FOSTERING GLOBAL COMPETENCIES AND DEEPER LEARNING WITH DIGITAL TECHNOLOGIES RESEARCH SERIES

CREATIVITY AND INNOVATION IN TEACHING AND LEARNING: A FOCUS ON WHAT THE RESEARCH SAYS

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EXECUTIVE SUMMARY

The reality of our current times is that creativity and an innovative mindset are requirements to succeed. The recent years have seen a plethora of varied research produced about creativity and innovation much of which has been aggregated and gathered here as the body of this study.

A prevailing axiom in contemporary research on creativity is that creativity is not an inherent attribute, but rather a skill that can be developed through education. Using this as an organizing principle, teachers and pedagogical practices play a central role in the development of creativity and innovation. This study summarizes educational literature in order to look at four areas of teaching, learning, and educational policy in creativity and innovation. Figure 1 shows how the present study is organized.

**Figure 1: Fostering Creativity and Innovation in Teaching and Learning at the Toronto District School Board: A Focus on What the Research Says**
Creativity is a concept that has numerous varied definitions. A major view of creativity in education, and the view used in this study, is that it has two components: an element of originality and an element of effectiveness. Originality revolves around something new being generated, whether it is a process, idea, or thing. Effectiveness involves this original idea being something of use that can achieve a tangible end. Both elements must exist in tandem for creativity to be present.

Creativity in education is of importance as contemporary times demand flexibility in students and the ability for them to self-learn new knowledge. Convergent thinking, finding one answer using existing information, and divergent thinking, finding multiple potential solutions to a problem, are both promoted within the classroom. The creativity inherent in the latter connects to the idea of moulding students into innovators who solve problems by rearranging and reorganizing a problem to find multiple potential solutions.

Innovation is connected to creativity, and even includes it, but also it is a unique concept on its own. While creativity involves generating something new that could have a use, innovation involves actually implementing the creative idea and making it a reality. Both creativity and innovation work best in environments where they are enabled by supportive people and processes.
Following is a collection of vignettes of best practices found in the literature about instilling student creativity and innovation. The reader is advised to study the complete study\(^1\) for full descriptions, including citations. Figure 2 summarizes the research-based instructional practices driving student creativity and innovation.

**Figure 2: Summary of Research-based Instruction Driving Student Creativity and Innovation**

**Promote Creativity as a Skill Accessible to All Students**

**Provide Ample Time**

**Use Classroom Assessments Which Promote Understanding & Self-Improvement**

**Make the Classroom a Place of Investigation**

**Provide Creative Learning Experiences**

**Promote Creativity as a Skill Accessible to All Students:** Research has shown that creativity can be improved upon and taught to students. Once, mistakenly, thought of as the jurisdiction exclusively of people of genius or high intelligence, creativity is accessible for all students.

\(^1\) For further information on this, please see: Fostering Global Competencies and Deeper Learning with Digital Technologies Research Series: Creativity and Innovation in Teaching and Learning: A Focus on Innovative Intelligence (I2Q) Pilot Program (Sinay, Nahornick, & Graikinis, 2016).
Make the Classroom a Place of Investigation: Rather than have the classroom be a place where students memorize specific, inflexible methods to solve problems, the literature suggests making it into a place of investigation where experimenting to solve problems in novel and creative ways is promoted. Encouraging students to get “stuck” on problems and letting them know those mistakes are okay has been shown to improve creativity and innovation. Further, having students not fixate on grades leads to a spirit of investigation and creativity emerging in the classroom.

Provide Ample Time to Work on Problems: Creativity cannot be rushed so students should be given ample time to tackle interesting and challenging problems.

Provide Creative Learning Experiences: Research shows that when teachers create learning experiences that use open ended questions and promote inquiry-based problem solving, the opportunity for students to improve their creativity and innovation is increased. In addition, a learning environment associated with open ended inquiry associated with science and technology works well to develop creativity in students.

Use Classroom Assessments Which Promote Understanding and Self-Improvement: The type of assessment used by teachers greatly affects motivation and creative output of students. Research shows that in order to promote creativity, self-improvement and understanding should be the goal of assessments and that assessment pressure related to students fixating on grades should be reduced. Further, classroom assessment environments that lead to social comparisons between students are a deterrent to the development of creativity.
TRENDS IN LEARNING SCIENCE RELATED TO CREATIVITY AND INNOVATION

This section looks at contemporary trends within educational research related to creativity and innovation.

21st Century Global Competencies: These competencies include creativity and innovation which together with collaboration, effective communication, critical thinking, and digital fluency with technology have grown in importance in diverse areas of life and are widely considered as student targets in several international educational frameworks. These global competencies have been shown to be imperative for students to compete in the present multi-faceted and globalized world. Amongst the competencies, creativity is linked to improved memory, problem solving skills, student satisfaction, well-being, and engagement.

Experiential Learning: Is the process of learning through firsthand experience rather than reading about other people’s knowledge. Experiential learning, either field-based learning or classroom-based learning, allows students to take ownership of tasks and learn through making mistakes. Field-based learning includes apprenticeships, internships, practicums, field-trips, and other experiences that allow students to extend themselves beyond the classroom to the real world. Classroom-based learning includes “hands on” activities within the class such as case-studies, simulations, role-playing, and cooperative learning. Both types of experiential learning have shown to improve student retention, dropout rates, self-esteem, and engagement.
**Authentic Learning:** Involves the usage of multi-disciplinary real life problems as a method to generate student engagement and develop 21st century global competencies. Specifically, authentic learning looks to arm student with flexible problem solving techniques that can be used in a variety of classroom and real life contexts. Authentic learning has become an integral component of Science, Technology, Engineering and Mathematics (STEM) education moving away from memorization of formulas towards making the classroom a place of investigation.

**Teaching for Successful Intelligence:** Involves teachers matching student learning experiences to their individual analytic, creative, and practical abilities. Often this involves organizing students into similar learning types in order for teachers to cater to their abilities and reach as large a cross section of their classroom as possible.

**Educators are Curators of Innovation:** This paradigm of learning involves educators inspiring student learning by carefully selecting, as a curator would, relevant and inspiring information to present to them. The intent is for teachers to select content which generates excitement in their students and a culture of inquiry and investigation.

**Student-Centered Learning:** The central element of this type of learning is students being the constructors of their own learning rather than just receivers of information. There are three major types of student-centered learning: a) *Inquiry-Based Learning:* This form of learning involves students leading their own inquiry into new knowledge by asking questions, looking for information, and generating the topics of inquiry. Inquiry-based learning has been shown to assist with student achievement by providing students with opportunities for creativity, exploration, and pattern building.
b) Problem-Based Learning: Problem-based learning challenges students to solve complex, real world problems. Students are actively engaged to seek out the appropriate information to solve the problem independently. This form of learning has been shown to provide advantages to students in critical thinking, learning development, and improved fluency in mathematics. c) Design-Based Learning: Design-based learning involves students generating knowledge through the act of creating. This area has shown popularity in the sciences and connects well to STEM-based educational plans.
Building innovation capacity for teaching and learning at schools across Canada will allow school districts to remain leaders in education. However, “Innovation is not just about ideas that don’t have any framework” (Malloy, 2016a). For innovation to take place, schools need long-term strategies. The Toronto District School Board (TDSB) currently nurtures creativity and innovation through many pockets of innovative programs and the cultivation of these student global competencies are part of its current policy. The narrative for innovation for the TDSB was put forward by the Director of Education in the spring of 2016: Unleashing Learning is a new vision for learning at the TDSB, which provides the framework where student creativity, together with the other global competencies of critical thinking and problem solving, communication, collaboration and leadership, and global citizenship and character can flourish (see Figure 4).

**Figure 4: TDSB’s Unleashing Learning: A New Vision for Learning**

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**Source:** (Malloy, 2016b, p. 11)
Capacity however, by its very nature is built on existing organizational structures and ways of knowing. As new promising approaches and initiatives to increase teaching and learning emerge, the TDSB can take advantage of the experience and the brilliant work currently present at the system level. As the TDSB Director acknowledges, “We are not starting at some new path; we are not moving to some new direction that it doesn’t have a significant platform. Build on what has been, we are moving forward” (Malloy, 2016a). There are several avenues at the district and school level that can be pursued to foster creativity and innovation within the current vision, Unleashing Learning.

A Well-Articulated View for the Future is essential in fostering creativity in students. In Ontario, a well-organized push is in the process to improve creativity and innovation. Investments in technology and innovative teaching practices are seen as vehicles for increasing the opportunities for student-centered work. The TDSB is pursuing these aims through many pockets of innovation. Examples include the Teaching and Learning Educational Technology Plan and additional initiatives that further develop teacher and student entrepreneurship skills. Official Policy and Policy Coordination must promote creativity and innovation. As official policy is the engine behind any change, it must be placed at the forefront of promoting creativity and innovation. Specifically, the types of professional learning available, assessment practices used, and curriculum policies in place must align themselves, along with adequate funding, to this goal.

Leadership and Supports must guide administrators, educators, parents, students, and communities towards the goal of creativity and innovation. This happens through transparent and authentic reporting of progress to all stakeholders by leadership. Support of leadership is essential. One of the best support mechanisms is coaches who act as agents of change by
training teachers to enact specific initiatives and lead changes in school culture. Along with quality leadership, resources and support staff are imperative to promote creativity and innovation.

**Contemporary Learning Environments** are important to grow as a means to develop creativity and innovation. The environments must support diverse ideas and perspectives and allow students the opportunity to learn from trying new things and struggling with tasks that do not have an immediate solution. Further, the physical environment should provide collaborative spaces for group project work, connected classroom capabilities, and seamless technological integration.

**Professional Learning** is crucial for any initiative to take hold as teachers must be trained in order to achieve specific goals such as increased creativity and innovation. Professional learning gives educators new ideas and practices and helps create a sense of belonging and purpose affiliated to the topic of the professional learning. With programs such as the *Teacher Learning and Leadership Program*, Ontario is at the forefront of promoting professional learning.

**Professional Learning Models** must be employed through the year in an organization looking to carry out complicated initiatives. Both formal, (including professional learning days, school based initiatives, and visits to other schools) and informal (learning partnerships, study groups, personal learning networks) professional learnings have each been shown to promote growth in areas such as creativity and innovation. The combination of formal and informal professional learning is essential to have teachers and administrators explore new ideas, try new things, and grow as educators.
Assessment of Learning Skills including assessment of 21st century skills is imperative. As many of the 21st century skills are not easily quantifiable, new methods to assess them are required. With this in mind, standardized testing needs to have components beyond merely memorization and recall and ideally include critical thinking, inquiry, and problem solving elements. To best assess these skills, research has shown that the assessments must be sufficiently complex, authentic, and connected to real world examples.
Successful schools and school systems around the world promote personalized, student-centered and skills-based instructional practices to improve students’ innovation and creativity skills. The concepts of innovation and creativity are increasingly gaining attention among educational scholars and practitioners (Amabile, 1989; Gustina & Sweet, 2014; Robinson, 2001; Sawyer, 2006; Vygotsky, 2004). Past research indicated that there is a relationship between creativity and learning (e.g., Karnes et al., 1961; Torrance, 1981), and creativity can be viewed as a panacea for the economy, the individual, the society, and the education (Craft & Jeffrey, 2001). In addition, high creativity capital is valued in STEM fields and creativity is linked to a nation’s prosperity (Brink, 2014; C21 Canada, 2012; European Union [EU], 2009; Florida, 2002; National Academy of Sciences, 2007; Organization for Economic Co-operation and Development [OECD] 2000; Partnership for 21st Century Skills [P21], 2004).

Teachers can play a significant part in nurturing students’ creativity and innovation and their importance of employing innovative teaching to increase students’ creativity has been widely acknowledged in the literature (Ayverdi, Asker, Öz Aydin, & Sanaş, 2012; Beghetto, 2005; Esquivel, 1995; NACCCE, 1999; Sharp, 2004; Simplicio, 2000). Learning experiences which lead to creative products and creative processes could
be delivered by teachers who are well prepared to do so. Teachers need to be reminded that “’creativity is not mysterious, elitist or inaccessible” (Simmons & Thompson, 2008, p. 606) and teachers who are unprepared may need training to explain what it takes to use innovative teaching which leads to the cultivation of student creativity and innovation.

As the largest and most diverse school district in Canada, the Toronto District School Board (TDSB) is an ambitious organization running several pilot programs in educational innovation. Currently, the TDSB attempts to improve its innovative approach in teaching and learning. As part of this effort, the Board has invested in assessing the innovative capacity of our teachers in different programs. This report is the second in a series of our research studies on Fostering Creativity and Innovation in Teaching and Learning at the Toronto District School Board which is released as part of the Fostering Global Competencies and Deeper Learning with Digital Technologies Research Series\(^2\) which focuses on what the research says in regards to best instructional practices to foster creativity and innovation and what needs to be done at district and school level to scaling up.

**WHAT THE RESEARCH SAYS ABOUT CREATIVITY, INNOVATION, AND INNOVATIVE THINKING**

In this section, the review of literature will summarize relevant research in the area of creativity and innovation in teaching and learning. The literature review will focus on three areas: (1) creativity, innovation and innovative thinking, creativity in the classroom, teachers’ perceptions and conceptions about creativity, and school supports of innovative teaching; (2) best instructional practices to promote students’ creativity and innovation;

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\(^2\) Fostering Global Competencies and Deeper Learning with Digital Technologies Research Series: Creativity and Innovation in Teaching and Learning: A Focus on Innovative Intelligence (I\(^2\)Q) Pilot Program (Sinay, Nahornick & Graikinis, 2017).
and; (3) trends in learning science research. Policy implications follow the literature review.

**CREATIVITY**

Creativity is a multidimensional concept that has elicited numerous ways to define it. Within the educational context a clear understanding of creativity is important. Often, creativity is viewed by teachers through the limiting scope of exclusively artistic or intellectual acuity (Moran 2010). The disadvantage with unclear or misguided scope can lead to the view that some people are creative inherently while others are not (Plucker, Beghetto, & Dow, 2004). Clear understanding of what creativity is within the educational context provides educators with the tools to aid students in producing innovative projects, solving problems, and contributing original and useful ideas.

There are varied ways to define creativity. Some useful definitions exist. Anderson’s (1992) view was that creativity is “nothing more than seeing and acting on new relationships, thereby bringing them to life” (p. 445). This viewpoint, which notes the importance of originality, encompasses part of a more nuanced theory of creativity. Originality is commonly associated with most definitions of creativity (Fouche, 1993), but it isn’t the full picture.

Researchers have combined originality of a product, practice, or idea with the concept of effectiveness (Cropley 2001, Runco, & Jaeger, 2012). The essence of this view is that in order for creativity to be present originality must be connected to achieving some type of tangible end which has been described in varied literature as being worthwhile, appropriate, and relevant (Cropley, 1967; Jackson & Messick, 1965; Kneller, 1965).
Originality must be moored with objective social and physical reality in order for creativity to be present. Gardner (1989) noted, “Creativity is best described as the human capacity to regularly solve problems or to fashion products in a domain, in a way that is initially novel but ultimately acceptable in culture” (p. 14). Without a purpose beyond simple originality or novelty, creativity cannot exist (Cropley, 2001). Heinelt (1974) coined the term *quasi-creativity* to describe when originality exists without effectiveness. An example of quasi-creativity would be the unstructured creativity of daydreams (Besemer & Trefinger 1981).

The combination of both these attributes, originality and effectiveness, is well articulated in the description of creativity suggested by Cachia and Ferrari (2009) which maintain creativity “as a product or process that shows a balance of originality and value. It implies the ability to make unforeseen connections and to generate new and appropriate ideas” (p. iii).

**INNOVATION AND INNOVATIVE THINKING**

Creativity and innovation are interrelated, but often mistakenly used interchangeably. Deeper review of the concepts shows a subtle yet important distinction. Innovation can be defined as a process, an idea, or a product which “is directed toward achieving a sustainable outcome that can improve what people do or how they do it” (Weiss & Legrand, 2011, p. 7).

While creativity can be perceived as *the infinite source of innovation*, innovation can be perceived as *the application and implementation of creativity* (EU, 2009; Ferrari, Cachia, & Punie, 2009; Craft, 2005). Put into other words, creativity is the act or capability of conceiving of something original, while innovation is the implementation or creation of something new that has value to others (Hunter, 2013). These acts can be separated
as creativity involves generating original concepts, ideas, and processes while innovation involves actually implementing the artefacts of creativity.

Both creativity and innovation are affected by the environment where they are expressed and there are resisters and assisters to creativity, for example, people that either promote or hinder the creative impetus in individuals (Trefinger, 1995). Similarly, for creativity fostering learning environments in educational settings to occur the presence of enablers must be in place. Examples of enablers include: culture, curriculum, teaching and learning format, teachers, assessment, technology, and tools (EU, 2009; Ferrari, Cachia, & Punie, 2009; Craft, 2005).

Weiss and Legrand (2011) focus on the innovation concept as a process, not an outcome. They argue that innovation takes place “when people use innovative thinking” and define innovative thinking as “the process of solving problems by discovering, combining, and arranging insights, ideas, and methods in new ways” (p. 7) in other words, as “implementing new ideas to create positive change” (C. Legrand, personal communication, March 11, 2016). According to the same authors, “for innovative thinking to take place by people, several enablers need to be in place such as leadership support, supportive culture and organization practices, and skills development” (C. Legrand, personal communication, March 11, 2016).

**CREATIVITY IN THE CLASSROOM**

Contemporary classrooms promote creativity to help prepare students for a rapidly changing world. Whereas, in the past individuals assimilated to one set of conditions that often remained constant, present realities require people to adapt several times during their lifetime (Cropley, 2001). It appears that skills learned today are experiencing progressively shorter
periods during which they are valid and do not need to be updated. As a result, schools have been tasked to help facilitate creative mindsets which allow their students to remain mentally flexible and adaptable in order to learn new skills on their own (Cropley, 2001).

More flexible, creative thinking, and problem solving styles are being promoted in schools. Guilford (1950) discussed the difference between convergent thinking (that is using existing information to find one correct answer) and divergent thinking (which generates creative ideas by exploring many possible solutions). He contended further that schools needed to not only promote convergent thinking, as they had done historically, but also divergent thinking. Divergent and convergent thinking was first linked to creative problem solving by Guilford (1959) and later by others (Dillon, 1982; Getzels & Csikszentmihalyi, 1976; Jay & Perkins, 1997; Newell, Shaw, & Simon, 1962; Tardif & Sternberg, 1988). The work of Mumford and his colleagues suggest that the tensions created during divergent and convergent thinking create new original categories of creative individuals (Baughman & Mumford, 1995; Mumford, Supinski, Baughman, Constanza, & Threlfall, 1997; Mumford, Supinski, Threlfall, & Baughman, 1996).

Innovative mindsets and the promotion of innovators is another area current trends in education are set to explore. Kirton’s original work (1985; 1987; 1989) addresses creativity as a problem solving process where people are distinguished as adaptors (those who seek to solve a problem by using knowledge and skills already known to them) and as innovators (those who seek to solve a problem by reorganizing and rearranging the same problem). Articulating this point, Kirton (1976) pushed for the proposal that “everyone can be located on a continuum ranging from an ability to ‘do things better’ to an ability to ‘do things differently,’ and the
ends of this continuum are labeled adaptive and innovative, respectively” (p. 622). He proposed that both adapting and innovating are part of the creative problem solving process. However, innovators and ideators reorganize and restructure current data based on changing variables and are able to detect opportunities where others fail to do so. Innovators also appear to be characterized among other things, by higher self-regulation, resilience, confidence, high energy, and confidence.

Cho’s (2003) *Dynamic System Model of Creative Problem Solving Ability* is another problem solving process model which assumes that creativity consists of cognitive, affective, and environmental factors. Creative individuals exhibit both cognitive and personality attributes. The foundation of the model includes domain-specific knowledge, general knowledge and skills, and motivation. Ennis’ (2012) contribution to the creative problem solving process is in the area of critical thinking. To him, critical thinking is defined as “reasonable and reflective thinking focused on deciding what to believe or do” (para. 1). Ideal critical thinkers display a series of dispositions such as, open-mindedness, desire to be well-informed, judging credibility of sources, identifying reasons and assumptions, formulating hypotheses, designing experiments, and drawing conclusions based on evidence.

Cropley (2009) suggested, teachers who foster creativity learning environments provide sources of inspiration for modeling creative teachers. He summarized the literature and found that the creativity-fostering teachers are those who:

“*Encourage students to learn independently*

*Have a cooperative, socially integrative style of teaching*

*Do not neglect mastery of factual knowledge*

*Tolerate “sensible” or bold errors*
Promote self-evaluation
Take questions seriously
Offer opportunities to work with varied materials under different conditions
Help students learn to cope with frustration and failure
Reward courage as much as being right.” (p. 138)

TEACHERS’ PERCEPTIONS AND CONCEPTIONS OF CREATIVITY

As it was emphasized in the beginning, teachers play an important role in nurturing students’ creativity. Examining their perceptions and conceptions about creativity, provides significant insights about the way they perceive creativity in the classroom.

Cachia and Ferrari (2010) using an online survey tool, examined if teachers from 32 European Union countries perceive creativity as an important characteristic of education and if they embrace creativity in their teaching. Analyzing the results, the authors reported on the creative practices in each European country and argued “that there is a discrepancy between how teachers perceive” (Cachia & Ferrari 2010, p. 9). Similar results have been found by others (Fasko, 2001; Kampylis, Berki, & Saariluoma 2009; Runco, 2003a; Westby & Dawson, 1995). Kampylis et al. (2009) studied the in-service and prospective Greek teachers’ conceptions of creativity using a self-reported 62 item questionnaire and found that the majority of teachers (80%) reported that they do not feel well-trained to facilitate the creativity of the students. Dikici (2012) examined the perceptions of creativity by Turkish pre-service teachers using the What Do You Think of Creativity scale. The author found differences produced by gender, socio-economic status and the location in which the teachers grew. Similar results were reported by Seng (2011) on teachers from Hong Kong and
Singapore. The results collected by Newton and Beerton (2012) from pre-service teachers in England showed that their conceptions about creativity were limited too, since they were “unable to distinguish clearly between the concept of creativity, an example of its occurrence in the classroom, and what feature of that example made it creative” (p. 165).

Using the Creativity-Fostering Teacher Index (CFTI), developed by Soh (2000), Edinger (2008) studied the creativity fostering teacher behaviors in secondary school classrooms in the US. The results suggested that Grade 9 and 10 teachers moderately used creativity-fostering behaviours and that both personal and environmental factors could potentially influence their behavior. Using a mixed-method approach, Dishke-Hondzel (2013) examined the Ontario teachers’ perceptions about creativity, the strategies they employed, and their experiences. Using the CFTI, 22 Grade 5-7 teachers were measured against their creativity-fostering behavior and structured interviews were completed with 12 teachers together with classroom observations. The analysis of the results revealed that the teachers’ perceptions, the dynamics of the interconnected nature of the school, the uncontrolled school environment, and the expectations by the Education Quality and Accountability Office (EQAO), influence teachers’ attempts to maintain creativity-fostering teaching environments.

**SCHOOL SUPPORTS OF INNOVATIVE TEACHING**

It is very important here to define innovative teaching and provide the distinction between teaching creatively and teaching for creativity. Teaching creatively can be defined as “using imaginative approaches to make learning more interesting and effective” (NACCCE, 1999, p. 89) while teaching for creativity refers to the ways teachers employ with the intention to develop students’ creative thinking, competency (perception,
attitude, skills), and behavior (NACCCE, 1999). In a classical study, Jeffrey and Craft (2004), effectively attempted to provide evidence to avoid the dangers of dichotomous thinking between the two practices. In attempting to examine if teachers can teach students to be creative, someone could examine if teachers are creative in their own teaching. They concluded that the two apparent distinctions are closely related and interdependent.

Assessing the current support received by the school is considered important during the development of creativity fostering teaching environments. Zhu, Wang, Cai, and Engels (2013) investigated the teachers’ core competencies in relation to their innovative teaching performance and concluded that besides their core competencies required (learning competency, educational competency, social competency and technological competency), school support is essential in supporting, cultivating, and maintaining the sustainable growth of innovative teaching.
II. BEST INSTRUCTIONAL PRACTICES PROMOTING CREATIVITY AND INNOVATION

Past research indicates that there are many ways to improve creativity in the classroom and in particular, instructional practices can play a significant role in developing students’ creativity and innovation.

**Promote Creativity as a Skill Accessible to All Students:** Creativity is a skill and as such, it should be accessible to all students. While creativity is often thought of as something for people with exceptional ability or geniuses this should not be the case (Stokes, 2006). On the same line of reasoning, Weisberg (1993) maintains that creativity is just an extension of normal thinking and it is a myth to think only geniuses are creative. He investigated the work of some of the most well-known and creative people in history such as Isaac Newton and Thomas Edison, and he suggested that creativity can be available to everyone, it just needs to be cultivated.

Research suggests that with practice, motivation, and involvement, students can develop creative skills (Torrance & Torrance, 1973). Simmons and Thompson (2008), as well as others (Silver, 1997), argue that creativity could be accessible to all. Cronin (1989) based on her research on misconceptions of creativity in elementary school classrooms points out
that creativity is a skill that can be taught to students. To her, creativity is no different than any other skill and can be studied and practiced.

**Make the Classroom a Place of Investigation:** Creative thinking can be developed by making the classroom a place of investigation. Piggott (2007) suggests having students get “stuck” on a problem as a way to develop creativity. When students are given the opportunity to get “stuck”, it pushes them to try new and unusual things, which can lead to creative thinking. As stated previously, creativity can be viewed as part of the problem solving process (Kirton, 1987, 1989), since the process of solving problems is similar to the process of “discovering, combining, and arranging insights, ideas, and methods in new ways” (Weiss & Legrand, 2011, p. 7). Problem solving activities are a great way to stimulate creativity, create connections, come up with hypotheses, and make conjectures (Davis & Rimm, 1985; Karnes et al., 1961; Subotnik, 1988).

To develop creativity and innovation the classroom should be more than a place of right or wrong answers. Cropley, Priest, and Cropley (1997) investigating the impact of creativity instruction to engineering students, argued that students need to be encouraged to make mistakes in order to try something new and unusual and teachers should reward courage as much as being right.

Many researchers explain that the classroom can be made into a place of investigation by supporting and reinforcing unusual ideas and responses of students (Feldhusen & Treffinger, 1985; Nickerson, 1999; Sternberg & Williams, 1996). Ginsburg (1996) examining an in-depth case study of a six-year-old girl’s mathematical learning, upholds the importance of using students’ mistakes as a way to go beyond standard material. The work by others (Midgley, 2002; Nickerson, 1999), support the idea that if students believe the only thing that is important is getting a high grade, then
students will avoid being creative. Students, therefore, should feel their ideas, especially the unconventional ones, are welcome in the classroom. By making the classroom a place of investigation, creative and innovative thinking can be stimulated.

**Provide Ample Time:** Classroom scheduling should allow for ample time for students to grapple with interesting and challenging problems. Silver (1997), defends the idea that creativity needs to be associated with long periods of work and reflection as to allow students with ample time to develop their creative and innovative ideas. It takes time and concentration to develop creative ideas, since not all creativity occurs immediately (Feldhusen & Treffinger, 1985). Students want to be challenged and they just need to be given the opportunity and therefore ample time is required.

**Provide Creative Learning Experiences:** One of the most important instructional practices to promote creativity and innovation is to provide students with learning experiences that lead to creative products. Ayverdi, Asker, Oz Aydin, and Saritas (2012), examined the relationship among creativity and STEM education to better understand how to develop creative individuals and found that using activities that require creativity in science and technology can help develop creativity in students. Aktamis and Oemer (2007) and others (Demirci, 2007) found “creative tasks” push students to be creative and innovative. Hoffman and Brahier (2008) maintain a similar viewpoint, that the classroom needs to offer more than formulas and algorithms and they suggest having students work on open-ended problems and creative activities as a way to gain different perspectives and promote new ways of thinking. Teachers who use creative teaching methods provide an environment for creativity to flourish. Fasko (2001) reviewing past research on student creativity and innovation, found teachers who use direct methods of teaching creativity such as inquiry,
discovery, or problem solving teaching methods give students more opportunities to develop creativity through learning experiences that lead to creativity and innovation. This argument is echoed by others (Cropley, 1997; Sternberg & Williams, 1996), who reiterate that teachers who foster creative learning environments provide excitement in the classroom to allow for creative thinking.

**Use Classroom Assessments Which Promote Understanding and Self-Improvement:** Assessment practices can greatly influence student creativity and it is important for the right assessments to be used to motivate students (Beghetto, 2005). To develop creativity in the classroom, assessment practices should promote understanding and self-improvement. Some assessments, such as tests, have been said to greatly diminish creative thinking, since students often feel there is immense pressure to get a high score on the examination and do not think critically when working on the questions (Crocco & Costigan, 2007).

Assessment pressure should be reduced to promote creativity. Beghetto (2005) explains in his article on the relationship between assessment and creativity, that if students feel pressure by an assessment, their willingness to be creative is reduced. He suggests that teachers try to reduce assessment stress and emphasize to students the goal of the activity as well as provide ways for the students to find personal connections.

The focus of assessments should be to build student understanding. Runco (2003a) and Fasko (2001) explain that assessments should not put too much of an emphasis on grades, but rather assessments should help students build their understanding which in turn will allow students to be creative. In fact, some researchers suggest self-evaluation to foster creativity, or even directly assesses creativity as a way to promote creativity (Sternberg & Williams, 1996), while others provide empirical
evidence that classroom assessment practices that focus on understanding and self-improvement motivate students to be more interested in learning and help with skill development (Pintrich, 2003; Nickerson, 1999; Stipek, 1998)

For assessment purposes, social comparisons in the classroom can be a barrier for student creativity. This includes displaying the work of the best students or charting student achievement in a visible place (Beghetto, 2005). Visible performance structures in the classroom can overemphasize the importance getting the highest grades and in turn stress to students that they should avoid mistakes or unconventional thinking (Midgley, 2002). Rather, teachers should be focusing on assessment practices that promote creativity, innovation, and critical thinking. Lastly, teachers can diminish creative thinking if they apply one or more of the following: have students work for an expected reward, set-up a competitive situation, focus on evaluation, watch too closely, and give students restrictive choice situations (Hennessey & Amabile, 1987).
III. TRENDS IN LEARNING SCIENCES

This section will focus on trends in educational research at the local and international levels. The main trends in learning science will focus on 21st century global competencies and innovative teaching practices.

21st CENTURY LEARNING GLOBAL COMPETENCIES

There are many national and international organizations which research, conceptualize, and advocate on the importance of skills and global competencies that today’s students need to develop during their studies. For Canada, the primary goal of education needs to ensure our students are prepared for success in the modern world. The scope of this study does not allow expanding the literature review to all these international studies and it will focus only in the Canadian context.

Competencies – a set of knowledge, skills, and attitudes – are part of all the student learning frameworks proposed in different Canadian provinces. Twenty-first century global competencies are considered fundamental competencies which students should possess in order to be prepared for the future and can help position youth for success in the global environment. Pan-Canadian 21st century global competencies are still an evolving concept.
Alberta’s *Framework for Student Learning* (2011) outlines the relationship among the fundamental skills of literacy and numeracy and the competencies students need to acquire during their studies. Creativity and innovation is part of the global competencies together with critical thinking and problem solving, communication, collaboration and leadership, and lifelong learning and well-being. British Columbia’s framework for cross-curricular competencies (2013) and Quebec’s cross-curricular competencies are still evolving but creativity or creative thinking are already part of their proposals. Other provinces (New Brunswick Department of Education, Nova Scotia School Boards Association, Prince Edward Island), also have included in their learning frameworks creativity and innovation and regard them as important competencies for their students (for review see Ontario Ministry of Education, 2016).

Ontario’s *Renewed Vision for Education* focuses on ways to increase student achievement. The document recognizes creativity and innovation as important attributes of graduates (Ontario Ministry of Education, 2014). The Ontario Ministry of Education (2016) in a systematic review of the competencies required by Ontario students states that “changing times are transforming the nature of competencies that have been valuable throughout history” (p. 5) and although the importance of some competencies remain the same, new competencies are considered relevant and some others are evolving to be integrated in a more sophisticated framework of competencies needed for Ontario’s students. For Ontario, 21st century global competencies and skills are in addition to the ones already accepted by the Ministry’s foundational skills of literacy and mathematics. The Ministry maintains that the emerging frameworks of competencies worldwide are still evolving and need to be reviewed periodically. Despite these precautions, the Ministry recognizes “creativity and innovation” as core competencies for students together with
“entrepreneurship, critical thinking, problem solving, communication and collaboration, metacognition, and local, global and digital citizenship” (Ontario Ministry of Education, 2016, p. 46). C21 Canada, an advocacy for learning in education group, maintains that the Canadian educational landscape must focus on literacy, numeracy, science, life skills, and 21st century competencies. According to the same group, 21st century competencies include creativity and innovation together with critical thinking, collaboration, effective communication, building character, culture, and ethical citizenship and comfort with technology (C21 Canada, 2012).

21ST CENTURY LEARNING GLOBAL COMPETENCIES AND CREATIVITY

Creativity and innovation are at the heart of 21st century global competencies because of how important these skills are for learning and personal development (Bellanca & Bellanca, 2010; Trilling & Fadel, 2012). Many researchers argue that creativity and innovation improve reasoning, memory, problem solving abilities and engagement, because the skills associated with creativity and innovation are analyzing, evaluating, creating, and refining existing problems (Guilford, 1967; Hondzel-Dishke, 2013; Isaksen & Treffinger, 2004; Torrance & Torrance, 1973;). Robinson (2011) suggests creativity needs to be nurtured in educational environments in order to foster student engagement and greater student satisfaction. In addition, together with innovation, creativity is considered a fundamental part of entrepreneurial activity. According to the Ontario Ministry of Education (2016), students equipped with such competencies are able to contribute to the solutions of complex problems, take risks while thinking and creating, and discover through inquiry activity. By extension, creativity and innovation are valued components of STEM
education as they give students ways to integrate their learning with the ability to create new ideas and products.

**INNOVATIVE TEACHING PRACTICES**

A major trend in educational research is the effect of innovative teaching and learning practices on creativity and innovation. As a result, many new approaches emphasizing student-centered learning have been developed. This section of the literature review will examine trends in educational research on innovative teaching practices including: a) experiential learning, b) authentic learning, c) teaching for successful intelligence, d) educators are curators of innovation, and e) student-centered learning.

**Experiential Learning**

Experiential learning is the process of learning through experience and this type of learning has become a trend in learning science research both locally and internationally. The idea of experiential learning started in the 19th century as a way to move away from traditional teaching methods, such as direct instruction. Lately, experiential learning has gained more popularity and acceptance in education and is considered an excellent way to promote creativity and innovation in schools.

In experiential learning, the learners create their knowledge through first-hand experience, instead of hearing or reading about others’ experiences and knowledge (Casanovas, Miralles, Gomez, & Garcia, 2010; Kolb, 1983; Mainemelis, Boyatzis, & Kolb, 2002; Patrick, 2011). This process of using experience as a method of learning allows the student to make sense of new information and relate ideas without the need for direct instruction.
There are two types of experiential learning: field-based experiences and classroom-based learning. Field-based learning has a long and important history in education and has been integrated in post-secondary education since the 1930s. Field-based learning includes apprenticeships, internships, practicums, and field-trips (Lewis & Williams, 1994). In field-based learning, students need to extend their skill and understanding from the classroom in meaningful ways to their uses in real-world experiences (Rogoff, 1991). Many skills including creativity, social interaction, and higher order thinking are learned through apprenticeship or field-based experiences (Collins, 1987). Casanovas, Miralles, Gomez, and Garcia (2010) investigated the effect of experiential learning on student success. They examined the effect of experiential learning versus no experiential learning training with 85 groups and found the experiential learning training significantly increased student fluency, flexibility, and creativity.

On the other hand, classroom-based experiential learning is about giving students a “hands-on” approach to learning and includes such things as case-studies, simulations, role-playing, and cooperative learning at school (Lewis & Williams, 1994) and it has been growing in popularity since Chickering and Gramson (1987) recommended active learning as an essential art of excellence in undergraduate teaching. This type of experiential learning involves connecting learning and broader culture, puts the student in control of their learning and improves student engagement (Kolb, 1983; Kuhlthau, Maniotes, & Caspari, 2007). In addition to this, research on classroom-based experiential learning has shown positive benefits in students’ engagement and improving understanding (Kolb, 1983; Kuhlthau, Maniotes, & Caspari, 2007).

In Ontario, the Ministry of Education deems experiential learning an important part of the education experience (Ontario Ministry of Education,
Recently, the Canadian Council of Learning conducted a detailed review of research on experiential learning and student success for the Ministry of Education in Ontario (Canadian Council of Learning, 2009). They reviewed 514 studies and found experiential learning programs have positive benefits on student retention, drop-out rates, improved self-esteem, and engagement (Canadian Council of Learning, 2009). In surveying Ontario teachers, Hondzel-Dishke (2013) found that teachers believe that experiential teaching allows students to take ownership of their learning, make deeper connections, and learn through mistakes. The same author identified experiential learning, together with collaboration and differentiated instruction, being used by a number of Ontario teachers “as a primary way of engaging and tailoring instruction to allow for creative expression” (p. 114).

**Authentic Learning**

Another global trend in innovative teaching practice connected to creativity and innovation is authentic learning. Authentic learning is about providing students with multidisciplinary real-life problems and activities (Lombardi, 2007). The goal of authentic learning is to develop students’ ability to work through real-life problems, synthesize information, improve their flexible thinking, and develop patience with messy problems (Lombardi, 2007). Often in classrooms, students solve questions by applying a single formula or algorithm, but in real-life, problems are complex and require multidisciplinary thinking (Schoenfeld, 1992).

Research on authentic learning has gained popularity and continues to search for the benefits in the classroom. Newmann, Marks, and Gamora (1996) conducted a large study investigating the effect of authentic pedagogy on achievement results with elementary, junior high, and high school students. They observed 504 lessons, analyzed 234 assessment tasks
and sampled student work to find that schools with a focus on authentic learning had higher levels of academic achievement among the sampled students (Newmann, Marks, & Gamora, 1996). Their study suggests authentic learning fosters understanding, comprehension, and student success.

Newmann, Bryk, and Nagaoka (2001) conducted another large scale study on the benefits of authentic learning. In this study, they investigated the effect of authentic pedagogy on students’ mathematical abilities and achievement on standardized tests. The researchers studied 2,128 students in 23 Chicago schools and found authentic learning allowed the students to make higher than normal gains on standardized test scores. Their research suggests that authentic pedagogy is an excellent way to build student comprehension and understanding in STEM subjects.

Authentic learning is becoming an integral part of STEM education too. Researchers have created a checklist of 10 design elements for educators to bring authentic learning in science into the classroom. They include: 1) real-world relevance, 2) ill-defined problems, 3) sustained investigations, 4) multiple sources and perspectives, 5) collaboration, 6) reflection, 7) interdisciplinary perspective, 8) integrated assessment, 9) polished products, and 10) multiple interpretations and outcomes (Reeves, Herrington, & Oliver, 2002). Overall, authentic learning allows students to develop content skills, while going beyond standard material to cultivate flexible and creative thinking.
Teaching for Successful Intelligence

The fundamental idea of teaching for successful intelligence is that instruction should match students’ analytical, creative, and practical abilities and involves capitalizing on student strengths and compensating for their weakness (Sternberg & Grigorenko, 2003). Teaching for successful intelligence involves teaching to students’ analytical, creative, and practical skillsets to achieve best student results. Sternberg, Grigorenko, Ferrari, and Clinkenbeard (1999) conducted a study on 326 high school psychology students to examine the effect of teaching for successful intelligence. The study examined the effect of placing students in a psychology course that best matched their analytical, creative, or practical abilities. Data revealed that students placed in a group best matching their abilities did better and suggested that playing to students’ strengths by teaching for successful intelligence helps teachers reach a larger cross-section of students than traditional teaching.

Based on Sternberg and Grigorenko’s previously summarized research, educators should attempt to integrate the following into their teaching order to promote creativity and innovation: (1) provide examples that cover a wide range of topics, (2) give students multiple and diverse assessment options, and (3) match assessment to student life goals.

Educators Are Curators of Innovation

Recently, there has been a trend in viewing educators as curators of learning. Some researchers see the role of educators as curator of ideas, similar to that of a museum curator, responsible for the creation of an environment of carefully selected relevant and important information to inspire students (Siemens, 2007; Trilling & Fadel, 2012; Weisgerber & Butler, 2012).
This focus of positioning teachers as designers of innovation can be seen in innovative schools in the United States. For example, High Tech High School is famous for the practice of providing a culture of inventing, tinkering, and investigation (New Technology High School, n.d.). At Napa New Tech High School in Northern California the classrooms are a hybrid between a corporate boardroom and a media production studio with the teachers acting as curators of learning (High Tech High, 2012). The importance of creating a culture of investigation in a contemporary learning environment is discussed (see Trilling & Fadel, 2012). By making educators curators of learning and innovation, a classroom environment emerges where creativity and innovation thrives.

**Student-Centered Learning**

Student-centered (reciprocal teaching, student-directed, or student-paced) learning is a growing trend in education research and became popular following the works of John Dewey, Jean Piaget, Lev Vygotsky, Carl Rogers, and Maria Montessori (Hondzel-Dishke, 2013). Today, many curriculum guidelines encourage educators to provide an active, individualized learning experience to students (Iowa Core, 2013; Jones, 2007). This type of learning takes place in an active and individualized learning environment where the students are the constructors of their own learning rather than receivers of information. In literature, there is evidence that student-centered learning has been used to increase student engagement, develop deeper understanding and foster a desire to learn, to increase motivation and student ownership of their learning, and to increase comprehension and test scores (Akers, 1999; Means & Olson, 1995; Palincsar & Brown, 1984; Trilling & Fadel, 2012). Examples of student-centered learning include: inquiry-based learning, problem-based learning, and design-based...
learning. Each of these topics will be examined in detail in the following section.

**Inquiry-Based Learning**

Inquiry-based learning is an approach where students make investigations, look for information, and ask questions and it has become a major part of the educational landscape in Canada (Ontario Ministry of Education, 2013a). Boaler (1997) examined the impact of inquiry-based learning in mathematics education in a longitudinal study over three years. She found the traditional forms of mathematics education develop procedural knowledge that cannot be applied to unfamiliar situations. Her study also suggests that inquiry-based learning can help students develop connections and more flexible thinking.

Other researchers have found inquiry-based learning to improve student achievement by providing students with opportunities for exploration, creativity, and building connections (Ontario Ministry of Education, 2014). Fasko (2001) conducted a comprehensive review of literature on creativity in the classroom and found teachers who use inquiry-based teaching practices provide students with opportunities to develop creativity, improve flexible thinking, and promote originality. Similarly, Hattie's (2008) work on a meta-analysis on inquiry-based learning found this teaching approach effective in improving student achievement.

**Problem-Based Learning**

Problem-based learning originated in medicine with McMaster University in 1972, where medical students were given case studies and complex medical problems to solve rather than attend lengthy lectures. The goal was to develop students’ intrinsic interest and deeper understanding and creating a greater sense of ownership of learning (Barrows, 1996).
Problem-based learning is based “on solving complex, real-world problems” (Trilling & Fadel, 2012, p. 111) in small groups using a case study approach and its impact has been verified by a number of studies. Problems are given at the start of a topic and before formal instruction to actively engage the learners to develop skills about finding information, identifying important information, and identifying missing information (Woods, 2005; 2006). The Cognition and Technology Group at Vanderbilt University (1992) studied 700 students from 11 school districts in the United States on the effect of problem-based learning and found students experienced large gains in understanding, problem solving, and having positive attitudes in mathematics. Similarly, Shepherd (1998) found that the elementary school students who engaged in problem-based learning scored significantly higher on critical thinking tests, than those who did not participate in problem-based learning. In another study, improvement on standardized test scores and learning development was found in 9 out of 10 schools that implemented problem-based learning (New American Schools Development Corporation, 1997).

To develop students’ conceptual knowledge and creativity in mathematics for Ontario’s students in Grades 1-7, the Literacy and Numeracy Secretariat developed a research-into-practice series on problem-based learning (MacMath, Wallace, & Xiaohong, 2009). In the same research series, the investigators found students often developed procedural fluency in mathematics, but struggled with solving new problems or making mathematical connections. The authors suggested using problem-based learning in the classroom to check student understanding, extend student thinking, and build creativity.
**Design-Based Learning**

In design-based learning the students are the constructors of knowledge through creating. Although in its relative infancy, this type of student-centered learning is quite popular in science education in elementary and upper secondary school education as a way to support scientific learning, for making observations, and for using information to support arguments and explanations (Kolodner, 2002; Kolodner et al., 2003). It appears that the designed-based learning approach in secondary school education results in gains on reasoning and self-direction. The program *Science by Design*, developed by the University of Michigan, has students design and create boats and greenhouses to learn about scientific principles (Trilling & Fadel, 2012). The researchers suggest that their program allows students to apply information in new situations, make connections, develop understanding, and engage meaningfully in the curriculum material. Similarly, Mehalik, Doppelt, and Schuun (2008) compared traditional script inquiry versus design-based system approach for students in Grade 8 in an urban school district and suggested the superiority of design-based approach in “knowledge gain achievements in core science concepts, engagement, and retention [and] … in low-achieving African American students” (p. 71). The benefits of design-based science education have also been linked with gains in the academic achievement of students in Grade 7 in a specific physics unit (see Ercan & Sahin, 2015).
What needs to be done at the district and school levels to foster creativity and innovation? This part of the study is based on the triangulation of the results of the I2Q focus study and the systematic knowledge from the related research literature previously described in this study in order to inform policy on what needs to be done at the district and school levels to foster creativity and innovation in our contemporary educational environments. A pictorial representation of our suggestions is summarized in Figure 5.

Figure 5: Policy and Supports to Sustain a Framework for Creativity at the TDSB
A well-articulated vision for the future is essential in achieving educational success and fostering creativity and innovation in school environments. Such a vision acts as a basic framework through which educational change can happen. Trilling and Fadel (2012) are respected global education experts and suggest that visions for the future need to be thoughtfully developed and shared among educators, districts, community, parents, and students.

Indeed, this is exactly what the Ontario’s Ministry of Education attempted. In 2013, parents, students, teachers, support staff, system leaders, and government officials came together to discuss a renewed vision for education in Ontario. The result of these discussions led to the following renewed goals for education: 1) achieving excellence, 2) ensuring equity, 3) promoting well-being, and 4) enhancing public confidence (Ontario Ministry of Education, 2014). Innovation and creativity are integral parts of the renewed goals for achieving excellence. To achieve success, Ontario will invest in technology and in innovative teaching practices, expand learning opportunities outside the classroom, and explore different models of learning such as project-based learning.

The TDSB is the largest and one of the most diverse school boards in Canada. “We serve approximately 245,000 students in 588 schools throughout Toronto, and more than 160,000 life-long learners in our Adult and Continuing Education programs” (TDSB, 2016, para.1). The TDSB is continually motivated to provide effective educational teaching and learning experiences and meeting the needs of 21st century students. The TDSB continues to establish well thought-out visions for the future while recognizing the importance of innovation and creativity in learning.

Currently, there are many TDSB projects and initiatives to explore the cultivation of the student global competencies: the I2Q project is a pioneer
activity which aims in fostering student creativity and innovation in the classroom. However, a number of other new activities and initiatives are currently underway in our district. For example, the TDSB’s global learning and teaching with technology strategic vision is being developed and supported through the Teaching and Learning Global Learning and Teaching With Educational Technology (Sinay, 2014). The plan focuses on supporting the needs of the global learner in the digital world by improving global learning and technology in TDSB schools and by underlying the importance of creativity and innovation for the identification and solution of problems. This includes: 1) building dependable Information Technology infrastructure along with providing appropriate technical support, 2) expanding internet access to all schools, 3) establishing Bring Your Own Device (BYOD) policies, and 4) providing educators with professional learning opportunities on technology in the classroom (Sinay, 2014). This strategic vision is just one way the district continues to support and develop creativity and innovation in the schools. Another TDSB initiative, the Mobile Computing Strategy 2.0 (MCS 2.0), TDSB’s one-to-one laptop initiative, runs for its third year of implementation and represents one of the attempts of the district to invest in the digital fluency of its students and teachers (Sinay, Graikinis, & Presley, 2016). A third TDSB initiative focuses on the vision of building the students’ entrepreneurial skills. The Board, in a joint initiative with the MaRS Discovery District, builds an educational program on entrepreneurial thinking and its implementation is currently underway. The goal is to embed entrepreneurial thinking into the Kindergarten to Grade 12 (K-12) curriculum as well as to offer related professional learning sessions for educators (Sinay, Resendes, & Graikinis, 2015).
OFFICIAL POLICY AND POLICY COORDINATION

In order for creativity and innovation to be fostered, official policy within the district and schools must promote the students’ global competencies. Bell and Stevenson (2006), whose work focuses on school change, explain that education policy drives school change, economic prosperity, and social citizenship. This is because official policy sets the stage for the framework and guides educational objectives, standards, assessment, and curriculum documents. Therefore, it is important that district and school policy are in place to support creativity and innovation. Furthermore, in order for creativity and innovation to be fostered, policies must be coordinated, consistent, and aligned. This means all official policies for creativity and innovation at the provincial, district, and school levels must be aligned and coordinated with other education policy such as professional learning, assessments, standards, and curriculum policies (Trilling & Fadel, 2012). In addition to official policy and policy coordination, there needs to be adequate funding to support change. Darling-Hammond (2010) argues for change to occur in education systems need to have: 1) developed teaching policies, 2) consistent long term reforms, and 3) adequately and equitably funded schools (Darling-Hammond, 2010). Thus, it is imperative that the district ensures all official policies are aligned, consistent, and funded in its efforts to support innovation and creativity.

The TDSB has adopted a new vision for learning, Unleashing Learning, which includes creativity as one of its core global competencies together with critical thinking and problem solving, communication, collaboration and leadership, and global citizenship and character (see Figure 4). The policies adopted need to allow room for experimentation and “although we need system expectations around how we are going to proceed, those expectations need to
be broad enough so that creativity can happen, but clear enough so you can actually tell our communities how we are improving” (Malloy, 2016a).
LEADERSHIP AND SUPPORTS

Successful educational programs and educational change require coordinated and distributed leadership efforts. This holds true in promoting creativity and innovation. In particular, education leaders must strongly and continually lead administrators, educators, parents, students, and community towards the same goals, which in our case is creativity and innovation. Leaders must be honest about progress and regularly communicate their progress to stakeholders. This means communicating both successful and unsuccessful endeavors and being forthcoming about challenges to administrators, educators, parents, students, and community members (Trilling & Fadel, 2012).

In addition to the aforementioned, the need for adequate leadership support which is equitably distributed, accessible, and non-judgmental at the district and school levels is essential. Teachers cannot work in isolation and need leadership support: “administrators, teacher educators, researchers, and policymakers must all understand the issues, take initiative and commit to supporting students and teachers” (Allexsaht-Snider & Hart, 2001, p. 2). One way to support leaders is through coaching and in Ontario, coaches have been used as agents of change (Fullan & Knight, 2011). For example, literacy coaches have been placed in low-performing schools as a way to improve results and lead changes in school culture. The literacy coaches spend their time working with educators developing lessons, observing instruction, and collaborating with teachers and administrators. Overall, after implementing literacy coaches, literacy rates have gone up 14% across the 4,000 elementary schools surveyed and positive changes in school culture have been observed. The district needs to continue to support schools with coaches by making them available and accessible to all schools.
Contemporary learning environments are places of learning that meet the challenges of 21st century learning by accommodating flexible learning interactions and supporting technology. Trilling and Fadel (2012) argue for schools to be learning laboratories, where learners can experiment, participate in workshops, and grow. In order to create this type of environment both the social and physical environments need to support flexible learning and the use of technology. School districts and individual schools should be focusing on contemporary learning environments as a way to develop creativity and innovation.

Social structures in contemporary learning environments need to allow for diverse ideas and perspectives to promote creativity and innovation (Hondzel-Dishke, 2013). According to Runco (2003a), a leading creativity researcher and cognitive psychologist, social influences from colleagues, parents, students, and administrators contribute greatly to the social climate in educational environments. School districts and schools need to allow for experimentation, allow teachers and students to try new things, and allow for some degree of failure when trying new things (Hondzel-Dishke, 2013). On top of that, districts need to focus on building positive relationships between administrators, educators, students, parents, and the community by better understanding their emotions and relationships (Brooks, 2011).

The physical environment is central in supporting flexible learning in contemporary learning environments. This includes providing space for project work, collaboration spaces, and having connected classrooms (Trilling & Fadel, 2012).
For successful education change to take place, professional learning needs to be a top priority at the district and school levels. Trilling and Fadel (2012) explain that some of the most important variables for a successful education system is supporting ongoing teacher learning and investing in teacher education. This is because teacher knowledge plays a large role on student achievement. Regular professional learning is thus essential in providing educators with new knowledge, practices, and ideas.

Professional learning can also help with creating a sense of belonging and engagement among educators (Allexsaht-Snider & Hart, 2001). Professional learning sessions give educators an arena to have discussions with experts and colleagues on classroom practices, teaching practices, gather new resources, and keep valuable teachers engaged and up to date (Darling-Hammond, 2010).

PROFESSIONAL LEARNING IN ONTARIO

In Ontario, educator professional learning is highly valued and supported in a variety of ways. The Ontario Government views professional learning as a way for teachers to be continually and actively engaged in improving their practice (Ministry of Education, 2009). Highlights of some of the professional learning opportunities include: 1) formal mentoring program for new teachers, 2) additional qualification programs for teachers to learn new subject areas, 3) designated professional learning days, and 4) informal opportunities such as collaborations with outside organizations (Ministry of Education, 2004). The Ministry of Education also offers a program to experienced teachers called the Teacher Learning and
Leadership Program, which gives teachers an opportunity to participate in a project-based professional learning opportunity.

Even with all of these well-thought professional learning opportunities, there is always room to improve. The Ontario Ministry of Education has suggested that there is a need for more formal mentoring programs, ensuring professional learning workshops connect to the everyday lives of students and teachers, giving educators more autonomy in selecting professional learning opportunities, and increasing the number of professional learning days in the school year (Ministry of Education, 2004).

In Ontario, three primary environmental factors have been identified as influencers of creativity fostering learning environments in the classroom and among them is time, money, and support from colleagues and administrators (Hondzel-Dishke, 2013). It appears that in order to promote creativity and innovation, professional learning opportunities must align with these needs, be widely available, and be connected to classroom practices.

PROFESSIONAL LEARNING MODELS

It is important for the district and individual schools to support continuous professional learning through a variety of professional learning models as a way to foster creativity and innovation in schools. Professional learning can be supported through both formal and informal endeavors that embed reflection and learning into the daily practice of educators (Lieberman, 1992).

Districts and schools can support professional learning through formal professional learning initiatives, such things as: 1) professional learning days initiated by the district, 2) school-based initiatives, 3) school-based curriculum projects, and 4) visits to other schools (Northern Territory Government, 2013). Each of these initiatives is a structured way to engage
and support teachers by sharing goals, engaging in teaching and learning dialogue, bringing in new resources, and empowering teachers (Nussbaum-Beach & Hall, 2011).

In the same way, informal professional learning models are an important factor in supporting continuous learning. Informal professional learning models allow for ongoing and self-directed learning that enhances and supports formal learning initiatives by giving educators control of what they learn and when they learn. Informal professional learning initiatives include such things as: 1) learning partnerships, 2) study groups, 3) mentors, and 4) personal learning networks, such as joining a teaching feed, blog, or listserv (Northern Territory Government, 2013). These professional learning initiatives allow for self-directed learning and personalized learning. Teachers get to select their own resources, develop deep collaboration among colleagues, and establish meaningful interactions in which they can develop insights that inform future practice, such as fostering creativity and innovation (Nussbaum-Beach & Hall, 2011).

The Ontario Government believes in the importance of professional learning communities as a way to improve student achievement. It sees professional learning as a continuous way for educators to inform their practice in structured and meaningful ways. It suggests administrators and teachers to: 1) reflect and learn together, 2) review student work and relevant data, 3) plan for student success, and 4) focus on students who are struggling (Ontario Ministry of Education, 2007).

In order to foster creativity and innovation, school districts and schools need to support and foster ongoing professional learning through a variety of formal and informal initiatives to give educators ways to explore new ideas, try new things, and grow as educators.
The importance of assessment in the change process lead some educators to declare that it is not the written curriculum that matters, but rather the assessed curriculum (Crocco & Costigan, 2007; Ravitch, 2011; Yong, 2012). There is a wealth of information in the literature for the assessment of 21st century student skills but not for global competencies. Although the terms skills and competencies are used interchangeably most of the times in the literature, they do not refer to the same aspects of student acquisition of abilities. While skill can be defined as the “ability to apply knowledge and use know-how to complete tasks and solve problems” (Cedefop, 2014, p. 227), a competency is defined as an entity which includes skill and “involves the ability to meet complex demands, by drawing on and mobilizing psychosocial resources (including skills and attitudes) in a particular context” (OECD, 2003, p. 4). There is an urgent need to develop a clear view on the assessment of 21st century student skills and global competencies since these are included in major secondary school education learning frameworks. Because the assessment of global competencies is still an evolving area, most of the information on this section focuses on the assessment of 21st century student skills.

In a seminal paper, Ananiadou and Claro (OECD, 2009) acknowledged that there are no clear assessment policies for the formative or summative assessment of 21st century skills and competencies in the countries surveyed, but noticed that these skills and competencies are often integrated into major curricular reforms. It appears that the skills and global competencies should not be assessed in isolation and more than one skill and global competencies might operate in a given environment. This greatly encourages the use of portfolios of desired outcomes in the
assessment process. On the same line, Soland, Hamilton, and Stecher (2013) suggest that assessment is not specific and should vary from site to site based on a number of guidelines the authors provide, such as: a) the assessment requires abundance of time, use of innovative assessments such as simulations or remote collaborations, b) determination of assessment based on the purpose of the assessment, c) assessment is context and culture-based, and d) difficulties might be encountered with ill-defined global competencies.

There is more information in the literature on 21st century skill assessment and it is reasonably argued that 21st century skills, as a fundamental part of education today, need to be evaluated on valid and widely acceptable ways (Greenstein, 2012). These skills include creativity and innovation, critical thinking, collaboration, effective communication, building character, culture and ethical citizenship and comfort with technology (C21 Canada, 2012). According to the Partnership for 21st Century Skills (P21), the first questions districts should ask themselves is: “is the district considering, developing or adopting achievement tests that include 21st century skills?” and schools should ask themselves “are educators in the school using classroom assessments that measure 21st century skills?” (P21, 2007, para. 5). Once these questions are considered, it is important to examine the specifics for the assessment of 21st century skills. P21 (2009) recommends 21st century skills need to be incorporated in large-scale assessments, such as standardized tests and they should include placing greater emphasis on critical thinking, problem solving, and creativity in standardized testing, rather than memorization and recall. Districts and schools should provide educators with rubrics, checklists, and professional learning on assessing 21st century skills and these resources should be shared freely.
When evaluating 21\textsuperscript{st} century skills it is important to ensure the assessment tasks are sufficiently complex, authentic, and connect to the real-world (Greenstein, 2012). Research indicates that the level of complexity of the assessment is key to assessing 21\textsuperscript{st} century skills (Lai & Viering, 2002) and student motivation is diminished if the task does not require meaningful understanding, reasoning, or critical thinking (Lai & Viering, 2002). P21 (2009) suggests using open-ended authentic tasks that integrate technology as a way to assess critical thinking, problem solving, global understanding, and leadership.

In Ontario, the EQAO conducts province-wide standardized testing on Reading, Writing, and Mathematics in Grades 3, 6, and 9 (EQAO, 2015). The EQAO testing is used to provide students, parents, educators, and the public with reliable information on student achievement (Desbiens, 2011). It is widely-accepted that in the majority of the current standardized testing models the main focus tends to be on recall and comprehension. Longo (2010), an education researcher who examines the implications of standardized testing on creativity, explains that the key to enhancing creativity and innovation is inquiry and therefore, it is important for standardized tests, including the EQAO, to have a greater focus on inquiry, creativity and innovation. The EQAO, as well as the \textit{No Child Left Behind} in the US, have been widely criticized for their anti-authentic teaching and learning assessment practices. Hondzel-Dishke (2013) concluded that the current EQAO standardized environment affects Ontario teachers who are interested in sustaining creativity in their classrooms. “The pressure teachers felt to meet the preparation expectations for EQAO set for them by the school administration and the Board of Education seemed to influence the ways in which teachers felt they had to run their classrooms and changed the methods they used in order to foster creativity in their students” and “Some teachers spoke of EQAO testing as a barrier to
creativity throughout the school year as they tried to incorporate EQAO-style testing into their regular classroom assessments and activities.” (p. 104-105). Attitudes of teachers towards EQAO testing were mixed and some teachers viewed the preparation of their students for testing required “them to take time away from what was perceived to be more meaningful classroom activities, and that it is incongruous with developing creative students.” (Hondzel-Dishke, 2013, p. 115).
REFERENCES


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