pursing effects, and connects with the authentic context of their lives.” As her students “built their own learning and solved their own problems, I was no longer the gatekeeper of knowledge. My role became more facilitative. I provided students with the tools and the guidance to pursue their interests to solve their own problems, and I supported them to build their own learning by asking intentional and strategically placed questions.” Camille indicated that although she still uses direct instruction in some circumstances, she more frequently utilizes instructional strategies such as “performance tasks, richer open-ended inquiry, differentiated instruction, project-based learning, and strategies
such as “Ask 3 Before Me,” which encourage students to look to each other and other sources for answers before coming to me.”

Technology was not a driving force in Camille’s emerging constructivist pedagogical stance, but she is adamant technology plays a big role in supporting a learner-centric learning process. “Online environments provide opportunities for students to build knowledge and connect with each other. Graphic organizing software makes learning physically evident. Discussion forums provide spaces where kids talk about what they’ve learned, learn from others, and give each other feedback. They also provide global perspectives and connections for kids…..the access to information resources is unbelievable! Students can then take new information and feedback and apply it to their work. This makes students think. How can I apply that feedback? Will I use that feedback? If not, why not? Online environments can slow learning down, and make it visible and deeper.”

Camille continued her educational career as a district-wide I.C.T consultant serving K-12 teachers. She is currently a newly promoted middle school Vice-Principal in a large urban school district. She “is still expanding my understanding of learning” as she assists classroom teachers who are examining their teaching methodologies to improve student achievement, and more fully engage students in their own learning.

Anya, the most experienced participant in the study, never considered a career in teaching until a university professor approached her after she finished a class presentation and suggested she would be a welcome addition to the teaching profession. Inspired by his belief in her ability to connect with learners, she enrolled in and completed teacher’s college, and began her teaching journey. Over the span of 29 years, Anya “worked in two rural north-eastern school districts, one large central urban school district, taught secondary students and adult learners and
took on leadership roles as a Guidance Counsellor, assistant department head, department head, and a district-wide I.C.T., e-learning and Computer Studies consultant serving K-12 teachers.”

Anya described her transformation from a traditional teaching approach to a learner-centric approach as “a slow grow” that occurred over the course of her career. “When I started teaching, I taught secondary students the curriculum. The curriculum was the focus for the activities and assignments, and I was the one delivering the content. I used assessment to determine what students knew of the topic and to evaluate student progress. As my career progressed, Ministry directives dictated efforts and learning skills were no longer to be included as part of academic grades, and there was a big drive towards differentiated instruction. It was at that time I began to see assessment and student agency for their work as the key to effective teaching and learning.”

As a result, Anya began to use teaching strategies that were different from her familiar traditional approach. “I added learning centres, cooperative learning strategies, and additional group activities where students read with each other and discussed content with guided questions. I kept student sample work as models, or examples, to guide their learning, and invited more guest speakers and former students to come into the classroom to help students learn. I provided student choice for learning topics and demonstrations of learning, and gave feedback and conferenced with students more. Before any learning took place, I reviewed not only the content but also the expectations, goals, and success criteria with students at the start of class, unit or activity to ensure all students understood what was expected and evaluated. I obtained student feedback at the end of a course about content, activities, and my availability for assistance, and really used this data to change practice. Students gave each other feedback according to the marking scheme. In some cases, I would assess the assessment and feedback
students were giving each other. During tests and evaluations I encouraged students use their notes and whatever they had stored on the computer, tablet or laptop. I made time for students to reflect upon their learning at the end of the class or unit —through journals, exit cards and partner chats.” Although Anya indicated her evolving approach to teaching was “a constructivist work in progress,” she described the shift in her teaching as “a move from a content focus to a student focus.” She suggested to support learning today “this is the shift that needs to happen for teachers….especially secondary teachers…..they need to release the content/expectations and focus on student learning. Students need to have choice and voice in their learning activities, culminating activities and final projects.”

Anya had technology as a tool to support learning in her classroom from the beginning of her career. A passionate supporter of technologies that readily engage students and build collective knowledge, she cautioned “technology itself doesn’t mean students will learn - the teacher and the strategies for learning are still the most important.” She explained this by referencing the importance of teaching cooperative learning strategies to assist in building community, as well as the importance of inclusivity to an environment for safe learning online. Anya indicated learning today without the support of technology is reprehensible. “Using technology in learning is a required 21st century skill. Technology opens up the world to students and provides opportunities to work respectfully with diverse cultures of people, with diverse ideas from others through the use of tablets, Google Docs and blogs that encourage collaboration, reflection and sharing. As learning is a social process situated in the community and culture of the class, a teacher’s role is be mindful of and grow those knowledge building communities in which learning takes place.”
Anya is currently continuing her educational career in the classroom as an Assistant Curriculum Leader of Technology Integration, and teaching Business and Computer Studies.

**Dylan**, a fifth year teacher in a mid-sized school board in Western Ontario, began his teaching career in the same way as many new teachers today. After attending teacher’s college, he was hired as a supply and long-term occasional teacher (L.T.O). Dylan described his early experiences as positive. He worked hard to capitalize on those early experiences. “I was lucky to be a supply teacher for some extraordinary teachers. I took notes of what I saw in their classrooms, and plans. I introduced myself to other teachers, and looked for mentor teachers who could help guide me. I met several mentor teachers during my first LTO, and am eternally grateful for all their support. I quickly learned that in teaching, it was very possible to exist as an island… but I knew that for me to develop as a teacher, I needed the opposite. I began to volunteer wherever I could, and to help others when I saw the chance. I made sure that I treated every situation and every person that I met as one that I could learn from.” After one year, Dylan received a full time teaching contract.

Dylan approached teaching with “the belief that we are all lifelong learners, and that to be successful as a teacher, you need to build positive relationships with all stakeholders in a student's education, and that student success stems from a positive, supportive and safe environment.” Dylan explained that although this belief has never changed, “my approach to teaching has evolved substantially over the past five years. Initially my approach to teaching was not constructivist, but I believe I have been taking on a more constructivist approach. I have moved away from direct instruction, whenever possible, in favour of student exploration, and group sharing and reflection. We encourage and celebrate creativity and innovation in the classroom whenever we can… even when it is something as seemingly innocuous as a sand
centre accidentally becoming a habitat of mud (the clean-up was brutal, but the scientific observations that were made by a group of 3 boys had to be recognized...).” Dylan identified mentor teachers, a recent action research project, the introduction of inquiry and play-based learning to Kindergarten, and his growing confidence in teaching supported by colleagues and administrators as key factors influencing his ability to explore new teaching approaches. He clearly explained “some of the more important components of change in my understanding of teaching have been recognizing the incredible importance of enthusiastic, active listening; the importance of working daily to build and strengthen a learning community; that one of the best jumping off points for a teacher begins with the phrase I don’t know, but let’s think about how we might find out; and that some of the best learning happens as a product of a loud, or messy, or seemingly unorganized investigation by students.”

Dylan is the only participant in the study that was born and raised in a digital environment. “My elementary school had Commodore PET computers accessible from the primary grades onwards. My Dad was an editor, so whenever I was at his work after school or on weekends, I would spend hours on the old terminal systems. My interest in technology just grew from there.” Dylan expressed he “wholeheartedly believes that technology and connectivity supports learning, and supported my transition towards constructivist teaching. I think that these two tools are invaluable in our classrooms. I found that many of my students, as digital natives, were more comfortable exploring concepts using technology than sitting and using concrete manipulatives. But students need a guide to support their understanding of computer literacy, media literacy and information literacy.” Dylan explained “I also knew from my personal experiences with technology as a student just how powerful having unlimited access to information on any topic can be, but also how overwhelming it can be to navigate.” To address
this tension when teaching Kindergarten-aged learners, Dylan suggested it was important to “set-up technology for free exploration and safe use that supports student learning, and that I can adapt to their interests.”

Dylan has now assumed the position of Information and Media Literacy Teacher, and Curricular Chairperson of Technology at his school. “Using technology to support knowledge building is a new and sometimes challenging concept for many students and teachers. It is the struggle that extends our abilities, accelerates growth, and drives great teaching. But not so much that students and teachers become frustrated. Timely interventions and scaffolding are critical to learning taking place.”

Jean, a “bored but successful student” was destined to become a teacher. Born into a family of teachers, and inspired by stories shared each night around the family’s rural northern Ontario dinner table, Jean knew from an early age she wanted to pursue a career in education. During her pre-service program, Jean was exposed to one teaching methodology; inquiry learning or what was then referred to as “the learner’s way.” She described her early teaching days as “inspiring and adventurous. I built creative units and supported the children as they discovered their talents and passions. But I have to confess, I had absolutely no idea whether the kids developed any skills, and I really had no way to assess whether or not they learned anything at all.”

In the mid-90’s, “driven by reports that questioned the perceived lack of accountability in public schools, the provincial government introduced a prescribed elementary and secondary school curriculum.” Jean described the new curriculum as “challenged due to its lack of developmental stages in learning.” Yet like all teachers in this era of heightened accountability, she raced to teach all the required grade level curricular expectations. “Time for inquiry learning,
self-discovery, and personally getting to know each student in my classroom was lost. Over time, I became a very traditional standards-based top-down teacher with a student achievement driven focus.”

Although strongly committed to the evidence-based instructional strategies she was learning to use, and despite receiving recognition for her new more effective teaching practices, Jean became disheartened. “I watched many of my students become disengaged.” Memories of her own school journey flooded her thoughts. “It was then I knew my teaching really wasn’t that effective, and I became empathetic to my student’s boredom. That year I had Tyson and Warren, two young disengaged boys in my Grade 3-4 classroom. My teaching, and what I did for them wasn’t reaching these students. So I introduced a series of hands-on science inquiries and watched how student-centred activities not only reignited their desire to learn, but brought a new energy to my classroom. Although my students came alive, I was conflicted. What approach to teaching would better improve student achievement, while keeping kids excited about learning? Was it my new teaching methods, or was it encouraging kids to guide their own learning”? Jean credits an activity she was tasked with during a professional learning session as the “spark” that ignited her transformative journey. “I was asked to create a mind-map to explain my learning. Before that afternoon, I had never so explicitly been asked to think about how learning actually happens. Understanding that knowledge is constructed through personal and social connections and experiences that make sense to me changed my beliefs regarding teaching and learning forever. Right then and there, I became a crazy-focused learner of learning.”

Jean, now a Principal who has served three elementary schools in two school districts, noted that she has encountered school staff “who seem to either do traditional curriculum, instruction and assessment really well, or who do creative, innovative engagement really well. I
talk with my staff about this balance all the time. There is a time and place for both direct instruction and student-centred learning. It’s not as simple as doing just one or the other, in fact, they actually complement each other. Different approaches to instruction are a set of tools we can draw upon to teach. Teachers know different situations require different practices. Determining when to use the appropriate strategy that best meet the needs of a particular student in his or her particular context is the hard part.”

A big supporter of technology enabled-learning, Jean challenges staff who believe technology itself is the driver for engaging student learning. “Students are motivated by asking and answering their own questions, talking to others who share their interests, and solving problems or making a difference in their own lives or in the lives of others around the world. I see technology as a tool that makes what students feel is meaningful learning possible.”

Addressing these puzzles in learning has been the focus of Jean’s leadership the past fifteen years. She believes Ontario needs “to stop the swinging pendulum, and bring balance to student learning with a forward thinking strategy that includes teaching practice that reflect research on how learning optimally happens, while keeping EQAO or some sort of outside agency to assess student progress, so the demand for public accountability can be maintained.”

Jean suggests “a balanced approach will encourage a more personalized curriculum, and multiple assessments to evaluate learning outcomes that support a wider definition of student success.”

**Section Two: The Grounded Theory**

The analysis and review of the totality of the data collected in this study regarding teachers’ journeys towards more flexible, dynamic, responsive, and emergent teaching approaches in technology-rich environments makes clear transformational change is both a cognitive and affective process. Fused together by multiple and varied ways of knowing that
result in common patterns, the transformation process described in this study is an inspiring demonstration of teachers as leaders and agents of change. Through a collaborative meaning making process in which nested layers of new ways of knowing and doing are actively constructed, transforming practice is revealed as an act of teacher empowerment. The data confirms changes in teacher’s beliefs alone are not enough to drive change in teacher practice. The capacity to make meaning of those beliefs, mindfully construct new outcomes, and then act upon both the outcomes and the internal and external conditions required to support achieving those outcomes, are essential factors to driving and realizing change in teacher practice. These findings reinforce literature regarding personal professional transformation (Clandinin & Connelly, 2006, 2000, 1995, 1994; Phillion, 2005).

Three core categories arose from the synthesis of the data. Individually, the three core categories represent the stages of teacher’s cognitive and affective exploration, and the intentional collaborative action taken during personal, professional transformation. All 6 participants remind us that each stage of transformation requires meticulous attention be paid to the way change is situated and managed, as successful change has to fit the culture and context of varied working conditions (Hargreaves, 2013). Collectively, the three core categories provide the overarching framework in which the theory is grounded, and the findings reside. The framework offers the educational community a viable and practical model “from the field” which may support others as they seek to collaboratively address change and improvement across schools and districts.

- **Reflect:** The first stage of the transformation process is initiated by a period of reflection regarding the rationale for change. This initial stage is supported by the exploration of
research and evidence to ground new understandings, which deepen the capacity to articulate new beliefs.

- **Construct:** The second stage of the transformational process is a collaborative act of constructing new ways of knowing amongst colleagues. New beliefs and understandings become the outcomes of teaching practice, and new teaching practices influence new beliefs. This collaborative act of construction is an iterative process.

- **Strategize:** The final stage of the transformation process places high priority on teachers’ roles in determining an intentional strategy to put new ideas into practice, and to identify and to align the supporting conditions that enable change to happen.

![Image of the Overarching Framework in which the Theory is Grounded](image-url)
1.0 Core Category: Reflect

1.1 Teachers’ diverse experiences can be powerful motivational drivers that influence beliefs which initiate the process of transformational change.

The study’s narratives demonstrate that diverse experiences, situated in a wide range of time, sometimes ignited by a “subjective cognitive spark” (Jack) yet always propelled by a “slow growth of understanding” (Anya), can initiate the process of transformational change. Although all 6 participants in this study indicated that their experiences influenced beliefs which initiated the change process, 2 of the 6 participants in the study noted that in some cases, teachers’ diverse experiences can also act to block change, and preserve the status quo.

Motivational drivers that influence beliefs that inspire teacher development are both intrinsic and extrinsic (Pink, 2009; Sinek, 2009). Intrinsic motivational drivers were reported as: an understanding of how knowledge is constructed; an acknowledgement that teaching practices were not reaching all students cognitively, emotionally or socially; a recognition that students, and the teachers themselves, were bored in the classroom; a commitment to improving student achievement; a commitment to ensuring students have the knowledge, skills and competencies to succeed in their chosen pathway; the desire to see all students as happy, confident and productive citizens; and the acquisition of self-efficacy to act upon, and overcome perceived tensions between prescribed teaching environments touted in a heightened era of accountability, and desired organic, fluid learning-centred environments. Extrinsic motivational drivers were reported as: observations of youth culture in a technology-mediated world; pressure from school leadership, district leadership and parents to improve student achievement; weak results on large-scale student assessments; the perception of a prescribed and outdated curriculum; conversations
about teaching and learning with colleagues; and the opportunity to work in a school, or district
culture that supports the collaborative exploration of more flexible teaching practices.

It is these types of powerful internal and external motivational drivers that influence
beliefs that then begin to change behaviors, and value systems. This corroborates a body of
literature that indicates teacher belief systems, which are the product of personal experience and
cultural context, are strong factors in their tendency to adopt constructivist practices (Fullan,
2011; Ertmer & Ottenbreit-Leftwich, 2010; Levin & Nevo, 2009; Elmore, 2002; Levitt, 2002).
However, literature also acknowledges it is not always beliefs that influence behavior.
Sometimes changes in behavior precede, and lead to changes in belief (Fullan, 2011).

1.2 The exploration of research and evidence deepens conceptual understandings of
new beliefs and influences the process of transformational change.

Exploring a wide range of research and evidence is essential to supporting new beliefs
that initiate the change process. This confirms literature that states teachers are more likely to
adopt new practices when the underlying assumptions of those new practices conform to their
epistemological beliefs (Levin & Nevo, 2009; Richardson, 1996; Yocum, 1996; Pajares, 1992). All
6 participants indicate the exploration of research and evidence that changes conceptual
understandings is an ongoing process that helps make meaning of new beliefs. This
conceptualization of the transformative process is supported by Levin and Nevo (2009) who
suggest that although beliefs do drive changes to teacher practice, while teachers are
transforming their practices, they may not be able to initially articulate their beliefs. Exploring
evidence and research assists teachers in doing so. Jean explains:

“As I compared how I had always taught and to how I wanted to teach and how I wanted
my classroom to be, I read and read and read. Was anyone else out there experiencing what I
was trying to deal with? Was anyone else trying to make this change too? Reading books by other educators about learning-centred environments, about learning theory, accessing stuff in the learning sciences and tapping into blogs and websites gave words to my thoughts and my feelings. It gave me educational vocabulary for what I was experiencing and what I wanted to achieve. I was really excited to know that where I wanted to go made sense.”

The importance of research to the transformative process is supported by Levin (2012) who argues that when addressing change effectively, it is imperative “research is embraced” and “it is used as a basis for policy and continued learning” (p. 21).

All 6 participants expressed that the time required to explore research and evidence that changes conceptual understandings of learning that results in sustainable change to teacher practice was measurable in years. Anya reports:

“Research and evidence help to guide my way as I look to continue to change my teaching practice. Changing practice is a slow and steady process. I have been moving from an understanding of teaching to an understanding of learning. I have been working on this my whole career and I continue to work on it every day. There is always new research or new evidence or new ways of doing things that I have to consider along the way. These pieces that I keep bumping up against are one of the reasons I love teaching. Every year, every month is different as I evolve as a teacher, a learner and a professional.”

In the case of this study, the research and evidence focused on how teachers may approach the adoption of constructivist orientations, as well as analyzing what the impact of these new approaches to teaching, and the use of technology as a tool to support learning, may have on learning. The 6 participants commonly cited the following researchers and pedagogues that enhanced deeper conceptual understanding of constructivist orientations in technology-rich
environments: Seymour Papert, John Hattie, Heidi Hayes-Jacobs, Robert Marzano, Wil Richardson, Steven Katz, Barry Bennett, Grant Stiggins, Anne Davies, Ruben Puentedura, Marion Small, Karen Hume and Carol Ann Tomlinson. They indicated that using research and evidence not only helped make meaning of new beliefs, but that it played a significant role in throughout their decision making processes to determine what new practices they may consider adopting to assume a more constructivist pedagogical stance. Camille reports:

“The research and evidence helped me begin to guide me through my decision making process. After reading, some of the stuff I was initially thinking would work to support a more learning-centred environment, like changing the physical design of my classroom, really became kind of superficial. Sure, quads and tables are nice, but if I wasn’t relinquishing control in the classroom, and giving students agency for their learning, it really didn’t matter where the kids were sitting.”

This understanding of the impact of research is supported by Earl and Katz (2002) who argue that using research not just for surveillance but “to develop a culture of data and an inquiry habit of mind” (p. 1010) ensures cultures of inquiry are nurtured, and decisions are made with evidence.

All 6 participants were aware of short term studies reported in popular media about the impact of technology on learning. However, 5 of the 6 participants expressed concern about a perceived lack of a long-term body of evidence regarding whether the use of technology today improves student outcomes.

“It is good to have little studies that say technology improves engagement in learning, and I can see that in my own classroom. But is there conclusive evidence that the use of technology improves student achievement or improves outcomes?” (Kien).
Higgins, Xiao and Katsipataki (2012) state there is a lack of evidence regarding casual links between the use of technology and student attainment. Yet when Hattie (2009) assessed the impact of learning practices on student achievement, he found a modestly positive effect size of 0.31 regarding computer assisted instruction. Fullan and Donnelly (2013) argue the reason Hattie’s research noted such a low impact for technology on student achievement is because simulations, gaming, and web-based learning may have been “employed with poor pedagogy” (p. 11). It was strongly suggested clear longitudinal research that determines “what else technology does, and how it directly impacts on student learning” (Dylan) would benefit the educational community. Participants emphasized accruing this body of research is essential to responding to the unanswered question regarding what affordances technology offers, and what value these affordances of technology add to learning. This research was also identified as a critical factor that could impact teacher’s decisions about whether to adopt technology as a tool to support learning. The Pew Research Centre’s Internet and American Life Project Online Survey of Teachers (2013) reinforce this position. Purcell, Heaps, Buchanan and Friedman (2013) report in the survey findings that “For many teachers, technology must add demonstrable value to justify incorporation into the learning process” (p. 49).

1.3 In understanding how knowledge is constructed, teachers are influenced by the ability and capacity of technological tools to accelerate knowledge building. This understanding of the nature of knowledge accelerates teacher’s transitions to constructivist practices in technology-rich environments.

All 6 participants clearly stated that technology itself did not influence changes to their teaching practice. “The way 21st Century Learning is discussed in mainstream media leads teachers to believe that this new way of learning is very much focused on technology. But I don’t
see it that way and I think this is confusing for teachers” (Anya). They describe technology as a tool to support sound pedagogical practice, and that the tools used should be connected to authentic teaching and learning. “Technology is only a learning tool. It’s just like a pencil. A student could use that pencil to write an insightful story or they could use that same pencil to poke the student sitting next to them” (Kien). This reinforces research that indicates although technologies have specific strengths and weaknesses, specific technologies do not require specific ways of teaching and structuring content. In other words, technologies do not determine how they are to be used, technologies provide teachers with a “zone of possibility” regarding teaching and learning practices. (Mishra & Koehler, 2006; Dirkin, 2009; Dirkin & Mishra, 2010; Mishra & Kereluik, 2011).

Instead, all 6 participants identified it was an understanding of how knowledge is constructed that accelerated their transition to constructivist practices in technology-rich environments.

“My approach to teaching makes a statement about my understanding of the nature of knowledge and how it comes to be. It is constructed. When I understood the way knowledge is built, I saw technology as more than just a tool to engage students in their learning.” (Jack).

“As I better understood brain research, where knowledge is situated….it exists in the brain and the only way to get it is through constructing it….. I realized technology was a great tool to support learning communities because it makes knowledge explicit, it makes the thinking process explicit and lets students build knowledge together” (Camille).

This reinforces the literature reviewed for the study that indicates technology alone is not the driver for changes to teaching and learning in the 21st century (Santiago, 2010; Severin & Capata, 2011; Haikin, 2012, Hattie, 2011; Dillan, Wang & Tearle, 2007; Moshed, Chijioke &
Barber, 2010). Participants cited technology as an enabler to learning due to its ability and capacity to support networked learning communities that accelerate knowledge building. They explained that networked learning communities among students contribute to making thinking more visible and documenting learning, thereby deepening the learning process.

The majority of the participants caution that to deepen learning, the application of constructivist principles in technology-rich learning environments using tools such as blogs, wikis, Nings, Google hangouts, Moodles, social networking sites and other Web 2.0 tools, requires careful consideration. In accordance with Jonassen (1999), who encourages the use of online branched designs that move learning away from a linear format of instruction, Jack explains:

“As content is no longer static and knowledge is built through collaborative processes, there is no reason all students have to learn all the same facts and things all at the same time. Teachers should be encouraged to design asynchronous online environments with collaborative tools that move learning away from a linear, static model towards models that are multidirectional, and that support thoughtful conversation.”

When doing so, Camille points to the importance of “ensuring group behaviors and group expectations are clearly laid out and understood by everyone, power relationships and equity issues are openly discussed and students have time to reflect upon their own metacognitive abilities before jumping into conversations.” Jean reinforces “teachers need to be vigilant that the equity issues they already deal with in face to face learning environments, such race, class, gender, language, culture, privilege and identity, are also addressed in online environments.” Kien explains “A networked knowledge building community requires teachers actively monitor the impact of technology on learning so that it does not erode human interconnectedness. It is a
teacher’s role to nurture and monitor a safe, trusting and authentic connectivity among learners within the knowledge building community.”

Hung and Chen (2001) identify these same factors as contributing to creating vibrant and sustainable online learning communities and define the factors as “situatedness, commonality, interdependency and infrastructure” (p. 7).

All 6 participants expressed concern about the limited way technology-enabled learning may be supported in some schools today. All participants suggest learning is not maximized in schools that model a top-down, read-only approach where information is simply gathered through technologies that are “didactic, static, restrictive and controlled by experts” and where “students work in isolation, only consume content, and there is no regular personal feedback.” They were quick to point out that they did not believe it is an intentional mindset that drives teachers and schools to resist the new realities and opportunities of technology today. Rather, it is more likely a result of not understanding the capacity of technologies to support learning, and a lack of comfort using technology in different ways to respond to student’s needs. Kereluik, Mishra and Koehler (2011) confirm “teachers need to be equipped with knowledge about various technologies and be able to use them as pedagogical strategies in their classroom” (p.3).

Participants also expressed concern about a district’s capacity to demonstrate to teachers that technology is a tool they can use to do their job better. Lack of funding, inadequate professional learning and non-existent or antiquated infrastructure compound these challenges.

Participants reported, at a minimum, schools should be encouraged and supported to embrace a Web 2.0 approach (DiNucci, 1999) which mirrors the ways in which students use technology to communicate outside of school today. Christensen, Horn and Johnson (2009) describe these technologies as disruptive innovations. A Web 2.0 approach uses “wikis, blogs,
voice threads, animation, simulations, microblogging, jams, ideation tools, Google apps” where students have the ability to “access open source resources” and “social network, tag and podcast to share ideas and experiences.” These types of Web 2.0 learning tools enable “students and teachers to work online with multiple users to create knowledge and content as a community and receive feedback about learning.” Participants referred to Web 2.0 tools as “participatory enablers” that can “distribute expertise and ensure inclusivity” and “encourage multimodal analysis of content which results in deeper learning.” Participants also noted that a Web 2.0 approach “breaks down industrial schooling structures of time and space,” “supports anytime, anywhere learning that gives students more choice, voice, control and independence in their learning and the learning process itself,” “allows for 24/7 feedback regarding learning” that can result in “ensuring the responsibility and ownership for learning is shared” (All participants).

There was both strong agreement and noticeable variance in participant’s belief about whether new technology-enabled approaches touted today to support student learning, such as flipped classrooms, gamified learning and MOOCs, actually add value to the learning experience. All 6 participants cautioned against the wide-scale adoption of flipped classrooms because unless they are intentionally designed within a transformed pedagogical model, the likelihood that flipped classrooms are only traditional teaching in a digital medium is high. Based on their experience using these tools, all 6 participants believe gamified learning adds value to learning. Games such as Minecraft, Guild Wars 2, Angry Birds, World of Warcraft, SimCity and M.I.T’s Scratch were cited as innovative tools that promote exploration, curiosity, collaboration, complex problem-solving, and creative agency for learning. “Games and simulations help students to work in a group to address a conflict, reassess and alter strategy, and persist and learn through failure.” (Camille). Jack elaborates:
“When a student applies knowledge in a game, knowledge becomes a resource to the student and to the community of learners playing the game. Students are motivated intrinsically to learn the content and skills. It requires discipline and practice to acquire the expertise to succeed, and to acquire new knowledge and learn and relearn. The new knowledge and new skills constructed become transferrable in the real world.”

When discussing whether MOOCs add value to learning for elementary and secondary students, response cited on the online discussion board was varied.

“Absolutely for secondary. When students and teachers do an individual education plan, can they not supplement with online learning?” (Anya)

“I believe Moocs can be beneficial for elementary as well. Learners can participate in their regular classroom experience and then pursue individual learning through MOOCs according to their interest.” (Camille)

“Not sure this is a good idea for Elementary. Online learning is not for everyone.. also, teaching or sharing virtually, does not necessarily lend to everyone’s strengths.” (Jack)

“I think that MOOCS would be beneficial to elementary grades, particularly in the primary grades in the context of offering extensions to classroom learning, review and skills-based learning (e.g., in mathematics). Primary students enjoy using technology and exploring Web 2.0 tools, but need to have effective collaborative strategies modelled for them, and time to develop their digital literacy skills before they would be able to take full advantage of MOOCs.” (Dylan)

All participants agree with Anya, who states:

“What I have noticed though…..online learning isn’t for ALL students and ALL teachers today. We have to teach students how to learn online. MOOCs are an option for learning that
need explicit teaching to be beneficial. And technology is still an issue. Schools need connectivity and devices.”

A number of factors arose that indicate there is not yet a fulsome understanding amongst teachers regarding MOOCs. There was confusion regarding whether MOOCs are available to students in Ontario today. Some participants suggested traditional educational structures may impede the use of MOOCs. Some participants questioned how the design of MOOCs may more effectively engage students in the context, content, and community of learning. Camille suggests:

“Personal touch is key…but couldn’t students have a classroom teacher and still be doing eLearning, or a MOOC while in the class? If it’s open inquiry-the teacher could have 30 plus students doing different research/MOOCs, and be there as a facilitator of knowledge. Again-this would be a blended timetable-some class and some open time….just like the sound of it! I’m a dreamer! Students would have to reflect daily on what they learned-metacognition is key, and the teacher would help the students with next steps etc....How about if students get a “credit” for creating a learning object/artifact from their individual research/MOOC? It would fit nicely with the new SEF indicators where students have to create and maintain learning portfolios from K-12. Their learning from the year, and their individual research could be used to create something that represents what interested them the most as a learner-and then they reflect upon the whole process?.”

To which Jack responds:

“Quest2Learn in Brooklyn NY was crafted in this exact way. It is about “Personal Learning Quests. There is a great deal of research and $$$ behind these types of learning institutions.”
All 6 participants agree careful consideration of research, structures to support online environments, and the elimination of traditional schooling structures that impede flexible learning designs will be required to inform the development of MOOCs if they are to become an additional and viable mainstream approach to supporting learning for elementary and secondary students in Ontario.

Equity was a consistent issue that arose among all 6 participants with respect to technology in both the individual and online focus group interviews. All 6 participants expressed a high degree of concern about issues of equity, specifically the perceived gap in required social capital to successfully participate in online environments, issues of access to online learning and concepts such as flipped classrooms, gamified learning and MOOCs. Dylan explains:

“Even though it is seemingly ubiquitous, I think that there is sometimes an equity piece involving students who don’t have the skills to participate in online learning, and the few students who may not have access to the internet in some communities. I don’t think flipped classrooms are the revolutionary pedagogy they are made out to be. MOOCs are better; however, I think for a MOOC to be most successful, it has to be accessible from most mobile devices (eg, using HTML5), rather than a proprietary platform (e.g., Silverlight) requiring a specific browser. As for gamified learning, a student can’t game if a student doesn’t have access to game. Equity of access to devices and the internet are key factors in all this.”

5 of the 6 participants suggested the adoption an approach that supports a “personal approach to learning where students have the ability to search and find any web experience in a personalized way through meta tagging that adds data to any file so it can be found more easily at any time” and “widgets embedded in pages for individual users that customize as they identify themselves” (Jack) as the optimum approach to support learning. Participants referred to learners
in this environment as free agent learners (Project Tomorrow, 2009), whom Waters (2011) describes as learners interconnected through the internet, untethered to traditional education institutions and who leverage a wide range of tools, learning resources, outside experts to support personalized learning. However, this approach, preferred because it is personalized, is acknowledged as a stretch today for schools exploring how technology may best support student learning. One participant disagreed with this approach to learning. He expressed that it was a totally unrealistic approach to consider with the lack of infrastructure and access to technology in today’s schools. More emphatically, he felt traditional schooling structures are an important part of the fabric of socializing young children.

2.0 Core Category: Construct

2.1 Collaboratively constructing the fundamental characteristics of the learning environment among teachers and students is the most significant factor influencing teacher’s tendencies to adopt constructivist practices in technology-rich environments. It is these characteristics that drive new pedagogical practices to transform the learning experience.

The data collected reveals all 6 participants strongly believe in conditions for optimum engagement and learning. This was evidenced by comments such as: “strategies to improve student achievement are important but conditions that support learning are more important. If those conditions are not in place, it is unlikely student achievement will improve” (Jean), and “the curriculum dictates content but as a group of learners in a classroom, we create the environment that nurtures the emotional, social and physical safety that ensures learning can happen” (Anya).
A wide array of literature confirms that the learning environment is a critical component to improving student outcomes (Sheskey, 2010; Bryk, Sebring, Allensworth, Luppescu & Easton, 2009; Davis, 2001), and the probability of engagement increases when certain conditions are present within that learning environment (Quaglia, 2013; Cambourne, 1993). Models focused on the conditions of the learning environment that support the needs of students in the 21st century are numerous. Perhaps the most cited is the comprehensive five pillar model developed by The Partnership for 21st Century Skills (2009). This model suggests that each of the five pillars identified as time; flexibility of design; tools for learning; communities for learning; and policy for learning, work interdependently to spur transformation.

While an awareness that learning environments need to be adapted is an important first step to transforming learning, the findings in this study reveal that it is not enough to just be exposed to literature and models regarding the critical nature of the learning environment, nor is it enough to believe in conditions that accelerate learning. Rather, it is the act of collaboratively investigating, identifying and constructing the fundamental characteristics of the learning environment that result in new ways of knowing that is the most critical factor to transforming learning so that students in the 21st century can be better served. Kien succinctly explains “Taking the time to investigate and construct the characteristics of the learning environment, and the relationships within that environment with my colleagues, and then to extend those characteristics to the context of my own classroom, was the most significant driver in my journey to adopting more learner-centric approaches to teaching.”

To successfully implement the fundamental characteristics of the learning environment, all 6 participants stress it is absolutely imperative the act of construction moves beyond collaboration with colleagues, to include collaboration with students. Students must be afforded
the opportunity to determine what these conditions mean to their learning, and how these conditions support their learning within that environment. Participants indicated working alongside students to re-construct the learning environment is a dynamic and recursive process that responds to the evolving needs, contexts, prior knowledge, and past experiences of students. Camille articulates:

“Working together with my students to figure out how the conditions for learning will play out in our classroom capitalizes on everyone’s ideas, energy, past experiences, and expertise. It makes the learning environment owned by everyone. Teachers don’t have to know everything. But we need to be open to constructing ideas with students if we truly want to transform learning.”

For the purposes of the study, the participants provided a window into the meaning-making process, illustrating how the process unfolds. In the individual interviews, all 6 participants discussed their individual beliefs, understandings and opinions of the optimal conditions that result in more fluid and emergent approaches to learning. 8 common conditions, or supports that accommodate the cognitive and social requirements for effective learning in the 21st century, were identified. They are learning that is: personalized; authentic; supported by emerging technologies; unbound by time, place and space; inclusive of multiple perspectives and partners; adaptive and responsive; focused on well-being; and supported by a caring adult.

The 8 common conditions were shared with the participants as part of the online focus group interview. The participants first collaboratively reviewed and confirmed the 8 common conditions on the online discussion board. They then identified the conditions as preconditions to learning, and responsive factors of learning in the 21st century that deepens learning.
The preconditions to learning were noted as learning that is: personalized, authentic, supported by a caring adult and focused on student well-being. The four preconditions to learning were determined as essential and timeless, and a strong indicator of a teacher’s tendency to adopt constructivist practices. The findings in this study suggest that all learning must be authentic, culturally responsive and include cognitively challenging learning tasks supported by scaffolding that effectively responds to each student’s particular needs. To transform learning, Brown, Collins and Duguid (1989) explain “in order to learn these subjects (and not just to learn about them), students need much more than abstract concepts and self-contained examples. They need to be exposed to the use of a domain’s conceptual tools in authentic activity” (p. 34). Participants in the study indicate learning is supported by strong relationships. This approach to learning requires getting to know every student well, attending to the knowledge, skills, beliefs, backgrounds and diverse experiences each student bring to the classroom, and building a respectful and empathetic learning culture. This means “knowing students likes and dislikes, strengths and challenges, their lifestyle, their family, their peer group and what influences and motivates them to learn” (Dylan). They refer to this an “attribute-based approach to teaching that supports learning for all” (Kien). The four preconditions to learning recognize emotion drives student motivation and therefore the affective domain has a direct relationship that supports learning outcomes. Hattie (2009) identifies teacher-student relationships as having a large positive effect size of 0.72. Quaglia (2013) states “Feeling valued as a member of the school community means believing that people genuinely care about who you are as an individual” (p. 8). He argues that a learning environment that is engaging, hosts a multitude of co-curricular activities, and uses advanced technological tools is not enough to support learning outcomes. Without the foundation of caring, where students hopes and dreams
are known, understood and supported, students will not feel valued for who they are nor feel school is welcoming. A lack of attention to the importance of the affective domain that supports learning may limit student outcomes.

The responsive factors of learning in the 21st century were determined as learning that is: supported by emerging technologies, adaptive and responsive, inclusive of multiple perspectives and partners, and unbound by time, place and space. These factors respond to the changing realities of learning in the 21st century, and are strong indicators of a teacher’s tendency to adopt constructivist practices in a technology-rich environment. The findings in the study indicate these responsive factors enable authentic competency-based learning that is collaborative, occurs in formal and informal contexts, offers varied perspectives from a wide range of others, and is relevant to solving problems in the real world. Learning environments ultimately become co-constructed, agile and dynamic.

To determine what the preconditions and responsive factors specifically mean to the learning environment itself, the participants then actively co-constructed contextually relevant and deeper understandings of those optimal conditions together. Through this act of co-construction, the participants identified the holistic and interconnected nature of the fundamental characteristics of a learning environment for the 21st century.

<table>
<thead>
<tr>
<th>Preconditions to Learning</th>
<th>What this means for the Learning Environment</th>
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<tbody>
<tr>
<td><strong>Learning is….</strong></td>
<td><strong>Personalized</strong></td>
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<tr>
<td></td>
<td>• Learning is personalized by interests, readiness, context and assessment results so it reflects each individual’s skills and passions</td>
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<td></td>
<td>• Learning reflects the diverse social realities of students</td>
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<td></td>
<td>• Students make choices about their learning</td>
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<td></td>
<td>• Learning environments are designed for varied interests and knowledge so that all learners achieve their full potential and can</td>
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</tbody>
</table>
| Authentic | • Learning is not something that happens to students and teachers, rather, they are active participants in the learning process (both the what and the how)
• Learning is meaningful and connected to students’ real world
• Learning ignites the desire for continuous improvement and inspires a belief of the essentiality understanding of lifelong learning |
| Focused on Student Well Being | • Learning includes an intentional and explicit focus on the affective domain
• The positive and protective factors that support strong relationships, inclusivity, physical and mental health, engagement and self-regulation are nurtured so that there is a sense of joy in the classroom and students feel safe, cared for, valued and free to take risks
• Mutual respect is a defining characteristic of the teacher-student and student-student relationships so that students can use each other as resources and are actively engaged in constructing knowledge and learning from and with each other in addition to the teacher |
| Supported by a Caring Adult | • Relational trust is fostered through authentic listening
• Focus is on the learner and understanding the strengths and needs of each student
• A teacher, parent or mentor is a caring, supportive model and coach who guides and scaffolds the co-constructed learning experience
• High expectations for all students are evident within an environment of collective responsibility for continuous improvement
• Responsibility for learning is shared between the teacher and the students
• Strong relationships are evident between teachers, students, parents and community |

### Responsive Factors to Learning in the 21st Century
- these deepen learning within the context of the preconditions cited above

| Learning is…. | What this means for the Learning Environment |
| Supported by Emerging Technologies | • Learning cultures that support online learning and the use of a variety of tools and social media features to develop 21st century learning skills are commonplace  
• Technological tools strengthen creativity, connectivity, innovation and deepen learning  
• Technological tools offer multiple entry points for student engagement  
• Teaching about technology does not occur in isolation—technological tools are used seamlessly and purposefully as part of a natural learning process  
• All learners, including learners with special needs, are supported with assistive technologies |
| --- | --- |
| Adaptive and Responsive | • Learning is a constantly evolving or recursive process that includes reflection, questioning, collaboration, creation, investigation, learning, application, and relearning  
• Learning reflects the diverse social realities of students  
• Learning is culturally responsive and asks critical questions of current issues, the curriculum, teacher and others  
• Learning promotes an understanding of a full range of equity issues, approached from multiple perspectives in a developmentally appropriate context, using current events and students’ lives  
• Cueing systems, anchor charts, exemplars, learning goals, targets, success criteria, student work samples, descriptive feedback and other cuing and reinforcing strategies to scaffold and support student learning are evident  
• Rigour, pace, choice in learning tasks and entry points to learning are adjusted  
• Learning includes purposeful student collaboration in face to face and online communication |
| Inclusive of Multiple Perspectives and Partners | • Global engagement, social advocacy, ethical thinking, and the cultural competence required to live, work and learn respectfully with diverse groups of people are elements interwoven into all learning experiences  
• Cross-cultural understandings are cultivated and diversity and varied perspectives are valued  
• Acquiring knowledge of community and global partners as “knowledgeable members” in learning supports an authentic interconnectedness that expands learning and leadership, builds awareness of cultural and inter-generational perspectives and affords opportunities for the exploration of multiple pathways for students and their future |
<table>
<thead>
<tr>
<th>Unbound by Time, Place and Space</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Structures support anytime, anywhere learning</td>
</tr>
<tr>
<td>• Learning spaces are flexible, refer to multiple environments and offer opportunities for both individual and collaborative learning</td>
</tr>
<tr>
<td>• The designs, which may include any combination of online learning, blended learning and virtual school options to meet the needs of many different types of learners, place a learners prior knowledge, passion and interests and the ability to support active knowledge construction through social interaction at the forefront</td>
</tr>
<tr>
<td>• The environment is facilitative, content is not prescribed and the direction of the flow of learning is determined by the learning collaborative</td>
</tr>
<tr>
<td>• Mobile learning opportunities are integrated into all learning delivery models, where and when appropriate</td>
</tr>
</tbody>
</table>

Figure 6: The Fundamental Characteristics of the Learning Environment co-constructed by the participants on the online discussion board

All 6 participants indicated that although technologies afford flexible learning designs unbound by time and space, most schools today are locked into a variety of structures reflective of industrial models of schooling. These traditional structures hinder efforts to adopt new structures to support new ways of learning. Many schools still place more emphasis on individual work, abstract thought, and reasoning. Many focus on teaching students to control, confirm, and test existing information. Time and space structures such as bells, secondary courses organized by the Carnegie Unit, physical classrooms that represent traditional subject disciplines and specific age-grouping of learners are pervasive. Actualizing learning designs unbound by time, place and space is identified by all 6 participants as the most complex challenge to large-scale educational transformation. It is a source of high frustration. Participants express this type of change will require a “cultural unlearning” of many of the pervasive
structures, founded on societal beliefs and values, that are engrained in education today. Dede (2010) confirms:

“A major, often unrecognized challenge in professional development is helping teachers, policymakers, and local communities unlearn the beliefs, values, assumptions, and cultures underlying schools’ industrial-era operating practices, such as forty-five minute class periods that allow insufficient time for all but superficial forms of active learning by students. Altering deeply ingrained and strongly reinforced rituals of schooling takes more than the superficial interchanges typical in “make and take” professional development or school board meetings. Intellectual, emotional, and social support is essential for “unlearning” and for transformational relearning that can lead to deeper behavioral changes to create next-generation educational practices. Educators, business executives, politicians, and the general public have much to unlearn if 21st century understandings are to assume a central place in schooling” (p. 4).

Extensive dialogue with all partners in the sector, supported by provincial intervention in the form of new policy implementation, will be required to assist in breaking down traditional schooling structures. Anya argues:

“This can happen if there is a will to do so. Some of these types of flexible structures are already in place, and are working well, to serve the requirements of students with special needs. Education needs to scale and spread these structures so that learning becomes more active, collaborative and responsive to the needs of every student.”

2.2 The ability to activate the fundamental characteristics of the learning environment so that new pedagogical practices transform learning experiences is a significant factor influencing teacher’s tendencies to adopt constructivist practices in technology-rich environments.
Constructivist pedagogy focuses on supporting student’s cognitive capabilities by placing the learner central to the learning process, and making learning a more self-directed and socially mediated process (Brown, 2003). Teacher practice reflective of this type of pedagogical stance varies significantly from traditional models of instruction. Teaching practices supported by networked digital technologies that activate the kind of learning environments advocated by the learning sciences require significant changes in pedagogical practices (Fullan & Langworthy, 2014, Fullan, 2012; Friesen & Lock, 2010; Dede, 2010; Sawyer, 2008; Scardamalia 2004, 2006, 2010; Koehler & Mishra, 2008). The co-construction of the fundamental characteristics of the learning environment, which are supported by an understanding that knowledge is fluid and constructed, drive these significant changes in pedagogical practice to transform student learning experiences. Through my research, the findings appear to indicate that to advance teacher knowledge that assists driving pedagogical transformation, it would be helpful to strengthen teachers’ understandings of the depth and breadth of pedagogy. The findings also appear to suggest that to spur change in teacher practice, teacher voice is recognized in the design and development of next generation technologies. These technologies can support concepts students need to understand and learn, assessment for learning, and game-based learning so that teacher goals and student needs are met, and the tools can be part of a district’s current infrastructure, bandwidth and budget.

The way pedagogy is conceptualized in the literature is complex as teacher pedagogy is situated in personal beliefs about teaching goals and practices. For the purposes of this paper, pedagogy is defined using Mishra and Koelher (2006) framework that identifies the relationship between Technological Pedagogical and Content and Knowledge (TPACK), and that argues teachers are more likely to change practices if they better understand that it is the intersections of
technology, pedagogy and content that has the greatest impact on learning. The TPACK framework is founded on Shulman’s (1986) seminal work regarding pedagogical content knowledge (PCK) which helped to enlighten past distinctions between teacher’s subject knowledge and teachers knowledge of pedagogy by suggesting pedagogical content knowledge builds upon the combination of the knowledge of subject matter and pedagogy. Shulman (1986) argued teacher’s pedagogical content knowledge is a form of practical knowledge used to guide their actions in highly contextualized learning environments. Pedagogical content knowledge, influenced by teacher’s conceptions of teaching and learning that are shaped by professional and life experiences, teacher preparation and sustained professional learning (Fullan, 1991; Fullan & Hargreaves, 1996), is a critical component in the knowledge base of teaching and the ability to transform teaching practices. With the emergence of new technologies to support learning, the TPACK framework helps to explain the intricate interplay between teacher knowledge and technology integration in the learning process by proposing that quality teaching and learning only occurs when there is a relationship between technological, pedagogical and content knowledge.

**Teacher Conceptions of Teaching and Learning:** Participants describe their pedagogy as “adaptive and collaborative,” “an interdisciplinary approach to learning,” “where multiple perspectives of content and concepts are explored, questioned and shared” and one in which “students are learning within a context meaningful to their own cultural lived experiences” (All participants). To successfully transition to a pedagogical stance that places the learner central to the learning process, all 6 participants indicate it is imperative to really understand the strengths, passions and interests of students. This conceptualization of learning is supported by Glaze, Mattingley and Levin (2012) who argue that making connections between student’s personal
background knowledge and experience, and new ideas, advances new understandings and knowledge building. All 6 participants also believe it is critical to nurture a culture of inquiry so that there is a sense of wonderment and curiosity about learning. This frame reinforces the position of Jang, Reeve and Deci (2010) that students are more likely to become engaged, self-directed learners in inquiry-based classrooms. The participants believe that when a wide array of tools to enhance communication and reflective thinking are used, and when real world examples and mentoring relationships are in place to support the learning process, students develop the capacity to think and act independently. Research in the learning sciences demonstrates that student learning is strengthened when students are engaged in learning that enables them to connect and ask questions, develop and discuss problem solving strategies, and reflect upon, apply and test information and ideas that develop deeper understandings (Small, 2008; Fosnot, 2005).

While the way in which the participants describe their teaching philosophy and pedagogical stance clearly reflect constructivist principles, most do not call themselves constructivists. “My approach to teaching is constructivist but I don’t really use the term” (Dylan), “I like to think of it more in the paradigm of who owns the learning” (Kien), “call it what it is, but I don’t. I just do what I know feels right” (Camille), “I don’t really use that term. We didn’t have any background in learning theory in teachers college, and we haven’t really ever discussed learning theory since. I only know the term now because I’ve read academic stuff about it” (Jean), “although I know the term constructivism, I don’t use it to describe the totality of my teaching because it really only applies to one set of strategies” (Any) and “I don’t believe constructivism is at the centre of learning, rather the student should be. The relevant and applied curriculum is where I feel the construction goes on” (Jack). Instead, learning-centred, learner-
centric, student centred and learning that connects and engages students are terms that repeatedly arose.

While the participants describe their pedagogical stance as learning-centric, all 6 clearly state their focus on content is not reduced or ignored. Content is used to pose complex questions, and is applied to solve problems to show what has been learned. Camille explains:

“In a learning-centred environment, knowledge building is the goal. Students are making sense of what they are learning through metacognition, and applying that learning. What is taught, understanding content, and content mastery, is as important as how it is taught. Content found in subject expectations provides a basis for instruction and learning.”

**New Roles for Learners:** All 6 participants pointed out that to achieve the desired transformation needed in learning today, a significant and authentic shift in the role of students and teachers as learners must also take place. This reinforces the literature that indicates teacher conceptions of teaching and learning are factors that influence the adoption of new teaching practices (Diaconu et. al, 2012; Brand & Moore, 2011; Scardamalia, 2002; Windschitl, 2002).

Participants describe the new roles of learners in learning as “reciprocal with the ability for collaborative teams to combine knowledge to accelerate learning and construct new knowledge, sometimes face to face and sometimes through technology” (Anya). They emphasized that all learners today have the opportunity to develop critical skills and knowledge with technologies that have profoundly influenced the ways in which deep, engaging and complex learning can take place. Similar to the McKinsey Global Institute’s (2013) research, Camille explains “collaborative technologies that support distributed learning are now common place. Learners have the ability to be connected and build knowledge together, anytime and anywhere from within the classroom, in their community, or by reaching out to others around the
Participants believe this cultural shift changes the role of students as learners because it leaves behind existing roles as “passengers within the four walls of the classroom” (Kien) and “opens the world stage to help to ignite their desire to become agents of their own learning” (Dylan).

As information and knowledge is not owned by the teacher anymore, participants emphasize teachers past roles as explainers, controllers of content, and givers of information are fading, it not gone. “Sharing power in the classroom means students become authentic sources of learning for the teacher and each other, and the teacher becomes a learner alongside the students” (Kien). In describing new roles for teachers, participants dismiss terms such as active facilitator, facilitator of learning and guide on the side. They believe the terms to be static, stale and disempowering. Participants prefer to think of teachers as agents of change with the ability to inspire, mobilize and strategically scaffold learning, and of teacher’s new roles as intentional architects of learning, investigators of thought, and architects of thoughts and ideas. They emphasize the change in teacher’s roles is “a seismic shift to an agents of change, comfortable with reciprocal teaching and social media that supported regular feedback, making thinking explicit and sharing ideas online” (Jack).

In the context of this type of technology-rich learning environment, I have learned that a more fluid and adaptive participatory learning culture emerges for all learners (Grose, 2013) where:

- Critical Thinkers and Problem Solvers use “evidence and data, analyze, think critically and manage projects, solve problems and make informed decisions using digital tools and resources” (schoolweb.tdsb.on.ca);
• Collaborators work together in all mediums and settings, in both face-to-face and virtual environments, to support personalized learning and to contribute to the learning of others (schoolweb.tdsb.on.ca);
• Communicators make and share meaning and their point of view using a variety of digital tools and environments with real and online audiences; and
• Creators and innovators “demonstrate creative thinking, construct knowledge and develop innovative products and processes using technology” (www.iste.org).

Dylan sums up the impact of assuming a constructivist pedagogical stance on the new role of learners as:

“Constructivist teaching involves teachers actively taking on the role of architects of learning and students having more agency in their learning (both in how they choose to explore a topic and how they choose to represent and demonstrate their learning). The ongoing dialogue between students and the teacher drives the learning experience, and ensures that the topic/problem at hand remains in focus, while also letting students have some freedom to explore tangential interests, as extensions of their learning. It differs from non-constructivist teaching in several ways. With greater agency, students arrive at their own conclusions based on their and their peers' explorations. This involves greater processing of information (vs direct instruction and shallow processing). Students will invariably arrive at the right answer because they are following their own logic in their explorations and the knowledge is co-created. By its nature, it encourages the development of problem solving abilities and there are multiple entry points for students to jump into the problem.”

In describing their own transformation to a new type of learning role, which took years of consistent and focused effort to achieve, participants acknowledge an initial level of angst.
“When I first did it, it was very frustrating. I kept falling back into my traditional role. This happened most when I was physically standing at the front of the classroom, when I thought the kids weren’t focused, when I was tired or when we had to get something done by the end of the class, or by the end of the day. I really had to stop myself and think about what I knew my new role was. It took time, energy and effort to move from being my old teaching self to what I knew I wanted to become” (Camille).

Balancing technology-enabled learning and new teaching roles is equally as frustrating.

“At first I had too much focus on technology and not enough on content and process. Now I use technology as a tool to advance learning. I also rely on student’s expertise with technology to fill my own gaps” (Anya).

Participants indicate that students also have challenges adapting to new roles as learners.

“Most students have been learning their whole lives with teachers in charge of the classroom. They are culturally adult-dependent. It took a long time for some students to break their dependency from me for feedback, guidance and direction. But over time, they did it!” (Anya).

The Curriculum: In discussing conventional curriculum, Dede (2010) argues:

“In the legacy curriculum, little time is spent on building capabilities in group interpretation, negotiation of shared meaning, and co-construction of problem resolutions. The communication skills stressed are those of simple presentation, rather than the capacity to engage in richly structured interactions that articulate perspectives unfamiliar to the audience. Face-to-face communication is seen as the “gold standard,” so students develop few capabilities in mediated dialogue and in shared design within a common virtual workspace” (p. 3).
As a result, many common frameworks for transforming teaching and learning call for changes to the curriculum, or what is taught (Organization of Economic Cooperation and Development; International Society for Technology in Education; Canadian Council of Learning; Education Testing Services; Partnership for 21st Century Skills). These calls focus on building conceptual knowledge that results in deeper learning, the application of the “4 C skills” using technology and problem-solving through inquiry, so that students graduate with flexible, innovative and adaptive skills applicable to a wide range of future employment possibilities.

The 6 participants confirm that these competencies are part of Ontario’s curricular policy documents. However, specific revisions to modernize the Ontario curriculum were identified. A broader and more personalized, attributes-based model, grounded in learning theory and research-informed concepts of child development which focuses on transferrable skills and collaboration, and that approaches learning recursively was suggested. The skills and knowledge to learn how to learn, and collaboratively solve complex problems by applying what has been learned in innovative and entrepreneurial ways, especially with respect to sustaining boundaryless, global economies, communities and environments, should also be considered. To enable this change, the overabundance of subject-specific expectations existing in Ontario’s curriculum today that “has the capacity to lend itself to a checklist mentality” (Jean) must be reduced. This leads me to believe that although the Ontario curriculum was written with overall expectations as “shall” and specific expectations as “may,” the approach to its presentation may have been misinterpreted by some teachers. To mitigate this confusion, “Expectations should be fewer, presented in an interdisciplinary way that blurs boundaries between traditional subjects and should be focused more deeply on transferrable skills that are brought to life in a web environment using illustrative examples” (Kien).
**Strategies of Instruction**: Participant response confirms research findings that indicate the ability to translate constructivist theory and principles into effective instructional practice is a factor influencing teacher’s tendencies to adopt a constructivist pedagogical stance (Levin & Nevo, 2009; Liu, 2011; Tondeur et al, 2008; Ertmer & Ottenbreit-Leftwich, 2010; Mishra & Koehler, 2006). Constructivism is a theory of learning as opposed to a theory of instruction. As such, constructivist principles inform instruction. Jean expresses:

“My beliefs influence the way I think about learning. The way I think about learning dictates my pedagogy. Articulating what I believed to be the conditions of learning was the hardest part of changing my approach to teaching. But it also took time to link these elements to worthy instructional practices.”

Participants pointed to specific instructional strategies that augment their constructivist pedagogical stance. Like researchers Small (2008), Fosnot (2005), and Marzano (2003), participant cited instructional strategies that support meaning making, enhance knowledge building, and promote the development of conceptual frameworks, in both face to face and online learning environments. These included: generating and testing hypothesis; using metaphors and analogies to explain thinking and learning; extensive dialogue using open-ended and strategically placed higher order questions; starting questions with verbs that prompt deeper understanding and extend learning; and providing wait time after posing a question.

Scaffolding provides the context in which meaning can be made. Tapping into past experiences and knowledge to make connections; using graphic organizers to organize information and represent ideas that shape student thinking to apply it to learning; modeling; using exemplars and think-alouds; think time; and talk time were specific scaffolding practices identified to make thinking visible and deepen learning. Participants indicate that to “understand
the process of scaffolding” and “determine levels of scaffolding required to accelerate learning” means “really knowing my students well” (Any, Camille, Dylan). Other instructional practices that respond directly to student’s needs and interests to make learning relevant and authentic were noted as: case studies that provide real world problem solving and complexity; project-based learning; KWL-H charts (what we know, what we want to know, what we learned, how we know it); mind maps; exploratory and experiential learning opportunities; inquiry learning; journaling; literature circles; bansho (an instructional strategy that makes varied ways of mathematical thinking visible); and cooperative learning strategies such as jigsaws.

All 6 participants are adamant that adopting constructivist teaching methodologies does not require eliminating traditional teaching methodologies. Transitioning to a learning-centred environment is not an either-or instructional proposition. Camille explains:

“I need to balance modeling, coaching and scaffolding with direct and guided instruction because to improve student achievement requires a set of diverse teaching strategies. Some are my old true tried-and-tested strategies which are probably more traditional and objectivist, and some are my newer more dynamic and flowing strategies that support cognitive models students use for learning” (Camille).

Levin and Nevo (2009) also found that teachers who were transitioning to more constructivist orientations do not solely adopt one set of principles and practices. Speaking of teachers’ perspectives, they conclude “By the end of the study their views also supported a constructivist orientation, although most teachers continued to express both behaviorist and constructivist principles” (p. 458). This leads me to believe that that from the teacher’s viewpoint, it is a menu, or tapestry of learning opportunities and experiences based on student needs, that should be considered for adoption.
Most of the participants repeatedly mentioned the hardest part of linking theory to practice is not the initial process of identifying constructivist instructional strategies. It is figuring out when and where to use them. Constructivist practices support the construction of knowledge of topics and disciplines in a context-sensitive and interactive environment.

“Constructivist teaching is flexible. It’s dynamic. This means my role as a teacher is to be aware of just-in-time teaching strategies and all sorts of learning tools, including technology, and to be able to apply them in a range of situations, and with a range of learners who have a range of learning needs” (Camille).

“I have to be really flexible in choosing the way I guide and scaffold learning because depending on the week, the day or even the moment, the conceptual and cultural knowledge my students bring to their learning varies. They all have different experiences and perspectives which need to be made visible, and either confirmed or challenged and reconstructed” (Anya).

Participants overcome real and perceived challenges in determining when and how to implement constructivist instructional strategies through the process of trial and error. Dylan shares: “We began to experiment with inquiries and we had a few false starts and great learning opportunities for me (e.g., never try to dictate an inquiry topic arbitrarily!). Anya explains:

“Initially I wasn’t so sure of the timing of when and where to encourage and how to support student-centred learning strategies, both with and without using technology as a tool to support learning. I needed to find a different flow to stepping up and sitting back while supporting learning that was authentic. It was no easy feat, and I am still working on this every day.”

All 6 participants revealed that new learner-centric practices were harder to implement than their familiar traditional practices. However, through the process of trial and error,
reflection, student feedback, and the support of colleagues and school leadership, making changes to their teaching practices got easier over time.

**Assessment Practices:** Data collected in the study reveals formative assessment using technology is a critical component to adopting student-centred learning orientations. Papert (1993) stated “The role of the teacher is to create the conditions for invention rather than provide ready-made knowledge.” Jack reinforces:

“It is up to the facilitator of those conditions to create every possible opportunity to provide the most authentic and mutually meaningful types of assessment. Formative types of assessment must be informative for the teacher, parent and student to guide and deepen a child's understanding of a concept. Technology provides such an opportunity for all invested parties, as it can serve as evidence for any contributor in the learning process.”

Formative assessment, which occurs continually during the learning process, makes thinking visible, shapes teaching, and guides learning. Research indicates that timely, specific and descriptive feedback is key to advancing student progress (William, 2011; Chappuis & Chappuis, 2008; Crevola, Hill & Fullan, 2006). All 6 participants emphasize technology provides unique affordances for students to explore and take ownership for their own learning through metacognitive processes (self-reflection), feedback from others (peer assessment), descriptive feedback, and embedded online assessments that give instant feedback. “Technology provides opportunities for students to direct their own learning by revisiting and reviewing particular concepts and skills that require additional understandings, and reconstructing their knowledge and evolving their understandings as a result of feedback” (Kien). Turner and Wilson (2010) argue student engagement and student learning increases when students have authentic opportunities to reflect upon their learning through the process rather than just at the end. All 6
participants indicate technology can enable multiple ways and a variety of forms of assessment for and as learning. “Rather than just assessment of learning through quizzes, tests and assignments, technologies can capture examples of student learning, and the process of student learning, individually and as a group” (Jack). Participants see the capacity of technology to deepen an “attributes-based approach to learning” that “builds on student’s strengths” (Kien).

All 6 participants indicated technology contributes to their ability to assess student learning which in turn informs their teaching practice. “Data is the key to tracking student learning patterns. These patterns inform my next steps for practice so I can stay the course, or I can change my approach to teaching and scaffolding learning to more effectively meet each student’s needs” (Dylan). The participants identified effective devices for documenting learning as: digital cameras and flip cameras for images, video and mash-ups; audio-taping apps and audio-recorders; cell phones; and tablets supported by apps for editing and capturing writing, notes, learning artifacts, conferences, charts and webs that may be collated into a student portfolio that represents learning over time. “Digital tools afford instant feedback that let me assess specific learning needs in a way I have never been able to do before in my whole career”(Anya). Participants indicate that these technologies provide students the opportunity to explore and present their thinking through any preferred learning modality that ultimately makes learning more visible; helps document the learning process; assists with the creation and sharing of artifacts to demonstrate learning; and engenders greater self-reflection and deeper student engagement in the assessment process.

Most participants referenced two key challenges with implementing formative assessment using technology. The first challenge was identified as the time needed to operationalize new assessment practices. Jack explains:
“It was very inspiring watching the students begin to take ownership of their own learning, but initially I found it very time consuming. It took much longer than my old traditional assessment methods which to be honest, were really just focused on assessment of learning. Once I figured out a system my students and I could use to collect evidence of their learning, not only was it easier to manage, but I could go back and analyze the artifacts and evidence of learning they had created to inform next steps in my own teaching.”

They also expressed some uneasiness about whether technologies alone could provide the depth and latitude of feedback students need to inform new learning. Camille cautions that technology-enabled formative assessment today is not as effective as a face-to-face student-teacher conference.

“Personal face-to-face feedback that addresses a student’s specific strengths and areas of growth is really important. Uninterrupted time to connect using fluid one-to-one conversation really helps to support deeper and more complex learning. Technologies can’t pick up student’s facial expressions, emotions and body language that a face-to-face conversation can. These affective messages are important to providing feedback around learning because learning is an emotional and social process.”

Similar to strategies of instruction, this leads me to believe that from the teacher’s standpoint, technology-enabled assessment should not be considered an either-or proposition, but rather part of a menu, or tapestry of assessment tools available to teachers and students.

3.0 Core Category: Strategize

3.1 Ensuring conditions for change are in place to support the transition to a learning-centred technology-rich environment is essential to realizing change. Teachers, as
leaders and agents of change, play a critical role in ensuring the conditions are in place to support changes in teacher practice.

**Self-Efficacy**: All 6 participants identify self-efficacy as a significant condition required to successfully support transformational change. Self-efficacy is one’s belief in their capacity to succeed, or perform well, and is influenced by how one perceives situations, and how one responds to those situations (Bandura, 1977). Participants identify self-efficacy as a condition of priority because “the path to adopting a learning-centric environment is just not that clear” (Jean) and there “is lots of ambiguity to deal with as teaching practices are transformed” (Dylan). They describe self-efficacy as a highly personal and emotional condition to address.

“It included both my belief in my own ability to transform my teaching practices, as well as my need to acquire the skills to transform practices. What I mean is that it wasn’t enough to just want to change, I had to figure out how to do it and what I needed to learn to make the change happen” (Kien).

Participants explained they were initially dissuaded from teaching the way they thought they should by a number of factors. “I was initially afraid to allow students too much agency because of potential classroom management issues,” “I was worried that while my kids took control of their learning, other teachers would see me as lacking classroom management skills,” “I was concerned my noisy classroom would affect my Teacher Performance Appraisal,” “I was anxious about losing power and control in the classroom. I was used to being the only judge and evaluator of student performance” and “I was THE leader in the classroom and I had to transition from being a teacher who managed all behavior and who expected my students to unconditionally follow my teaching, to being a teacher who supported students taking ownership, initiative and responsibility for their own learning.” Jean summed it up by stating “I had to
really work to get over these things. Because I knew my kids needed to be served differently, I had to swallow my pride. Because the only thing that inhibits me is me, and my beliefs in me.”

Participants noted their self-efficacy is strengthened by factors such as: watching other colleagues modeling constructivist teaching approaches; working with like-minded teachers who were striving to expand their use of a more diverse set of teaching practices; receiving encouragement from teachers or principals about their capacity to expand their approach to teaching; and achieving success with new teaching approaches in their own classrooms. Dylan explains

“I discovered that giving students greater agency in a co-constructed environment did not lead to an increase in behavioural issues, lost time, or interventions necessary to keep our community on task. I found the opposite, in fact. This was very interesting to me since my first inquiry attempt, that was teacher-driven, was not able to keep the students engaged for an extended period because it didn’t respect their agency in topical choices” (Dylan).

From the data collected in the study, I have determined self-efficacy is strengthened most significantly by the act of collaboratively working with like-minded colleagues striving to expand their use of a more diverse set of teaching practices. For new teachers, it appears observing other colleagues model a constructivist orientation is also a significant factor. It would also appear that while self and collective efficacy is not always impacted by the encouragement or disapproval of other teachers, it can be significantly impeded by school or district leadership that does not encourage, nor provide positive feedback regarding expanded approaches to teaching and learning.

**A Supportive Learning Culture:** Participants indicate a positive, supportive and collaborative learning culture is instrumental to the adoption of constructivist teaching
approaches in technology-rich environments. Participants situate the learning culture in both the school, led by a collaborative, team-building, forward-thinking principal, and in the district, which provides more than just broad political statements about learning, but truly values learning and the learning process. This finding reflects research that indicates the context in which teachers work is a factor that can enable or hinder the conditions for optimum learning and thus the adoption of new teaching practices that support technological use (Angeli & Valanides 2005, 2009; Porras-Hernandez & Salinas-Amescua 2013).

There is abundant literature and empirical evidence that documents the power of positive school climate on learning (Thapa, Cohen, Guffey & Higgins-D’Allessandro, 2013) and that demonstrates socio-emotional dynamics are instrumental to the development of cognitive abilities and the acquisition of new knowledge (Dewey, 1916; Vygotsky, 1978; Goleman, 2006; Zambrana-Ortiz, 2011). The role of leaders is to create the conditions in which learning can flourish (Marzano & Waters, 2009; Marzano, 2003). Participants place high priority on genuine team collaboration, where teachers feel empowered to learn, explore, grow and make mistakes in order to build collective efficacy that enables transformation, especially with respect to technology-enabled learning which in many ways is new to teaching and learning. The effects of a school culture of compliance and conformity can be devastating to supporting change and improvement. Jack warns:

“As teachers move to adopt student-centred technology-enabled learning, things cannot be punitive for teachers. They need to know as they explore new practices, their change efforts may not always work. When that happens, they need to know their Principal, School Superintendent and the Director has their back. Or teachers aren’t going to try anything new.”
**Multilevel Engagement:** An understanding of the preconditions to learning, and the responsive factors that deepen learning within the context of those preconditions, requires the adoption of pedagogies that are different traditional teaching. Participants note that new conceptions of learning, and new roles for students and teachers in learning, require the support of all educational partners including students, colleagues, principals, parents and district staff. This finding reinforces Fullan (2005, 2007) who argues “Change strategies should provide mutual interaction and influence within and across all levels of the organization” (Levin, 2012, p. 18). Jean explains:

“Involving the whole community is critical to building a supportive and collaborative learning culture that will transform education for students. My experiences have showed me this is especially essential to the adults. They need opportunities to openly discuss their beliefs so that they, as teacher-parent teams, can effectively understand and build support for the structures and practices that capitalize on student voice.”

All 6 participants strongly suggest this type of learning transformation is best supported when parents, students and educational stakeholders, all of whom have varied perceptions of what a good education looks like based on their own beliefs and experience, have multiple opportunities to discuss the rationale for transformation, and are able to provide authentic input into the desired outcomes. This leads me to strongly argue that building sustainable large-scale education plans that change the culture of learning for every child, in every school, will require the collaboration of all partners serving the education sector. Each partner is a valuable source of learning. Together, all partners will need to discuss and deeply evaluate the efficacy of current educational structures and practices. Dede (2010) confirms:
“Altering deeply ingrained and strongly reinforced rituals of schooling takes more than superficial exchanges. Intellectual, emotional, and social support is essential for “unlearning” and for transformational relearning that can lead to deeper behavioral changes to create next generation educational practices” (p. 19).

**Operational Factors:** Corroborating the literature reviewed for the study, all 6 participants identify infrastructure for technology, funding and time for professional learning, and access to an array of technological tools as essential components to supporting transformational change. (Kereluik, Mishra, Fahnoe & Terry, 2013; Liu, 2011; Tonduer et al, 2008; Mishra & Koehler, 2006, 2008; Ertmer, 2005; Gulbahar, 2007).

Of the three common operational themes, participants place highest priority on an immediate investment in infrastructure, bandwidth, connectivity and points of access that are “currently non-existent or way too slow to handle the high-tech tools being developed for learning today” (Anya). Participants agreed there is “no point investing in professional learning, or determining how to deal with expanding access to technological tools, if the tools cannot be used to support the learning process” (Anya). Funding and time for professional learning regarding technology-enabled learning was cited as the second priority essential to supporting change and improvement. Participants cautioned that professional learning for teachers requires careful consideration of the context in which teacher’s teach due to the variance in tools, and the connectivity between teachers and schools within a district. Greater access to technological tools for both teachers and students was cited as the third priority.

Participants suggest a lack of access to technological tools can be remedied by combining the adoption of district-wide Bring Your Own Device (B.Y.O.D) practices, with aggressive provincial procurement that results in sourcing low cost devices that would be financially viable
for most families. Participants indicate the ongoing discussion about whether or not and how to adopt B.Y.O.D. policies and practices is “old and tired” (Jack). Some suggest that the current climate of risk-related management practices that had inhibited the adoption of B.Y.O.D policies in some districts was “born out of the fear of not being able to control what may happen in a classroom” (Jean) when in fact “teachers in those classrooms are aware of, willing and capable of directly responding to those risks” (Dylan). Others noted “Top-down I.T. policies do not impact the classroom nor result in the compliancy districts may wish to achieve because technologies inspire creativity, innovation and a whole new way of communicating and learning” (Jack). Participants strongly agree teachers must constantly look forward to see how new technologies can support student learning and improve student outcomes. Yet they also stress the importance of applying a critical lens to what they call “the spectacle of new technologies” (Camille) that are constantly introduced by high-tech companies, and purchased by school boards, to support learning. They caution “Not every single tool, app, or device can actually be the game-changer for learning it is marketed to be” (Anya).

**Personalized Professional Learning:** Opportunities for teachers to personalize their learning was identified by the participants as a critical component to successfully supporting change and improvement. Teacher choice and voice in learning ensures teacher construct their own new learning, rather than have professional learning that is “done to them” (Kien). Personalized learning designs result in an agenda for learning that is owned by the learner, and reflects their authentic learning needs.

Through the interviews with the participants, I came to understand how strongly teachers believe a wide array of professional learning designs that allow for choice, voice and personalized constructions of learning based on authentic learning opportunities directly
connected to classroom experience, and the learning goals of each teacher, are critical to the collaborative process of change and improvement. Embedded in a district’s capacity building strategy, these designs assist teachers, schools and districts in exploring their “21st century” pedagogical voice. Preferred collaborative designs, reflective of many of the attributes described in Easton-Brown’s research (2005, 2013) on powerful professional learning, were noted as: classroom observation and debriefing; demonstration classroom learning (followed by observation and debriefing); co-planning/co-teaching; collaboratively assessing student work; networked learning within or beyond the school site; and choice from a variety of professional learning sessions. Action research projects; journaling; conferences with practitioners and researchers; self-directed investigation; and book clubs were also cited. Katz and Dack (2013) reinforce that to transform professional practice that results in sustained and permanent change, activity-based professional development must give way to professional learning that deepens conceptual change, and encourages cognitive and behavioral change. Their research suggest that professional learning designs that focus on learning, support collaborative inquiry, and provide formal or informal instructional leadership can result in sustained and permanent change. All 6 participants emphasized the importance of including self-reflection and the intentional sharing of knowledge and practice; steeping professional learning in a combination of pedagogy and content; and ensuring the content is personalized, relevant and paced according to the needs of each adult learner, within these designs. Participants also suggested that multiple designs to expand professional learning opportunities for school-based mentors were critical to the collaborative process of change and improvement.

All 6 participants reported that it is critical professional learning regarding technology results in teacher’s understanding of how, when and why to use technology to support teaching
and learning. Research conducted by Kereluik, Mishra, Fahnoe and Terry (2013) affirms this finding, yet stress that knowing when and why to use it is most important. They posit “Knowing when to use a particular technology for activities such as collaboration, or why to use a certain technology for acquiring specific disciplinary knowledge, is a vastly more important, transferable, infinitely relevant type of knowledge, one that will not quickly become antiquated with ever-changing technological trends” (p. 133). Similar to assertions made by Last (2012) and Joyce and Calhoun (2012), all 6 participants suggest to sustain new technology-enabled learning practices, new structures for supporting technology at the school level need to be considered.

There was inconsistency in participant response with respect to when and how the use of technology could best be positioned in professional learning designs to support teachers in their adoption of technology-enabled learning. All but one participant asserted technology was “an enabler” (Jack) and “should be integrated into professional learning regarding constructivist teaching” (Camille). The TPACK framework (Mishra & Koehler, 2006) and the Substitution Augmentation Modification Redefinition, or SAMR model (Puente-dura, 2009), were cited as strong examples of how to position technology to support more constructivist approaches to learning. TPACK is considered a good framework for teachers to use to examine what knowledge they need to have when integrating technology. The SAMR model is seen as beneficial because it demonstrates how technology can be used as an innovation rather than simply as a substitution for traditional teaching methodologies. These two models were also seen by the participants as beneficial because they provide a common language for the collective work of teachers in their efforts to change and improve practices. The sole participant that believed technology is a distractor to learning about constructivist teaching practices indicated to lessen anxiety about transitioning to new practices, technology should be “added in after as it is
needed” (Jean). I have to come to believe this inconsistency may be due to the fact that professional learning regarding when and how to use technology requires careful attention be paid to the varied context of teacher’s work environments. Koehler and Mishra (2008) confirm that integrating technologies in the classroom is a complex and context-dependent process. They posit it is “a complex and ill-structured problem involving the convoluted interaction of multiple factors, with few hard and fast rules that apply across contexts and cases” (p. 10).

**Moving to Implementation: First Steps**

The data collected in the study reflects the voices of teachers’ personal and professional experiences. It identifies the factors that impede and accelerate their transition from traditional teaching practices to constructivist orientations in technology-rich environments. Whether teaching in elementary, middle or secondary school settings, all 6 participants reported four common strategies that other teachers may consider initially adopting in their efforts to translate learner-centric beliefs and constructivist principles from theory to practice.

The participants indicated that unleashing the potential of each of the four strategies requires thinking deeply about one’s role as a teacher, developing tacit knowledge through the process of trial and error, collecting evidence of one’s impact on student learning, and committing to focused and sustained effort over time. In adopting the four strategies as first steps to support the implementation process, the participants confirm that the knowing-doing gap can be bridged (Pfeffer & Sutton, 2000), pedagogical practice can be extended, and authentic learning environments can be realized.

**Strategy One: Share the power in the classroom so that students become partners in learning:** Of the four strategies suggested to assist teachers in creating learning-centred environments, all 6 participants place highest priority on ensuring students are partners in
learning. This is achieved by co-constructing the learning environment, building relationships with students as partners in learning, and by actively listening to students.

Engaging students as partners in learning requires the fundamental characteristics of an effective learning environment are co-constructed in partnership with students and teachers so that students have agency for learning, and the learning process itself. This study’s findings identify the act of co-constructing the characteristics of the learning environment as the most significant factor influencing teacher’s tendencies to adopt constructivist practices in technology-rich environments because it is these characteristics that drive new pedagogical practices to transform the learning experience.

Margaret Wheatley (1992) argues “What gives power its charge, positive or negative, is the quality of relationships. Those who relate through coercion, or from a disregard for the other person, create negative energy. Those who are open to others and who see others in their fullness create positive energy” (p. 39). Nurturing caring relationships that attend to the cognitive and socio-emotional dynamics of learning can be achieved by: modeling respectful conversation; honouring diverse viewpoints and varied perspectives; accessing the prior knowledge student bring to learning; and using strategies that ensure everyone is a source of learning from each another. It is these strategies that can explicitly demonstrate that relationships are at the heart of a culture of learning.

Engaging students as partners in learning requires actively listening to students. This means that teachers need to stop talking at students, and start listening to students. Hattie (2013) contends teachers transform learning in classrooms by actively listening to students to glean a deeper understanding of how they are learning, how they are experiencing their learning, and what they feel they need to better support their learning. This occurs through conversation, and
the process of pedagogical documentation that makes thinking visible (Ontario Ministry of Education, 2012). These approaches offer teachers benefits to transforming practices. When teachers know their students well, scaffolding learning and responding to student’s individual strengths and areas of growth with just-in-time interventions becomes easier, and learning becomes a dynamic, reciprocal process. Actively listening to students so that they are respected members of the learning community is relevant to both face-to-face and online discussions. Asynchronous discussions that afford flexibility, time for reflection, and spaces for knowledge construction, require carefully structured and moderated spaces so that all students are sources of learning and so that deeper conversations occur.

**Strategy Two: Applying constructivist teaching practices in technology-rich environments requires careful attention to planning:** For teachers starting to support the application of constructivist teaching practices in technology rich-environments, the participants suggest using a backwards mapping design (Wiggins & McTighe, 2011, 2005) to plan the implementation process. All 6 participants caution that backwards mapping, a vital and necessary planning process, takes time.

“If I had one piece of advice for teachers it would be that this approach to teaching and learning, which ultimately puts students in charge of their own learning, requires spending about 80% of your time on the planning process, and 20% of your time in the actual implementation process. I would also suggest you do it with a colleague because initially it’s hard work. However, expect to be amazed with what your students can achieve” (Anya).

During the planning process, teachers should consider that learning should be authentic, collaborative, include a process of investigation, discovery and inquiry, and integrate technology
as a tool to support the learning process. There should be opportunities to share new learning with wider audiences.

A similar five step backwards mapping curricular planning process is used by all participants:

- **Step One: Start with the End in Mind**- identify curricular expectations, “Big Ideas,” the learning goals and the success criteria to verify student learning to be met; co-construct exemplars at Level 3 and 4 with other teachers;
- **Step Two: Craft the Driving Question**- students construct their inquiry questions;
- **Step Three: Plan the Assessment**- determine tools to assess student learning, including the use of technology to support formative assessment that will drive deeper learning, identify and co-construct learning goals and success criteria with students;
- **Step Four: Map the Project**- organize and coordinate the human, technological and curricular supports students may need throughout the learning process, including “preparing for research, accessing resources, processing information and transferring learning” (Ontario Schools Library Association); and
- **Step Five: Facilitate the Learning Process**- support students through their inquiry project using a combination of modeling, facilitating, coaching, scaffolding and direct and guided instruction and strategies to consolidate learning. Students also moderate and assess their own and others work using the co-constructed success criteria and descriptive feedback from teachers and peers.

Attention to planning ensures learning is rigorous, challenging, and that there are structures in place to encourage interaction with content and collaboration with others.

Participants reinforce that “it would be helpful to start slowly by focusing on just a few curricular
expectations, limiting the time of the inquiry to perhaps a month, and limiting the technological tools used through the inquiry so that time is spent on mastering the design and implementation process” (Dylan, Camille, Anya). As constructivist practices support the construction of knowledge of topics and disciplines in a context-sensitive and interactive environment, augmented by technology as a tool to support learning, comfort with and knowledge of the implementation process grows both explicitly and tacitly therefore leading to an ongoing process of trial and error.

**Strategy Three: Expand technology-enabled assessment practices.** A balanced system of assessment for, as and of learning supports learning-centred environments and ensures assessment practices meet a wide variety of purposes. Technology assists in the collection and analysis of multiple forms of data regarding student progress, in real time and on a continued basis.

Participants in the study suggest that teachers who are looking to expand technology-enabled assessment practice should focus first on expanding formative assessment because formative assessment in a learner-centric, competency-based environment is a critical tool for providing meaningful feedback in order to advance learning.

“Self-assessments allow students to individually monitor progress towards their learning goals, and peer-assessments that provide feedback regarding learning and performance build skills required for life-long learning.” (Camille)

“Online environments and technologies capitalize on the ability for students to demonstrate their knowledge through any preferred learning modality, anytime and anywhere. A Google Doc to edit early and final versions of writing assignments to evaluate learning outcomes is a great way to start. Adaptive online assessments can also be useful.” (Anya)
Collecting evidence of student’s prior knowledge to guide instruction and facilitate timely, ongoing, descriptive feedback can be made easier by using technology. Teachers have available a wide array of technological tools to support high quality formative assessment practices. These digital tools include Admit and Exit Tickets such as Liniot, iBrainstorm and Wallwisher; surveys and polling tools such as Socrative, Poll Everywhere and Survey Monkey; and online graphing software such as Popplet. Teachers and students using these types of technology-enabled formative assessment tools should be encouraged to share their experiences and perceptions of the value of these tools to their roles as co-learners, as well as the impact of these tools on student motivation and engagement in the learning process with their colleagues.

As teachers gain comfort with technology-enabled formative assessment, expanding technology-enabled assessment as and of learning is the natural next step. Self-assessment, peer assessments and digital portfolios, projects and presentations using a wide range of multi-media knowledge sharing platforms such as Educreations, Book Creator, Explain Everything, Keynote, Weebly and iMovie can assist in growth in this area.

“Digital portfolios capture broad and longitudinal examples of success through a wide range of work samples that demonstrate the application of knowledge and skills in real world situations as well as growth and learning over time.” (Jack)

Learning Management Systems (LMS), or student information systems, used to support instruction and learning and monitor student progress, support teachers by informing individual learning plans, and assisting in the design of flexible groupings based on skills, interests and needs for scaffolding to maximize a blended model of personalized and self-paced student learning. Participants suggest LMS should be accessible to parents so that they also review student projects, lessons, attendance and grades.
Strategy Four: Reach out to the world: Technologies provides opportunities for students to reach out to others in local and global communities through exploration, play, research, inquiry and discovery. Students are partners in knowledge building communities regardless of the restrictions of time, age, location or space. To support knowledge building, Dede (2010) explains:

“Richly interactive complex communication among team members is not limited to face-to-face dialogue, but frequently relies on mediated interaction across distance in which the team co-constructs and negotiates shared interpretive understandings and a problem resolution strategy” (p. 20).

In an age-appropriate manner, teachers can encourage students to capitalize upon these affordances to pursue self-directed questions, learning goals and passions. Reaching out to the world to make deep connections between prior knowledge and current and historical local, regional and world events, makes learning authentic, stretches thinking, provides real audience and with the assistance of a skilled teacher, can help students develop a sense of social justice. Technologies support these authentic contexts, activities and the guidance and feedback from expert others required for situated learning that supports knowledge transfer and legitimate peripheral participation (Lave & Wenger, 1990; Wenger; 1998).

Quality teaching flourishes in supportive environments nurtured by school teams working collaboratively to improve learning. Structures and technologies in schools today support common planning time, including observation of classrooms and sharing universal designs of learning. Yet even with these structures in place, all participants lament teaching can still be an isolating profession. Like students, if teachers feel isolated, it is challenging to engage in the learning process. Teachers may wish to build personal learning networks by embracing online
knowledge building communities unbound by bricks and mortar to share and build expertise, to access mentors and to participate in flexible informal and formal professional learning. I have come to believe that with the world of education evolving so quickly, and teacher’s needs to model life-long learning for their students critical, interconnectivity with knowledgeable members has become a cognitive, affective and social necessity.

Summary

The findings of this study emphasize that change and improvement is a cognitive and affective process, influenced by a wide range of cultural and political factors, often facilitated over a number of years. It demonstrates that when teachers, as leaders and agents of change, are entrusted and empowered to collectively construct new conceptions of teaching and learning such as those advocated by the learning sciences that require significant changes in pedagogical practice, it is the act of collaborative construction that drives new forms of learning for schools and districts. When teaching practices are transformed in this way, a more fluid, context-dependent approach to teaching, and a dynamic, authentic, participatory learning culture emerges.

<table>
<thead>
<tr>
<th>Participant</th>
<th>I Used to Think Learning Was………..</th>
<th>I Now Believe Learning Is………..</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jean</td>
<td>What I did for the kids and that I had the path for them</td>
<td>The kids helping me understand their path through exploration and inquiry. I learn from them so they can learn</td>
</tr>
<tr>
<td>Kien</td>
<td>Fairly simple</td>
<td>Very complex, knowledge construction by collaborative teams</td>
</tr>
<tr>
<td>Camille</td>
<td>What students needed to know from the Ministry perspective</td>
<td>Determined by personal learning goals</td>
</tr>
<tr>
<td>Jack</td>
<td>I enabled</td>
<td>To be achieved by everyone</td>
</tr>
<tr>
<td>Anya</td>
<td>Knowing and applying the expectations by listening to the teacher, taking notes, doing the assignments and demonstrating learning through tests, quizzes and presentations. The teacher</td>
<td>Personalized and authentic. Students are given the opportunity to be responsible for their own learning and have choice in the way they learn and time to reflect upon what and how they learned. Structures are</td>
</tr>
<tr>
<td>Participant</td>
<td>I Used to Think Learning Was..........</td>
<td>I Now Believe Learning Is..........</td>
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<td>------------</td>
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</tr>
<tr>
<td></td>
<td>was at the front and students were at desks writing and listening</td>
<td>removed. Students learn in various groups or alone. Resources include each other, paper, charts, markers, technology, etc.</td>
</tr>
<tr>
<td>Dylan</td>
<td>The accumulation of knowledge by students dependent on the instructional skill and subject-specific knowledge of a teacher</td>
<td>Experiential, student-driven, accessible to all, with the curricula folded into the inquiry/exploration/problem</td>
</tr>
</tbody>
</table>

Figure 7: Participants Initial and Transformed Conceptions of Teaching and Learning

Although there remains a significant level of frustration among some teachers regarding the constraints of the traditional structures and practices embedded in schools today that impede the development of more flexible learning designs, capitalizing upon authentic technology-rich learning environments can propel deeper learning that is personalized, engaging and complex, and can result in better serving all students in the 21st century.
Chapter Five: Implications of the Study

Introduction

This study contributes to the exploration of teacher change and its impact on new ways of learning in the 21st century. The study highlights the viewpoints of teachers in the jurisdiction of Ontario, Canada. Although the study’s sample size is small, and limited to one geographical area, the findings of the study add to the existing body of empirical data regarding change and improvement in 21st education.

The study demonstrates that teachers have multiple context-specific beliefs and perspectives regarding teaching and learning. It confirms change to teacher practice is deeply influenced by a wide array of cognitive, affective, cultural and political factors beyond what individual teachers do. It shows that change is a collaborative and collective activity, in which teachers work together to develop new skills over time by supporting and reinforcing each other’s learning and practice. It reveals that as familiar teaching methodologies give way to personalized learning approaches based on student’s varied needs and contexts, the act of teaching becomes more rigorous, creative and complex, and deep, reciprocal learning-centred environments evolve. Like research that reveals the positive effects that high performing teachers have on the instructional practice of their colleagues (Leithwood, Louis, Anderson & Wahlstrom, 2004; York-Barr & Duke, 2004), the study confirms teacher leaders are influencers who build the instructional capacity of their peers to support continuous improvement, and impact positively on student learning.

The study also contributes to the current pedagogical and policy discourse regarding the development of large-scale educational plans that strive to ensure students in the 21st century are better served. To achieve real and long-lasting improvement, this study suggests transforming
educational practice to build cultures of learning is dependent upon four factors. First, transformation requires educators recognize that rather than passive responders, they are proactive agents and leaders of change empowered to collectively drive educational improvement. By analyzing local and global contexts and trends to determine their possible outcomes, and identifying new evidence-based ways forward applicable to local contexts of learning, the actions educators take today can have positive effects on preferred outcomes for learning. Second, transformation requires honest reflection on personal and professional motivation because it is motivation that drives the sustained effort required to change educational practice. Levin argues (2012) “real improvement is only possible if people are motivated individually and collectively to put in the efforts to get results. Change practice across many, many schools will only happen when teachers, principals and support staff see the need to commit themselves to make the efforts to improve their practice, and when students and parents see the desired changes will be good for them too” (p. 14). Third, transformation requires teachers work together to reinforce each other’s learning and practice, and that the practices are supported by the whole organization. Lastly, authentic and sustainable large-scale education plans that change the culture of learning for every child, in every classroom, in every school, require the collaboration of all partners serving the education sector as valuable sources of learning. As the OECD notes Ontario’s education system as a model of excellence, some aspects of the study’s findings may be helpful to other jurisdiction’s contexts, or to change and improvement efforts.

Suggestions to Support Student Learning in the 21st Century

The suggestions being advanced in this study to evolve an evidenced-based, measurable and sustainable strategy for new forms of learning cannot be considered in isolation because
change and improvement at the individual, school and system level supporting student outcomes is holistic and interdependent. The suggestions carry implications for teachers implementing practices, parents as primary caregivers, and school and district leaders who support classroom practice. They carry implications for provincial governments who set educational policy, and universities responsible for the efficacy of pre-service programs. Most importantly, the suggestions carry implications for students as key clients to the sector. Hargreaves and Shirley (2009) remind us that students must be recognized as “partners in change rather than merely targets of change services and efforts” (p. 59). Students, as partners in change, are recognized by listening to and respecting their opinions, ideas and concerns regarding change and by activating opportunities for student voice in all stages of learning (Hattie, 2013; Quaglia; 2013; Quaglia, Fox & Corso, 2010).

It is critical each one of these groups has ample opportunity to activate their voices, and share their opinions and concerns in all stages of the planning and implementation process. A nimble strategy will ensure change and improvement practices, processes, and resource allocation can be refined as a result of timely, ongoing, descriptive feedback. Implementation must be supported by rigorous, shared accountability structures so that there is coherence and consistency to practice across classrooms, schools and districts. Securing accountability requires monitoring practices, processes and resources, providing informed feedback regarding curriculum and instruction through processes such as collaborative school reviews, and committing to open and ongoing dialogue with partners in and serving the sector as valuable sources of learning. These structures assist in ensuring planned change brings about the desired improvements in student achievement, well-being and engagement in learning the educational community strives to achieve.
To Support Teachers’ Focus on Student Learning

Less emphasis on the terms “21st Century Learning,” “the best approach to teaching” and “constructivism” may assist change and improvement efforts.

To support change and improvement, less use of the terms “21st Century Learning,” “constructivism” and “the best approach to teaching” should be considered as these three terms do not appear to resonate well with teachers. The term “21st Century Learning” may be a barrier to teacher transformation due to its lack of clear definition, and the fact we are already in the middle of the second decade of the 21st century. A new conceptual framework that explicitly positions the interplay between learning theory, pedagogy, learners and learning environments at the fore, and which enables teachers to examine context-sensitive tools and artifacts used to support teaching and learning within the social, cultural and political context of real time has been suggested. The term “constructivism” does not appear to appeal to teachers considering new pedagogies and instructional methodologies in technology-rich environments. Preferred are terms that place students central to learning and the learning process, such as student-centred, learner-centric and learning-centred. Terminology found in popular literature, and sometimes within the educational community itself, regarding what may be perceived as “the best approach to teaching” in the 21st century should also be addressed. This study has revealed it is important teachers remain cautious about considering the exclusive adoption of constructivist principles and pedagogies as the standard for educational practice as there are many evidence-based practices already widely understood as drivers to improve student achievement. An effective approach to supporting student learning requires a thoughtful, fluid and dynamic range of teacher-directed and student-led strategies. The personal professional latitude to balance a
diverse array of instructional practices responsive to the differing contexts and needs of students is critical to supporting student success, change and improvement.

To assist teachers in their efforts to develop a deeper understanding of effective teaching and learning in the 21st century, it is suggested:

- One coherent research-based provincial vision of effective teaching and learning in the 21st century be established. Key policy documents, such as the School Effectiveness Framework, the Ontario Leadership Framework, the Ontario Curriculum, Teacher Performance Appraisals and the OCT Standards of Practice, should reflect the common vision to bring clarity to the role of teachers as leaders and agents of change. Illustrative examples of what effective teaching and learning in the 21st century looks like in classrooms, schools and informal learning environments should be created to support the vision.

- Once the provincial vision has been established, teaching and learning practices should be embedded into the core content of expanded two year teacher education programs. Opportunities for reciprocal teaching and learning between faculty members, teacher candidates, and associate (host) teachers in schools should be included.

**Time and space for collaboration is required for change and improvement.**

The findings of this study reveal that it is the act of collaboratively constructing new understandings with colleagues, and then collectively acting upon those new understandings, that is the most significant factor influencing change to teacher practice. If change is to be realized across many schools and districts, time and space for collaboration is a necessary condition. Systems provide lateral capacity building, professional development and training for teachers. Schools provide time for teachers to co-teach, and to participate in collaborative inquiry,
moderated marking and common planning. Individual teachers pursue self-direct professional growth. Although different, all are necessary to building system capacity.

The participants in this study have stressed the importance of adopting a wider array of personalized professional learning designs to support authentic learning. With the affordances of technology, time and space for teacher-led collaboration takes on new possibilities:

- An online space for Ontario educators devoted to networked learning and knowledge exchange should be established. The online space should be structured so that any participant can create discussion forums about learning. Discussion forums could focus on improving practice, sharing learning, co-creating teacher resources to support student learning. They could also serve as a feedback mechanism for teachers, students and developers designing next generation mobile apps, interactives and game-based learning tools during the research and development process.

- Interactive modules, supported by illustrative examples of quality teaching and learning in K-12 learning environments, could be created by teachers for teachers to support each other as they work collaboratively to bridge the gap between learning theory and instructional design, and to implement technology-enabled learning.

- To assess the array of educational resources being touted to support technology-enabled learning, the online space for Ontario educators should include the ability for teachers to share their opinions and assessment of the quality of these types of resources. This functionality could be similar to a trip advisory model.

- To support personalized professional learning designs that result in an authentic agenda for learning that is owned by the learner, limit large-scale professional development events. Funding targeted for these events could be reinvested to support evidence based
job-embedded learning designs such as classroom observation and debriefing, mentoring, and collaborative assessment of student work. For areas of the province with large distances between schools, funds could be reinvested to build the infrastructure that affords virtual classroom visits to de-privatize practice and reduce isolation.

Cognitive learning theory, research methodology, neuroscience, the effect of the learning environment on student outcomes, and teaching strategies that embrace technology as a tool to support learning should be part of all professional learning. This includes expanded two year pre-service programs.

Ontario’s education system has a strong, diverse and enviable continuum of formal programs and informal practices that support and sustain professional learning for teachers throughout their career. This investment in the professional capital of the system has been a key driver to Ontario’s success. Continued commitment to professional learning for all staff in the sector is the most important investment the province can make to prepare Ontario children for their future.

High-quality teaching is at the heart of every high performing school. Teaching requires a set of skills that are developed over many years. Malcolm Gladwell (2008) suggests professionals require approximately ten thousand hours of focused, sustained learning and practice before comfortable levels of expertise in their chosen field are realized. Ontario’s educational innovation capacity depends upon building the professional capital of the system. Capacity building is a strategic enabler to educational innovation because the adoption and implementation of extended pedagogy depends upon each and every teacher. Teacher beliefs, teacher knowledge and teacher practice must all be addressed. The infusion of digital technologies that are driving unprecedented levels of change in today’s global society requires
careful consideration of the content of professional learning for teachers, principals, district staff and teachers in pre-service programs. To deepen the sectors capacity for change and improvement, the participants in the study determined formal and informal professional learning would benefit from a focus on:

- Learning theory that supports the cognitive demands of a learning-centred environment;
- Research methodology that encourages teachers to conduct research in their classrooms and schools;
- Advances in neuroscience that explain brain plasticity and demonstrates how the brain is shaped by active learning and the interdependent relationship between cognition and emotion.
- The impact of the act of co-constructing the characteristics of the learning environment to driving new pedagogical practices to transform the learning experience.
- The ways to effectively combine technology, pedagogy and content knowledge into learning to support collaboration, networked knowledge building and the relationship between multimodal theory, multimodal analysis and instructional design. As teaching in the 21st century becomes more complex due to the proliferation of digital technologies, both TPACK model (Koehler & Mishra, 2008) and the SAMR model (Puentedura, 2009) are strong examples of how to think about positioning technology to support learning.

To Support Schools’ Focus on Student Learning

Change and improvement will benefit from school-based and system leaders who model, monitor, and sustain cultures of learning.

The Wallace Foundation’s research (Leithwood, Louis, Wahlstrom, Anderson, Mascall & Michlin, 2009) confirms that school-based leaders are the most important school-based factor in
impacting student achievement, next to teachers. While maintaining a relentless focus on quality, consistency and effort, school-based and system leaders create learning opportunities necessary for teachers to make deep and meaningful changes in their classrooms to engage students in authentic, participatory cultures of learning. Cultures of learning demand leaders who can break down traditional hierarchies, embrace distributed leadership, and create the conditions, resources, and opportunities in which collaboration, innovation, and creativity flourish (Stoll & Temperley, 2009).

Creativity is a key attribute of authentic, participatory cultures of learning. Stoll and Temperley (2009) posit creative leadership “is a disciplined process, planned for and purposeful, and geared towards engendering creativity in colleagues in order to enhance creative learning opportunities for children” (p. 75). School-based and system leaders who nurture creativity to build cultures of learning demonstrate trust and integrity, expose colleagues to new ways of thinking, intentionally relinquish control, and value the thoughts and ideas of others. They provide ample time for new ideas to evolve, challenge issues that may hinder learning for students or staff, and model risk-taking themselves.

Creativity must also be nurtured in networked learning communities where teams build collective responsibility to deliver on desired results. Networked learning communities supported by “knowledgeable members” who keep the focus and expand the learning are constructs for knowledge creation, and are an effective mechanism for change and improvement in schools. In my experience serving the education sector, I have seen dynamic school-based and system leaders create what I believe are inspiring “creative leadership ecologies” within these networked learning communities. Creative leadership ecologies capitalize upon the fusion of creative, open-ended and operational, analytical thinking, which in turn can drive deeper, more adaptive,
responsive approaches to change and improvement. Creative leadership ecologies are supported by an intentional balance of individual and collective professional learning designs that reflect a focus on learning, collaborative inquiry and instructional leadership. Katz and Dack (2013) believe this type of professional learning encourages permanent cognitive and behavioral changes in practice, and results in embedding a genuine and sustainable learning culture in the school. Creative leadership ecologies support capacity building and structural changes that are authentic, not just new ideas adhered to the purpose or structures of industrial schooling models. Harris (2008) confirms, “we cannot have twentieth century structures shaping twenty-first century leadership practices” (p. 6).

**Traditional industrial educational structures must begin to give way to more adaptive and responsive learning designs.**

This participants in this study have suggested that as an understanding of how knowledge is constructed accelerates teacher’s transitions to student-centred practices in technology-rich environments, it is imperative the understanding of how knowledge is constructed drives changes to some of the structures found in education today. Traditional industrial structures such as time, timetabling, school year calendars, class size, and silos of instruction based on discipline, age-cohort and special learning need that promote the efficiency, hierarchy and standardization required of schooling in the 20th century, must begin to give way to more flexible learning designs. To support the implementation of responsive designs, the participants suggested:

- An agile tapestry of flexible learning designs that supports a diversification of programming models should be developed. This design includes year round, semested and full year school models, with an adaptable combination of blended learning, e-learning, mobile-learning, bricks and mortar learning, custom paced, anytime, anywhere
learning, and partnerships that position learning for students in the community. Students should be afforded opportunities to seamlessly transition between programming models with choice and flexibility in the pace and intensity of learning supported by learning resources on mobile devices. Within the agile tapestry, bricks and mortar learning environments should continue to serve students of the same age range so that social and co-curricular activities such as arts, athletics, citizenship and leadership opportunities are developmentally appropriate.

- New schools could be located in businesses and community centres so that learning is moved from inside traditional school buildings to outside as part of the community.

- To support strong relationships in community neighbourhoods, and the cognitive, physical and socio-emotional development of students and their families, elementary and secondary schools should be integrated-service centres that act as hubs of the community.

- Rather than maintaining traditional educational structures that withdraw English Language Learners and children with special needs from learning environments that may result in what is described as a reductionist curriculum (Gibbons, 2002), new structures and practices that value the unique and diverse background knowledge and experiences student bring to learning in full participatory learning cultures should be considered.

- New programs focused the cross-disciplinary nature of science, technology, engineering and mathematics, and which include computer coding and design thinking; apprenticeship programs; and experiential learning opportunities relevant to the exploration and application of learning, must be expanded to fill the gaps in Ontario’s work force. This wide range of applied learning opportunities should be supported by
anytime, anywhere blended learning. Outcomes of these new experiences must be tracked and analyzed.

- With a transition towards customized and competency-based pathways, high school graduation awarded based on competency should be explored. This may be supported by credits offered through prior learning assessments, competency based assessments, work-based placements, and completion of courses on MOOCs.

**Depth and breadth of pedagogy must be expanded.**

Dede (2011) states “Teaching is like an orchestra. There are many different instruments, and to reach everyone you need to put a symphony of different kinds of pedagogy together. Learning technologies provide a set of instruments teachers can use to achieve that range of instructional strategies.” To support what the participants in the study likened to a menu of learning approaches and opportunities based on student need, the following approaches may assist in extending pedagogical practice:

- Moving beyond a 20th Century model of schooling requires the instructional core be situated within a knowledge building learning environment (Friesen & Lock, 2010). To facilitate this type of transformation, pedagogy and understanding of cognitive and affective learning outcomes need to be addressed (Fullan & Donnelly, 2013; Higgins et.al, 2012). Applying the 12 principles that serve as pedagogical and technological design parameters for knowledge building (Scardamalia, 2002; Scardamalia & Bereiter, 2006, 2010) is one way to extend pedagogy. Knowledge building communities, enabled by age-appropriate participatory, interactive digital tools, support active, open-ended exploration, play, inquiry learning and projects, during which teachers scaffold learning. This type of pedagogy extends collaboration and communication over distance and time.
It ensures deep thinking occurs within a multimodal, non-linear, participatory environment.

- Personalized learning, supported by digital content and interactive adaptive software that tailors learning according to student performance and the pace of each student’s needs, also extends pedagogy. These types of learning opportunities that demonstrate to students what they can achieve, and how they can track and customize their academic experiences, ensure students have agency for directing their own learning. Multiple measures of assessment provide feedback, and can inform instruction and instructional intervention that allow teachers to scaffold, monitor progress and intervene where required. To challenge disadvantage, personalized learning programs can support issues of identity. Written, spoken, visual, musical or multimodal forms of communication students produce that reflect their personal background knowledge and lived experiences, referred to by Cummins, Brown and Sawyers (2007) as “identity texts,” give students voice in their learning, affirm unique cultural contexts and relevancy in learning and ensure student identity is visible and respected.

- A move to mobile learning is another way to extend pedagogy, and can assist in offering a wider range of learning opportunities for all students. Referring to the future of Ontario’s post-secondary institutions, Jean-Louis’ (2011) reports that it is critical to begin to leverage Ontario’s e-learning competency into mobility. “If you want to lead, focus on mobile learning” (p. 46). This comment is applicable to elementary and secondary learning only once action has been taken to close the digital divides. A mobile learning strategy can offer digital content that is ubiquitous, personalized and available 24/7 and year round, so that students can follow their learning goals, work collaboratively with
others from any location, and demonstrate their knowledge through their preferred learning modality. Assessment can be embedded within mobile learning tools which can then drive the pace of learning forward, while simultaneously identifying requirements for remediation where needed.

To Support Systems’ Focus on Student Learning

Action must be taken to confront digital divides

Although more research is needed to determine whether technology adds value to learning, and how to effectively measure the impact of technology on student outcomes, technologies have become an integral tool to support learning in the 21st century. Shattuck (2007) confirms “educational technologies have become a critical part of the mix of resources that will improve and extend learning” (p. 23). Yet networked knowledge building communities and technical proficiency are only achievable if action to close digital divides is taken. Lack of digital infrastructure that impacts connectivity, affordable and universal access to broadband and mobile devices, and the technical skills needed to thrive in today’s society, must be addressed.

Connectivity leads to: the ability to offer a wider and more flexible range of courses to all students; increased engagement in learning; increased opportunities for students the to learn from, with and within the global community and from knowledgeable others; more robust networked learning communities for teachers; and the ability to adapt instruction and enhance real-time feedback regarding learning for all learners. This potential cannot be realized without ubiquitous technological learning environments. To confront the digital divides, the following strategies are recommended:

- Ontario has wide range of socio-economic inequities. To address the disparity of access to broadband and mobile devices, aggressive provincial procurement that results in
sourcing low cost devices financially viable for all families across Ontario should be facilitated.

- School boards should redirect funding expenditures on desktops and laptops to purchase mobile learning devices.
- Information literacy and technological skills have been identified as important to learning in the 21st century (Pellegrino & Hilton, 2013; Manyika et al., 2013; Mishra & Kereluik, 2011). To address the growing digital divide based on the ability and skills needed to use technology efficiently and effectively (ETS 2007; Kosma, 2010), a whole-system capacity building strategy regarding technology-enabled learning must be developed.

The 3 R’s remain the foundation of learning, however, a more comprehensive framework of literacy is required.

Educators understand that literacy and numeracy remain the foundation of learning. The fundamentals of reading, writing and mathematics are timeless skills that have been pervasive in education for centuries. There is long standing literature that points to the importance of extending traditional understandings of what it means to be literate (Jenkins, 2009, 2006; Temple 2005, 2006; Freebody & Luke, 1990; Luke, 2007). Jenkins (2009) explains “Participatory culture shifts the focus of literacy from one of individual expression to community involvement” (p. 4).

Networked digital technologies have made communication even more complex. Students today need a variety of skills to navigate text and media laden environments, and to think critically about language in particular contexts to succeed in learning, work and life. The requirements of digital, multimodal and multifaceted new literacies demand a new definition of literacy (Last, 2012; Roswell & Walsh, 2011; Dede; 2010; Jenkins, 2006). As Dede (2010) contends “Frameworks that discuss new “literacies” that are based on the evolution of ICT help to
illuminate this aspect of 21st century learning” (p. 24). To continue to support a strong foundation of learning:

- New definitions of literacy should continue to evolve as new applications, tools and media evolve.
- Math specialists, starting in Grade 7 and 8, should be considered for all schools.

**Broaden today’s definition of school success**

Reading, writing, mathematics and science are critical to student success. To ensure public accountability for these outcomes, education systems measure success using high quality standardized tests for summative reporting. These large-scale assessments include: EQAO; the Trends in International Mathematics and Science Survey (TIMSS); the Progress in International Reading Literacy Study (PIRLS); and the Programme for International Student Assessment (PISA). Teachers monitor and measure student progress using classroom assessments that provide feedback to students and their parents regarding student learning. Both types of measures serve important functions, and are critical to supporting student outcomes. Yet citizenship, physical, emotional, social and mental health, and a positive school climate are equally essential attributes of a strong education. To broaden today’s definition of school success, everything that matters needs to be measured.

As student-centred approaches to learning are more open-ended, and capitalize on personalization and student agency, a deeper understanding of multiple forms of assessment to evaluate a broader range of learning outcomes critical to a culture of learning is needed. There is growing body of research that suggests large scale pencil and paper assessments may be limited in their capacity to effectively measure a student’s ability to process a wide range of information and to interact with digital media, and to measure skills such as creativity, collaboration, cultural
competence, resilience and grit that are required to thrive in the 21st century. Sawyer (2008) confirms existing testing practices no longer align with the literature regarding newer understandings of learning. Zhao (2009) posits there is a possibility that international assessments do not capture a broad enough range of competencies critical to a global knowledge and innovation economy. Dede (2010) argues:

“Classrooms today typically lack 21st century learning and teaching in part because high-stakes tests do not assess these competencies. Assessments and tests focus on measuring students’ fluency in various abstract, routine skills, but typically do not assess their strategies for expert decision making when no standard approach seems applicable. Essays emphasize simple presentation rather than sophisticated forms of rhetorical interaction. Students’ abilities to transfer their understandings to real world situations are not assessed, nor are capabilities related to various aspects of teamwork. The use of technological applications and representations is generally banned from testing, rather than measuring students’ capacities to use tools, applications, and media effectively” (p. 3).

To broaden today’s measures of school success:

- A province-wide assessment tool to measure student engagement should be developed to track and monitor longitudinal student engagement data. This tool could be used at key junctures that have historically indicated lower levels of student engagement, such as in Grade 4 and Grade 9 or 10.

- Research should be undertaken to develop online interactive assessment tools that measure multiple competencies critical to new understandings of learning, and that better reflect what is valued as part of holistic student development.
• Varied forms of performance assessments, supported by extensive feedback and a growth mindset, must be embraced and valued. This includes the development of K-12 digital portfolios that contain work samples, grades, self-assessments, peer assessments and multimedia performances of understanding to demonstrate progress and learning.

A Note of Caution

Change to teacher practice and development of whole system reform models that strive to better serve students in the 21st century will be challenging. Competing interests regarding the “right” balance between formal authority, shared leadership and autonomy for the control of learning that have always existed among sector partners will intensify change and improvement processes. Tensions will arise as traditional relationships between teachers and students shift to support a culture of shared ownership for learning in which students are authentic partners. The move to more personalized curricula for students will be difficult to implement in times when there is strong public demand for increased conformity and accountability in the form of a standardized curricula. Standardized reporting timelines, practices of student retention, and a lack of alignment in governance philosophy may inflame this tension. The parameters of the collective bargaining agreements that govern teacher practice will need to be renegotiated if traditional educational structures begin to give way to an agile tapestry of flexible learning designs to support program diversification. As decision-making practices become shared, models of resource allocation may need adjustment. Investment historically allocated to support centralized structures may need to be decentralized and reinvested to support learners in local districts and schools.
Conclusion

We are approximately 15 years into the new millennium. There is much to celebrate regarding student success, and teacher capacity in Ontario. Ontario’s education system must remain committed to maintaining high expectations for all students, and to setting ambitious standards for teachers and student learning. The goals of the system must remain coherent and aligned with every day classroom practice, and all educators must be encouraged to continue to look outwards to learn with, from, and alongside other jurisdictions.

Yet past success does not ensure future success. If changes to the way we live, learn and work are beginning to outpace changes being made in education, a renewed large-scale educational plan that thoughtfully and strategically extends the success of the past decade is required. Ontario is now at a point where critical decision must be made to better serve students. Improving Ontario’s educational system solely by adding innovations to the structures of 20th century models of schooling will not be enough. Whole-system educational plans to transform learning and educational structures require a directional shift (Hargreaves & Shirley, 2009; Crevola, Hill & Fullan, 2006).

To prepare students for the demands of the future, student motivation in a culture of learning must be addressed. Knowledge, pedagogies and curricula must be adapted to support new understandings of the process of learning and ubiquitous, networked digital technologies. To shift practice to improve student outcomes, teachers, as leaders and agents of change, must be empowered to collectively shape change initiatives because teachers are the ones who make real change happen in classrooms and schools. In accordance with Purcell et al (2013), Benton-Borghi (2013) and Higgins et al (2012), this study reveals that to support teachers in their change and improvement efforts, there is a clear urgency for scholarly research that provides evidence
that technology adds demonstrable value to improving student achievement to justify its’
incorporation into the learning process. There is also a need for additional studies focused on an
educational equity perspective, classroom pedagogy and online learning designs. Our
commitment to equitable and inclusive education must be deepened. A transparent, accessible
process by which all partners serving the sector reach consensual decisions regarding the
policies, practices and outcomes that ensure our education system becomes more innovative,
integrative, forward-thinking and sustainable, must be adopted. Igniting these forces will make
certain what and how students are learning is engaging, relevant, and measurable, and that
curriculum, instruction, assessment practices, and learning environments are modernized.
References

p. 3-12

American Association of Colleges and Universities. (2007). College Learning for the New
Global Century. Washington, DC: *AACU*

Technological Pedagogical Content Knowledge. *Journal of Educational Computing
Research, Vol 48(2)*, 199-221


Record*. http://www.tcrecord.org ID Number 17112


Battista, M. T. (1999). The mathematical miseducation of America's youth: Ignoring research
and scientific study in education. *Phi Delta Kappan 80*: 425-433


In Leithwood, K., McAdie, P., Bascia, N., & Rodrigue, A. (Eds.), Teaching for Deep
pp. 17-25.

Benton-Borghi, B.H., (2013), A Universally Designed for Learning (UDL) Infused
Technological Pedagogical Content Knowledge (TPACK) Practitioners’ Model Essential

Berry, B. (2011). Teaching 2030: What we must do for our students and our public schools-now and in the future. New York: Teachers College Press


Elmore (Eds.), Handbook of complementary methods in education research (pp. 375-385). Mahwah, NJ: Lawrence Erlbaum.


Dirkin, K. H., & Mishra, P. (2010). Values, beliefs, and perspectives: Teaching online within the zone of possibility created by technology. In D. Gibson, & B. Dodge (Eds.), Proceedings


Grose, K. (2013) Beyond Bricks and Mortar, Presentation at ORION Conference, Toronto


International Society for Technology in Education. (2007). The educational technology standards and performance indicators for students. Eugene, OR: *ISTE*

Jang, H., Reeve, J. & Deci, E.L. (2010). Engaging students in learning activities: It is not autonomy support or structure but autonomy support and structure. *Journal of Educational Psychology, 10* (3), 588-600


Marzano, R., Waters, T., & McNulty, B. (2005), School leadership that works, Alexandria: VA: *Association for Supervision and Curriculum Development*


Marzano, R. & Waters, T. (2009). District leadership that works. Bloomington, IN: *Solution Tree Press*


Ontario Ministry of Education. (2013). Know Thy Impact: Teaching, Learning and Leading: An Interview with John Hattie. *In Conversation, 4* (2)


Organization of Economic Cooperation and Development. [www.oecd.org](http://www.oecd.org)


Organization for Economic Co-operation and Development (OECD) (2011). Education at a glance. Retrieved from [www.oecd.org/document/2/0,3746,en_2649_37455_48634114_1_1_1_37455,00.html](http://www.oecd.org/document/2/0,3746,en_2649_37455_48634114_1_1_1_37455,00.html)


Shattuck, G. (2007). The historical development of instructional technology integration in K-12 education. Retrieved from the University of Georgia website:


Vygotsky, L. (1934) 2. Piaget’s Theory Child Language and Thought. (This chapter is an abbreviated version of the preface written by Vygotsky for the Russian edition of Piaget’s first two books (Gosizdat, Moscow, 1932), Windschitl, m. (2002). Framing constructivism in practice as the negotiation of dilemmas: An analysis of the conceptual, pedagogical, cultural and political challenges facing teachers. *Review of Educational Research, 72* (2), 131-175


Online: http://www.marxists.org/archive/vygotsky/works/words/ch02.htm


Zambrano-Ortiz, N.J. (2011) Pedagogy in (E)Motion: Rethinking Spaces and Relations, *Explorations of Educational Purpose (Vol 16)*